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MAPS IN VOL. IX.

POLITICAL.

CITIES.

PLATES.

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.

e: 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*).

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

ɜ: 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*.

hw: 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*).

ɬ: 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.

ñ: 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*).

q̡: 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.

ţ: 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.

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*.

ăy or *ā*.. same, but less prolonged.

ā..... 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*.

yŭ..... 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*.

kh..... 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*, *kh*, 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 *kh*. 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 *kh* 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; *kh* 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.

ptics [from Gr. *τὰ ὀπτικά*, neut. plur. of *ὀπτικός*, optic, pertaining to sight. Cf. *ὄψις*, sight, and *ὄπωπα*, I have seen]: the science which treats of the phenomena of light. The subject is usually treated from two points of view. 1. The laws and properties of light, as ascertained by observation, may, by applying the principles of pure geometry, be employed to explain the phenomena. 2. A definite theory having been adopted in regard to the nature of the luminiferous medium, the phenomena may be expounded as the necessary consequences of their assumed physical cause. The present article will be confined to a brief history of optical discovery.

A notion was for a very long time prevalent among the ancients that vision is effected by means of rays proceeding from the eye to the object. This idea is not found in Aristotle, but it was introduced into the school of Plato, and continued to be received for many centuries. The elementary phenomena of reflection and refraction suggest a natural division of the science of optics into two principal branches; and this distinction is made by the earliest systematic writer on the subject whose works have descended to us. This was Euclid, supposed to have been the geometrician of that name, who lived about 300 years before our era. The general laws which govern the reflection of light, being comparatively easy of detection, were stated by him with tolerable correctness; but what he has written on refraction is of little value. Ptolemy, the astronomer of Alexandria, who was born about the year 70 of our era, attempted to discover the law of refraction by experiment. His apparatus was ingenious, and was not different in principle from that which has been employed by Silbermann, Soleil, and others, in our own time, for the same purpose. He measured the angles of refraction corresponding to various angles of incidence, between 0° and 90°, for both water and glass, and left his measurements recorded in his *System of Optics*. We may judge of the degree of accuracy attained by him by comparing the indices of refraction deducible from his determinations with those of the same bodies fixed with severe exactness by modern observers. The ascertained index of refraction for water is 1·33582. If we make a computation of its value from the measured angles of Ptolemy, we find a mean of 1·30147; but if we take his measurements at the incidence of 50°, where the relative variations of the angles of incidence and refraction are most marked and most easily measured, we obtain 1·33555, which is exceedingly near the truth. As an astronomer, Ptolemy noticed the effect of atmospheric refraction upon the apparent positions of the heavenly bodies; and he recognized the fact, which others after him disputed, that the displacement is always in a vertical plane, and also that it attains its maximum in the horizon and is zero in the zenith. About the beginning of the seventeenth century Galileo, Jansen, and Metius invented the telescope independently, and Galileo by its means made important astronomical discoveries. Shortly afterward Kepler explained how to find the focal lengths of lenses, and gave the true theory of the telescope; he also made experiments on the nature of colors, and showed that the images formed on the retina of the eye are inverted.

It was impossible, however, that optical science should make any important progress so long as the law which determines the path of a ray in passing from one medium to another remained unknown. Willebrord Snellius, Professor of Mathematics at Leyden, who died in 1626, left behind him manuscripts, among which was contained a statement of the law in question. It was first published by Descartes, eleven years after the death of Snellius. It is therefore frequently referred to as the law of Descartes. See Refraction.

The next important step in the progress of optical discovery, after the detection of the general law of refraction, was made by Newton, who in 1672 communicated to the Royal Society the experimental researches by which he established the compound nature of light and the unequal refrangibility of its component rays. This phenomenon of the separation of the component colors of light by refraction has been called Dispersion (*q. v.*).

The dispersion of light by refraction furnishes an easy explanation of the interesting natural phenomenon of the rainbow. This beautiful meteor had before Newton's time been the subject of many unsatisfactory speculations; and though De Dominis, as early as 1611, had conceived a true theory of the manner of formation of the inner bow, he had not been able to account for its colors. Newton's discovery furnished the necessary supplement to the theory. See Rainbow.

In 1665 there was published at Bologna a posthumous work by Francis Maria Grimaldi, an Italian Jesuit, in which were for the first time described certain phenomena now familiar under the name of Diffraction (*q. v.*). They were carefully studied by Newton and others, and have occupied a prominent place in all the discussions which have since arisen in regard to the nature of light.

In 1669 the attention of the scientific world was called to a case of new and extraordinary refraction observed to take place in crystals of carbonate of calcium—a species of refraction which, from the circumstance of its dividing an incident beam into two beams entirely distinct, or of presenting two images of any object seen through the crystal, has been called double refraction. (See Refraction, Double.) The first publication on this subject was made by Erasmus Bartholinus, a physician of Copenhagen, who gave to the mineral the name of Iceland spar, from the circumstance that his specimens had been obtained from that island. The phenomenon was more fully explained by Huyghens, who also originated the undulatory theory of Light (*q. v.*). Soon after his announcement of the compound nature of light, Sir Isaac Newton made public the results of his investigations in regard to the colors exhibited by *thin plates* of transparent substances. (See Thin Plates, Colors of.) These investigations, together with many improvements of the teleseope and his corpuscular theory of the propagation of light, completed Newton's contributions to the science.

The next important step in the progress of optical science was the discovery of the progressive propagation of light and the determination of its velocity. Dominic Cassini suggested that certain irregularities in the observations of the first satellite of Jupiter could be accounted for by supposing that light took an appreciable time to travel from Jupiter to the earth. He seems, however, to have abandoned the

idea, but Römer followed it up with perseverance and conclusively established its truth. See Light.

The next discovery of importance was made near the close of the eighteenth century by Dr. Wollaston in his observations upon the prismatic spectrum. He discovered that by employing a pencil of light very narrow in the direction of the plane of refraction, but broad parallel to the axis of the prism, several well-defined dark straight lines could be distinguished crossing the spectrum at right angles, and maintaining invariably the same positions relatively to the colors. See Spectrum.

In the year 1808 the French Academy of Sciences proposed the problem of the double refraction of light as the subject for a prize to be awarded two years thereafter. The successful competitor for this prize was Malus. To him is also due the polarization of light by reflection.

In the year 1811 Arago communicated to the Academy of Sciences of Paris one of the most remarkable and beautiful discoveries that have ever been made in the history of optics. Upon examining thin plates of certain transparent crystals, such as mica, selenite, or quartz, by means of transmitted polarized light, he found that when the light was received upon the eye through a prism formed of Iceland spar the richest conceivable colors made their appearance, which were complementary to each other in the two images, and which varied in intensity with the azimuth of the laminæ or of the prism. (See Polarization of Light.) When a bi-refringent prism was employed as an analyzer, the two images seen were constantly complementary in color, and as the analyzer was turned they ascended in tint, in the order of Newton's scale, from red to violet. Biot in subsequent experiments discovered that in some crystals the ascent of the tints in the scale is produced by a right-hand rotation (the ordinary direction of a screw), and in others by a left-hand rotation. These classes of crystals have been distinguished by the names right-handed and left-handed crystals, or *dextrogyre* and *lævogyre*. The peculiar kind of polarization produced by quartz has on this account been called *rotatory* polarization.

In the year 1815 Biot discovered that many liquids possess the power of rotatory polarization—a discovery which was independently made by Seebeck. Arago early made the discovery that the light which comes to us from the atmosphere is polarized. Brewster also made investigations concerning the double refraction of crystals. He discovered that the great majority of non-isotropic substances are doubly refracting, and are in general biaxial—that is, have two axes. (See Crystallography and Mineralogy.) The determination of the undulations in such bodies, or the form of their "wave surface," was, approximately at least, effected by Fresnel, one of the latter's most brilliant discoveries. It led to Sir William Hamilton's prediction of the two species of conical refraction, which was experimentally verified by Lloyd and others, viz.: in one case a single ray passing through a plate of a biaxial crystal comes out as a hollow cone; in the other case a single ray which falls upon the plate is transformed into a cone inside the crystal, and comes out as a hollow cylinder. Fresnel also discovered that glass and other simply refracting bodies are rendered doubly refracting when in a state of strain: and Clerk Maxwell showed that shearing stress applied to viscous liquids renders them temporarily doubly refracting.

For an account of the present state of the science, see Preston's *Theory of Light* (1890); also Tait's *Light*, Glazebrook's *Physical Optics* (1883), and Basset's *Physical Optics* (1892). Revised by R. A. Roberts.

Optimism [from Lat. *op'timus*, best]: the doctrine that the world is the best possible, or that evil is only relative and contingent, being incident to the evolution of good—that good is substantial, evil only temporary. It is the philosophical counterpart to the religious doctrine of an overruling Providence that educes good out of evil. The divine purpose in creation is held to be the bringing of good into existence where nothing existed before, and the replacing of the imperfect by the more perfect; in general, it is to change chaos to a cosmos, and make it reflect the attributes of God. Creation, evolution, or change of any sort involves contrast and the manifestation of two principles. Hence the passive principle (chaos), which is eliminated by the activity of the good, is manifested or made apparent by the same activity that annuls it. Without the activity of creation the passive or negative principle (chaos or mere potentiality) would remain a pure zero, and be neither good nor evil. In all the stages of the realization of good, from the lowest to the highest, there is contrast, and hence the phenomenon of evil: but evil or the relatively imperfect exists only as the battle-field upon which it receives defeat from the victorious higher good. This is the view *sub specie æternitatis*, as Spinoza called it. Of course, any partial view, taking its point of observation from some one imperfect being, would see in the destruction of that being the triumph of evil rather than of good, and evil might seem predominant in the world. The optimistic theory is consistent only with theism, perhaps only with Christian theism. It finds place in the theory that God creates the world from nothing (chaos or pure space) and makes it in some sort his manifestation or self-revelation. Opposed to this is the emanation-theory characteristic of Oriental thinking, in which the Absolute is an abstract unity devoid of attributes, impersonal, and above multiplicity, and all creating is removal from unity toward multiplicity, and hence evil; it is a lapse from the Absolute, and finite existence is therefore altogether a mistake, or perhaps even a punishment for sin in a former state. This is called "pessimism." The return of all finite to the infinite through absorption or annihilation is regarded as the desirable end: Nature is not a conflict of good and evil, but altogether evil. Still, even in this theory, the good is the only true being; for all creation is held to be *maya* or illusion of the senses and intellect. The religion of the emanation-theory lays chief stress on ascetic renunciation with a view to reabsorption into the Absolute. Even the destruction of consciousness and individuality is regarded as blessedness. "The conclusive, incontrovertible, one only knowledge, is that neither I am, nor is aught mine, nor do I exist," says the *Sankhya Karika*.

In contrast with this, European thought generally embraces optimism. From the doctrine of Plato, that God is the absolute good, and "the Good possesses not envy, and on this account has made the world most similar to itself," down to the doctrine of Hegel, that all nature and history are the celebration of God's personality, optimism accompanies the doctrine which makes man a free, progressive, immortal spirit transcending nature, and nature to be the theater best fitted for his development. The Christian philosophers have variously expanded this doctrine. St. Augustine explains that evil is only contingent, or incident to finitude in its different degrees of imperfection, and that it exists only as an adjunct of the good; "as a painting with dark colors is beautiful when seen as a whole, so the sum of things when seen with one glance is good." St. Anselm adopted the same view, and asserted that the fall of man rendered him capable of attaining higher good. We should say that the fall renders possible the development of free individuality, hence makes possible independent reflection of the divine. St. Thomas Aquinas likewise: "The infinite manifoldness in the objects of nature is requisite in order to display God's infinite perfection; evil is only the privation of perfect actuality incident to the mere participation in the divine." Malebranche says that God has used everywhere the simplest means to realize his purposes, and accordingly has admitted the fewest evils possible into the world. Leibnitz, who is the best-known defender of optimism, distinguished three kinds of evil: (*a*) metaphysical, owing to the finiteness of things: this is unavoidable; (*b*) physical evil or pain, which is conditional good, being a monitor to warn us against error; (*c*) moral evil or wickedness, for which man alone is responsible, being incident to freedom, which is his highest gift. "God, therefore, out of the infinite number of possible worlds which he saw, chose the one which is actually the best." William T. Harris.

Opzoomer, Cornelis Willem: See the Appendix.

Oracle [viâ O. Fr. from Lat. *ora'culum*, oracle, deriv. of *ora're*, pray]: a term applied to answers given by the ancient Egyptian and Greek deities when solemnly consulted by their votaries, and also to the places where they spoke. Oracles spoke in different ways—in some cases through a human being, who uttered words of inspiration (e. g. at the oracle of Apollo at Delphi); in others by signs, which the priests watched and interpreted (e. g. at the oracle of Zeus at Dodona); then by dreams, as in the temples of Asclepius; and lastly by calling up the shades of the dead, as when Odysseus consulted the shade of Teiresias (*Od.*, xi.). The ancients consulted oracles on all important affairs, whether public or private. If, as often happened, an enterprise failed even though the gods had seemed to favor it, the oracles still

lost no credit, for their answers were so ambiguous that it was no easy matter to interpret them clearly.

O'ran: department of Algeria; bounded N. by the Mediterranean, E. by the department of Algiers, S. by the desert, and W. by Moroeco. Area, 44,616 sq. miles. Large tracts of this province are cultivated with the utmost care, and wheat, maize, cotton, and wine are grown with great success. The climate is hot, but healthful. Pop. (1891) 942,066. Its capital is Oran, a Mediterranean seaport.

Orange [= Fr., from Arab. *nāranj*, orange]: the fruit of many varieties of the genus *Citrus*. The botany of the genus is much confused, but it is now held that the oranges of the U. S. represent but two species, the common type, *Citrus aurantium*, and the mandarin or kid-glove type, *C. nobilis*. The bitter or Seville orange is a form of *C. aurantium*. *Citrus* is a genus formerly placed in the family *Aurantiaceæ*, but now included in *Rutaceæ*. It embraces trees and shrubs, all exotic and unable to endure the climate of the Northern States. In the extreme southern parts of the U. S. the orange is productive. The foliage is fragrant, and the flowers are pure-white, odorous, and beautiful. Wherever known throughout the world they are regarded as the appropriate ornaments of a bride. These flowers have from twenty to sixty or more stamens, sometimes in sets, and have one style. There are from four to eight, usually five, petals. The filaments of the stamens are more or less united, and the ovary many-celled, with a prominent disk at the base. The fruit is a juicy and luscious berry with a leathery rind. This rind contains little cysts or cells filled with a fragrant and volatile oil which is easily inflammable. The branches of the trees are spiny and the leaves in reality compound; that is, they consist of a single leaflet, as is shown by the articulation between the blade and the petiole. This is also shown by the trifoliolate leaf of the related *Citrus trifoliata* (properly *Ægle sepiaria*).

The original of the orange came from the East Indies or from China. The orange has now spread over all the warmer regions of the earth. It has an astonishing productiveness. The trees we meet with in conservatories usually bear a bitter, unpalatable fruit, and are chiefly grown for ornament. Oranges are evergreen, and bear simultaneously fruit and blossoms. The leaves are fragrant and have a limited use in medicine in cases of hysteria, where they are employed instead of tea. Oil of neroli is prepared from orange-flowers, and is the basis of the popular perfume known as eau de cologne. The fruit contains citric acid, but not in so large proportion as the lemon. The rind enters into various articles of confectionery, and is used for flavoring. The numerous seeds often contain more than one embryo. Sicily, Malta, Spain, the Azores, Portugal, and Cuba have furnished most of the oranges of commerce, but Florida and California are now strong competitors. The Riverside district, California, had in 1900 19,200 acres in oranges, with 1,536,000 trees, mostly of the seedless variety. The crop is valued at $6,000,000 annually.

Consult Wickson's *California Fruits*, Manville's *Orange Culture*, Moore's *Orange Culture*, and the volumes of Bailey's *Annals of Horticulture*. Revised by L. H. Bailey.

Orange: town of France, in the department of Vaucluse; on the left bank of the Aigue; 18 miles N. of Avignon (see map of France, ref. 8–H). It is old, ill-built, and dirty, but it has several well-preserved and interesting remains from the Roman time (a triumphal arch and a theater), some manufactures of linen and cotton fabrics, and a large trade in honey, wine, spirits, essences, oil, truffles, saffron, and madder. Pop. (1896) 9,980. The *Arausio* of the Romans, it became after Cæsar an important Roman colony. It was an independent countship from the eleventh century until 1530, when it fell by marriage to René of Nassau Dillenburg, stadtholder of the Netherlands, who, being childless, chose as his successor his cousin William, father of William the Silent. As William III., King of Great Britain, who was Prince of Orange, died childless, there began a controversy as to the succession between Frederick I. of Prussia, of the older branch of the house of Nassau, and the head of the younger branch. At the Peace of Utrecht in 1713 the King of Prussia made over Orange to Louis XIV., still calling himself, however, Prince of Orange; but the title was also assumed, and has been retained since, by the stadtholders and Kings of the Netherlands of the younger line.

Orange: city (first settled as a part of Newark about 1666, created a township in 1806, divided by separation of East Orange and Fairmount 1862–63, incorporated as a city in 1870); Essex co., N. J. (for location, see map of New Jersey, ref. 2–E); on the Del., Lack. and W. and the Erie railways; 4 miles N. W. of Newark, 12 miles W. of New York city. The city is connected with Newark, Bloomfield, East Orange, and South Orange by electric street-railways; it is lighted by electricity, and owns a water-works system with a reservoir between the First and Second Mountains, completed in 1884, and a sewerage system, completed in 1894. There are 6 public-school buildings, including a high school, a manual-training school, public-school property valued at more than $165,000, several high-grade private schools, public library, 2 national banks with combined capital of $250,000, 2 savings-banks with aggregate deposits of $1,750,000, and a monthly and 5 weekly periodicals. Llewellyn Park, extending from the base to the summit of the First Mountain, comprising 750 acres, and containing many fine residences; Eagle Rock, 650 feet above tide-water, in West Orange, from which New York city and harbor may be seen; and Hemlock Falls, the wildest mountain part of South Orange, are among the attractions of the city and its immediate vicinity. Pop. (1890) 18,844; (1900) 24,141.

Orange: city; capital of Orange co., Tex. (for location, see map of Texas, ref. 5–K); on the Sabine river, at the head of navigation, and on the S. Pacific Railroad; 103 miles E. of Houston. It is in a rice, cotton, orange, sugar, and stock-raising region, and contains lumber and shingle mills. Pop. (1890) 3,173; (1900) 3,835.

Orange, or **Gariep**: the largest river in South Africa, S. of 20° S. lat. It is about 1,150 miles long, rises on the western slope of Mont aux Sources in the Drakenbergs (29° S. lat.), runs through Basutoland, in a narrow valley and with swift currents and many waterfalls, and receives in the upper two-fifths of its course all its important tributaries, the Caledon and Vaal being most important. Then flowing W. through a wide semi-arid region the river loses much of its volume through evaporation, and in its lower course it is often fordable. C. C. Adams.

Orangeburg: city. See the Appendix.

Orange City: town. See the Appendix.

Orange Free State: formerly an independent Boer republic in Southeast Africa, with the Transvaal Colony on the N. and separated from the Indian Ocean by Natal, Basutoland, and Cape Colony. Now the Orange River Colony of Great Britain. It was founded by Boers who withdrew from Cape Colony in 1836. Area, 48,326 sq. miles. Pop. (1890) 77,716 white and 120,787 black. The undulating and healthful plains are well adapted for stock-raising, which is the leading industry. It joined with the South African Republic in the Boer war of 1899–1900. After the capture of Bloemfontein (Meh. 13) Lord Roberts proclaimed it a colony of Great Britain, May 28, 1900. See Africa. The capital is Bloemfontein (*q. v.*). C. C. Adams.

Orangemen: members of a political association whose official name is **The Loyal Orange Institution**, formed, in opposition to the Roman Catholic association of the Ribbonmen, for the purpose of defending the Protestant religion in Ireland, maintaining the legislative union between Great Britain and Ireland, and the Protestant succession to the throne. The term Orangemen, which came into use after the Revolution of 1688, meant originally the supporters of William III., Prince of Orange, against the deposed Stuarts and their Roman Catholic adherents; but the association was not formed till 1795, when the first Orange lodge was founded in the north of Ireland. The society grew rapidly, and the hostility between its members and Roman Catholics soon gave rise to bloody conflicts, which it required considerable military force to suppress. At last, in 1836, the association was dissolved, but in 1845 it was revived as a secret society. In 1829 the institution was transferred to British America with great success, but there, too, as well as in New York, its processions have sometimes occasioned riots.

Orange, Prince of: See William of Nassau.

Orange Sands: See Lafayette Formation.

O'rang U'tan, or (vulgarly) **Orang'-outang'** [from Malayan *ōrang ūtan*, man of the woods; *ōrang*, man + *ūtan*, wood, forest]: a large anthropoid ape (*Simia satyrus*) inhabiting many of the low districts of Borneo, and more rarely found in the eastern portion of Sumatra. In bulk the adult male orang comes next to the gorilla, but, owing to the shortness of the legs, the animal rarely attains a height of 4 ft. 6 in., the maximum size recorded being 4 ft. 8 in. The arms

are very long, the digits of the hands and feet much curved, the thumb very small. In the old males the face, which is black, or nearly so, is almost round, owing to the presence of cheek callosities. The collar-bones are so long that the shoulders are nearly on a level with the ears. The canines are large and the jaws powerful, but, although the

Female orang utan.

males fight with one another, the orang is a timid animal and harmless unless brought to bay. The females, which are much smaller than the males, have no facial callosities. The orang is sparsely clad in coarse red hair, which is subject to considerable variation in tint. It is strictly arboreal, never descending to the ground unless compelled to do so, for it walks poorly, owing to the curvature of the toes and the oblique manner in which the foot is set on the leg. The orang prefers low-lying or swampy forests, feeds on fruits and vegetables, and builds a rude nest in which to sleep.

F. A. Lucas.

Oraon: See Dravidian Languages.

Orato'rio [= Ital. < Late Lat. *orato'rium*, chapel, neut. of *orato'rius*, pertaining to praying; cf. *ora're*, speak, pray]: an elevated form of musical composition in which voices and instruments combine to represent scenes, passages, or themes from biblical or sacred history, the text consisting of verses from the Scriptures arranged with a view to moral and spiritual effect; the music comprising chorus, recitative, aria, quartette, trio, solo—in short, all the recognized combinations of harmony and melody, with organ and orchestral accompaniment, as in opera. It differs from opera principally in being sacred instead of secular, and in being unsuited to stage or scenic representation. When it becomes operatic in the sense of scenic and passionate, as in the case of Rossini's *Moses in Egypt*, it ceases to be oratorio. The movement is subjective, the development ideal, the characterization intellectual, the spirit epical. The oratorio was never intended to do service in the offices of worship, was never written in the direct interest of Sabbath or cathedral observances. It was, in fact, an effort to associate the charm of musical composition with the solemnity of sacred themes. Hence, in large measure, its popularity in England with the "evangelical" Protestants, who are forbidden by their religious feeling to attend operatic and theatrical entertainments, and with a similar class in the U. S. In Paris it has, in fact, no abiding-place, nor is it held in favor in Italy, where it originated. In Germany, also, oratorio is seldom heard, except at occasional festivals where many voices can be grouped together. The germs of oratorio existed in the Middle Ages in the shape of *mysteries* and *moralities*—scenes from Scripture rudely dramatized, with some primitive sort of music, the design being to entertain the coarse and vacant-minded peasantry and entice them from idleness and vicious pleasure. The steps of development in conception and form can not be traced. In the middle of the sixteenth century St. Philip Neri, a man of deep humor and genuine sympathy with the people, attempted to mingle instruction and entertainment by engaging the music director of St. Peter's church to aid him in his popular interpretations of sacred story. The musician introduced songs in passages of dialogue and soliloquy. That the attempt was successful appears from the fact that it was made in other places and with more art. In the year 1600 one of these musical dramas was exhibited on a stage erected in the Church Sta. Maria in Valicella. It was called *Soul and Body*, was composed by Emilio dei Cavalieri, and may be regarded as the first systematic production of oratorio, with chorus, recitative, and song. To these the dance was added. From this point to the time of Handel the history of oratorio is uncertain. In the seventeenth century Giacomo Carissimi composed *Jephthah* and the *Judgment of Solomon*; in the latter part of the same century Francis Federici composed two pieces, *Santa Cristina* and *Santa Catarina di Siena*, which were called oratorios. Among composers of oratorio may be mentioned Alessandro Scarlatti, Alessandro Stradella (*John the Baptist*), Giacomo Perti (*Abraham*), Benedetto Marcello (*Judith*), Heinrich Schütz (*Resurrection* and *Seven Words*), all of about the same period (1645–1710) Among oratorios the *Passion Music according to St. Mat thew*, composed by John Sebastian Bach, must be regarded as the greatest, most monumental work of its kind. Equally imbued with the religious spirit of its day as in case of Handel's *Messiah*, its technical value is far greater. From the standpoint of popularity, using the word in its best and broadest sense, the *Messiah* seems to enjoy a perennial life wherever the English tongue is spoken. Both by the number and caliber of his works, and by their enduring influence down to this day, Handel may well be considered the great master of oratorio. His best-known works were *Saul* (1740); *Messiah* (1741); *Samson*, *Judas Maccabeus* (1747); *Jephthah* (1751). All have English words. The greatest, *Messiah*, is considered the masterpiece of its kind. *The Creation*, by Haydn (1798), ranks next to it in popular repute. They have but one peer, Mendelssohn, whose *St. Paul* (1836) and *Elijah* (1846) are brilliant and beautiful examples of the capacity of this species of composition. With lovers of music *Elijah* is greeted with more enthusiasm than even the *Messiah*, its spirit being more modern, its musical form more flexible, its conceptions more intellectual. While the tone is purely and throughout religious, the ideas, less confined to dogma, are addressed to the imagination rather than to the heart—to the æsthetic rather than to the "spiritual" sense. Revised by Dudley Buck.

Oratory, Congregation of the: a monastic order in the Roman Catholic Church, founded in 1560 by St. Philip Neri; established in France in 1611. Its first rule was oral, but was afterward written out, and received papal approval in 1612. The fathers are mostly devoted to the spread of learning; they assume no vows but those of the secular priesthood. One of the most eminent of their number in modern times was Dr., afterward Cardinal, J. H. Newman. Baronius, Bosio, Bérulle, Malebranche, Gallandi, and Massillon are among those who belonged to the order in times past. The French Oratory, called the Oratory of Jesus, was always a distinct though kindred organization. It is now nearly extinct. Revised by J. J. Keane.

Orbego'so, Luis José: politician; b. near Huamachueo, Peru, Aug. 25, 1795. He was a rich proprietor, took an active part in politics, and on Dec. 20, 1833, was elected president of Peru by the constitutional convention which was then sitting. Strictly speaking, the convention had no right to elect a president, but Orbegoso was popular, and for a year his rule was generally accepted. In Jan., 1834, Gamarra declared against him, proclaiming Bermudez as supreme chief. The civil war which followed was ended in April by mutual agreement, but new rebellions, headed by Gamarra, Salaverry, and others, broke out early in 1835, and Orbegoso, after repeated defeats, accepted the intervention of President Santa Cruz of Bolivia. The result was the invasion of Peru by Santa Cruz, who formed the Peru-Bolivian confederation in 1836 (see Santa Cruz), Orbegoso being nominated president of North Peru, one of the confederated states. In 1837 he was defeated by Gamarra and the Chilians. After passing several years in exile, he was allowed to return to Truxillo, where he died in 1847. H. H. S.

Orbigny, ōr'bēn'yee', Alcide Dessalines, d': zoölogist and ethnologist; b. at Coueron, Loire-Inférieure, France, Sept. 6, 1802. From 1826 to 1833 he explored Southern Brazil, the Platine States, Patagonia, Bolivia, and Peru. The results of this journey were published at the expense of the French Government, with the general title *Voyage dans l'Amérique Méridionale* (1834–47); the work includes, be-

CATTLEYA EXONIENSIS
(EPIDENDREAE).
HYBRID OF CATTLEYA MOSSIAE AND OF
LAELIA PURPURATA.

STANHOPEA MARTIANA
(VANDEAE).
MEXICO.

BOUQUET OF ORCHIDS
COMPOSED OF
LYCASTE SKINNERI.
GUATEMALA.
VANDA BATEMANNII.
PHILIPPINES.
ODONTOGLOSSUM ALEXANDRAE.
COLOMBIA.
EPIDENDRUM VARICOSUM.
MEXICO.
EPIDENDRUM LINEARIFOLIUM.

DENDROBIUM TARMERI
(EPIDENDREAE).
INDIA.

ODONTOGLOSSUM RUBESCENS
(VANDEAE).
NICARAGUA.

ORCHIDS.

sides the narrative, several volumes on zoölogy, and *l'Homme Américain* (2 vols.), an important treatise on South American ethnology. D'Orbigny also published various monographs on Foraminifera, etc.; he contributed the volumes on Foraminifera, Mollusca, and birds to Ramon de la Sagra's *Historia de Cuba*, and collaborated with his brother, Charles Dessalines d'Orbigny, in the *Dictionnaire d'histoire naturelle*. His most important work was the *Paléontologie française* (14 vols., 1840–54; unfinished). From 1852 he was Professor of Palæontology in the Museum of Natural History at Paris. D. near Paris, June 30, 1857. H. H. S.

Orbil'ius Pupil'lus, Lucius: a grammarian and teacher at Rome in Horace's boyhood; b. at Beneventum. He served at first, as stated by Suetonius, who mentions him in his list of distinguished grammarians, as an attendant on the magistrates of his native place, then in the army in Macedonia. In his fiftieth year he removed to Rome, in the consulship of Cicero, where he taught school for many years, and had among his pupils the poets Domitius Marsus and Horace, who recalls in his *Epistles* the severity of his master. His teaching brought him more fame than profit, for he died poor at the age of nearly a hundred. His fellow townsmen erected a marble statue to his honor in Beneventum. Suetonius cites a work of his with the title *Perialogos*, but this name is evidently corrupt. See Teuffel, *Lat. Lit.*, § 200; Estré, *Prosopogr. Horat*, p. 437.

Revised by M. Warren.

Orbit [from Lat. *or'bita*, wheel-track, course, circuit, deriv. of *or'bis*, circle, wheel]: the path in which a heavenly body moves. When there are but two bodies the revolution occurs in consequence of their mutual gravitation, combined with the original relative motion of the bodies. The orbit is then described in accordance with Keppler's laws, which, when modified in accordance with modern mechanics, are as follows:

1. Each body describes an ellipse in space, having the center of gravity of the two bodies as the center of motion, in one of its foci. If the motion of the lesser body is referred to the greater, taken as a point at rest, as is usual in astronomy, the lesser still describes an ellipse having the greater in one of its foci.

2. The velocity of each body in its orbit varies in such a way that the radius vector, or line drawn from one body to the other, sweeps over equal areas in equal times. The velocity is therefore greater the nearer the two bodies come together.

3. The cube of the semimajor axis of the ellipse, divided by the square of the time of revolution, is proportional to the combined masses of the two bodies.

These laws of Kepler were shown by Sir Isaac Newton to result directly from the theory of gravitation. From them it follows that, in order to determine and define the motion of a body around an attracting center, such as a planet around the sun, certain quantities, called *elements*, are necessary. In the case of an elliptic orbit these elements are as follows, the symbol which follows each being the letter commonly used to represent the elements:

1. The mean distance, or half the major axis of the ellipse in which the planet moves around the sun. It is equal to half the sum of the greatest and least distances of the planet. Symbol a.

2. The eccentricity of the ellipse, symbol e. Instead of e an angle ϕ is often used, of which e is the sine.

3. The longitude of the ascending node, or the angle which the vernal equinox makes with the line in which the plane of the orbit intersects the plane of the ecliptic. Symbol Ω.

4. The inclination of the plane of the orbit to that of the ecliptic. Symbol i.

5. The longitude of the perihelion, by which is commonly meant the longitude of the node, plus the angular distance from the node to the perihelion as seen from the sun. Symbol π.

6. The mean longitude of the planet at some given epoch. By mean longitude is here meant the longitude of a fictitious or imagined planet which moves around the sun with uniform velocity, in the same time as the actual planet, and in such a way that, in a general average, it is as much behind the actual planet as in advance of it. Symbol L.

7. The mean daily motion, or the daily angular motion of a planet which would revolve around the sun in the same time as the actual planet. When the masses of the two bodies are known this element can be determined from the mean distance. Symbol μ or n.

Various combinations of these elements are sometimes introduced, among them the distance from the node to the perihelion, symbol ω, and the mean anomaly, symbol M. The relations of these quantities to the other elements are:

$$\omega = \pi - \Omega$$
$$M = L - \pi$$

If but a single planet moved around the sun its motion would take place in strict accordance with Kepler's laws, and the elements of the orbit, as above described, would remain invariable; but, owing to the attraction of the other planets, each planet deviates from such an elliptic orbit. Moreover, this elliptic or mean orbit is slowly changing from century to century. These changes are called secular variations, and the problem of their computation is one of the most remarkable of modern astronomy. Their laws can not be derived from all the observations hitherto made on the planets; but from mathematical investigation, founded on the theory of gravitation, the changes in the orbits can be computed for hundreds of thousands of years past and to come. S. Newcomb.

Orcagna, ōr-kaan'yăă, Andrea (also called Andrea di Cione, after his father): painter, sculptor, and architect; b. at Florence about 1316. He learned sculpture as a child from Andrea Pisano. After a few years he studied painting, which he preferred, with the Gaddis, and architecture by studying the works of Giotto and Arnolfo di Lasso. The principal chapel in Sta. Maria Novella was painted by Andrea and his brother Bernardo. Andrea executed *A Last Judgment* and *Christ and the Virgin enthroned in Heaven*. From 1358 to 1360 he was chief architect of the cathedral at Orvieto. His architectural skill is shown in the Loggia dei Lanzi and in the tabernacle of Or San Michele, one of the wonders of the age for its richness of ornamentation. It was completed in 1569. Few of his paintings remain. One, a retable painted for the Church of St. Pietro Maggiore, in Florence, is now in the National Gallery in London. Orcagna was also a poet. D. about 1376. W. J. Stillman.

Or'cein (*lichen-red*, *Flechtenroth*): $C_7H_7NO_3$, the chief ingredient of the red and purple dyestuffs known under the name of Archil (*q. v.*). It is formed by the action of ammonia and oxygen on orein, $C_7H_8O_2$, and consists of two substances, one having the composition $C_{14}H_{13}NO_4$, the other $C_{14}H_{12}N_2O_3$. When ammonia is added to a solution of orcin, and the whole is exposed to the air, the liquid assumes a dark-red or purple tint by the absorption of oxygen. On acidulating with acetic acid, a dark-red precipitate of orcein is obtained. Orcein is slightly soluble in water and freely soluble in ammonia and fixed alkalies, with a purple or violet color; it is very soluble in alcohol.

Revised by Ira Remsen.

Orchardson, William Quiller: genre and portrait painter; b. in Edinburgh, Scotland, in 1835. Studied in the Trustees' Academy, Edinburgh; painted portraits in Edinburgh until 1863, when he went to London; was elected Royal Academician 1878 and a D. C. L. of Oxford in 1890; was awarded third-class medals at the Paris Expositions of 1867 and 1878; first-class at Paris Exposition of 1889. His works are distinguished by fine quality of color and have a marked personality. Studio in London. W. A. C.

Orchestra, ōr'kes-tra [from Lat. *orches'tra* = Gr. ὀρχήστρα, the space in a theater between the stage and the audience, liter., dancing-place, deriv. of ὀρχεῖσθαι, dance]: the place or structure occupied by performers on instruments in a theater, music-hall, or other building fitted for concerts, oratorios, etc. In oratorios, cantatas, and other pieces with vocal parts a portion of the orchestra is also allotted to the choir. The term "orchestra," in modern use, often means the body of instrumental performers themselves, especially as distinguished from the choir or vocal department, in the execution of such works as are for voices and instruments.

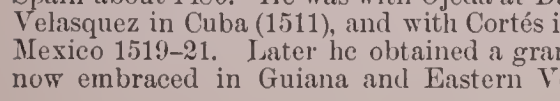
Orchids, or **Orchida'ceæ** [Mod. Lat. *Orchidaceæ*, from *Or'chis*, the typical genus = Lat. *or'chis* = Gr. ὄρχις, orchid, testicle, so called from the shape of its tubers]: a family of perennial endogenous herbs, found all over the world except in very cold and very dry climates. In the cooler regions they are terrestrial, while in hot countries they are often air-plants, growing upon stones and trees, but epiphytic rather than parasitic. They have irregular and often extremely beautiful, but sometimes very grotesque, flowers, perfect, with a hexamerous adnate perianth, a one-celled ovary, numerous ovules, and three parietal placentæ. The stamens are one, two, or three; the pollen generally coheres in masses.

Fertilization is almost always effected by the aid of insects. Many of the species have flowers singularly resembling insects in form. Many have very fragrant blossoms. This vast order affords a few useful plants, among which are vanilla, faham, salep, also several medicinal products. Florists successfully cultivate many superb tropical epiphytes of this order. The U. S. has comparatively few species of orchids, although some, like the lady-slippers, are curious and beautiful. See CATTLEYA, CYPRIPEDIUM, EPIDENDRUM, HOLY GHOST FLOWER, etc. Revised by L. H. BAILEY.

Orchil: See ARCHIL.

Orchom'enus (in Gr. 'Ορχομενός): an old city of Greece, situated in Bœotia, at the entrance of the river Cephissus into the Lake Copais; the capital of the prehistoric empire of the Minyæ. It is reported by Homer to have sent thirty ships to the siege of Troy, and to have contained riches which might be compared to those of Thebes in Egypt. In the Persian wars it abandoned the national cause, and in the wars between the various Greek races it always sided with the aristocratic party; but in 367 B. C. it was taken and destroyed by the Thebans. The buildings were burnt, the men put to the sword, the women and children sold as slaves. Rebuilt by the Phocians, it was again destroyed by the Thebans in 346, and although Philip of Macedon once more rebuilt it, it never again acquired any importance. The site was excavated by Schliemann in 1880, 1881, and 1886. See his *Orchomenos*, but better Schuchhardt, *Schliemann's Excavations* (London, 1891), pp. 299–303. J. R. S. STERRETT.

Or'cin: a compound belonging to the class of PHENOLS (*q. v.*), being closely related to ordinary phenol or CARBOLIC ACID (*q. v.*). It is derived from TOLUENE (*q. v.*) by the substitution of two hydroxyl groups for two hydrogen atoms:



Toluene. Orcin.

It is obtained from certain lichens which yield ARCHIL (*q. v.*), though in most of these it is not contained ready formed. It is produced by transformations of other constituents of the lichens, especially erythrin, $C_{20}H_{22}O_{10}$; lecanoric acid, $C_{16}H_{14}O_7$; evernic acid, $C_{16}H_{14}O_7$; and orsellinic acid, $C_8H_8O_4$. It can be made artificially by a number of methods, and is so prepared on the large scale. Ammonia converts it into ORCEIN (*q. v.*). IRA REMSEN.

Ord, EDWARD OTHO CRESAP: soldier; b. in Cumberland, Md., Oct. 19, 1818; graduated from the U. S. Military Academy, and was appointed second lieutenant of artillery July, 1839; served in Florida and on frontier duty, and at the outbreak of war in 1861 was stationed in California. Appointed brigadier-general of volunteers, he fought the battle of Dranesville Dec. 20, 1861; and as major-general of volunteers commanded the left wing of Gen. Grant's army in Mississippi Aug.-Sept., 1862, participating in the battle of Iuka, Sept. 19–20, and while in command at the action on the Hatchie, Oct. 5, 1862, was severely wounded. He commanded the Thirteenth Army-corps during the siege and capture of Vicksburg and capture of Jackson: the Eighth Corps and middle department July 11–21, 1864; and the Eighteenth Corps before Richmond, July 21–Sept. 29, when again wounded in the assault and capture of Fort Harrison. On Jan. 18, 1865, he relieved Gen. Butler in command of the department of Virginia and North Carolina and of the Army of the James, with which army he remained throughout the siege of Petersburg and subsequent pursuit of the Confederate army of Northern Virginia, ending in the surrender at Appomattox Court-house. At the close of the war he had received brevets from lieutenant-colonel to major-general, U. S. army, had attained the rank of lieutenant-colonel of artillery, but continued to hold his volunteer rank of major-general, and commanded various districts and departments until Sept., 1866, when mustered out of the volunteer service, having, however, been appointed a brigadier-general (July, 1866) in the regular army. He was in command of various military departments 1866–80; and on Dec. 6, 1880, was by special act of Congress placed on the retired list with rank of major-general Jan. 28, 1881. D. in Havana, Cuba, July 22, 1883. Revised by JAMES MERCUR.

Ordaz, or **Ordás**, DIEGO, de: soldier and explorer; b. in Spain about 1480. He was with Ojeda at Darien (1509), with Velasquez in Cuba (1511), and with Cortés in the conquest of Mexico 1519–21. Later he obtained a grant of the country now embraced in Guiana and Eastern Venezuela, and in 1531–32 he made the first exploration of the Orinoco, ascending, it would appear, to the mouth of the Meta. During this journey one of his officers, Martinez, wandered far inland, and claimed to have seen a magnificent city whose king was gilded with gold-dust; this account or invention was the origin of the myth of El Dorado. On his return to the coast charges were made against Ordaz, and he was arrested and sent to Santo Domingo; there he was released, and started for Spain, but died at sea 1533. H. H. SMITH.

Ordeal [O. Eng. *ordāl*, *ordēl*, judgment: Germ. *urtheil*, judgment. The original meaning is something dealt out; cf. Goth. *us-*, out, and Eng. *deal*]: a form of trial of guilt or innocence, consisting in an appeal to the immediate judgment or intervention of God by subjecting a person to a certain test in the belief that if he be innocent God will so shape the result as to indicate it.

Evidence of the existence in one form or another of the trial by ordeal is found in the earliest records of all the races of mankind; and the institution formed a prominent part of the jurisprudence of the Christianized barbarian races of mediæval Europe, from which the nations of modern Europe are descended, being the survival of customs which obtained among them when pagans. Its legal existence has survived in some countries into the nineteenth century, as in England, where trial by BATTEL (*q. v.*) was only finally abolished in the year 1819 (59 George III., c. 46). There are traces of the institution in the literature of all the civilized nations of antiquity, as among the Greeks in Sophocles's *Antigone* (ver. 264–267), and among the Jews in the Bible (Num. v. 11–31; Joshua vii. 16–18; 1 Samuel xiv. 41–42).

The tests which have been resorted to for the purpose of trial by ordeal are very numerous, such as fire, wager of battle, boiling water, the drinking of poisoned water, etc., the last mentioned being a very general practice among savage races.

Trial by *wager of battle* was a very common form among the Germanic nations, and was resorted to in both criminal and civil cases. The accused challenged the accuser, and they fought, either in person or later by champions, in the presence of judges, the victor being deemed innocent or just in his cause. (See BATTEL.) The trial by battle continued in practice until the seventeenth century, and survives today in the modern duel. See DUEL.

Trial by *fire* was one of the forms of ordeal most thoroughly established in mediæval Europe, and was sanctioned by the Christian clergy, and administered under their superintendence. At first it was used only on very solemn occasions, but later became quite common as a more aristocratic mode of trial than that by water, which later came to be considered plebeian. It had various forms, such as the putting on of a red-hot iron glove, walking barefooted and blindfolded over red-hot plowshares, and passing through a fire with nothing but a thin shirt for a covering; but the most common method was for the accused to carry a piece of red-hot iron in his hand for a given distance. If unhurt, he was declared innocent; if burned, guilty. Cases in which persons were injured or killed by this ordeal were very rare, for the trial was seldom granted, except when the accused by some means could be given a victory. It was granted to noble ladies as a means of proving their chastity, and tradition records a number of instances in which the ordeal was successfully submitted to. In 1498 Savonarola appealed to the trial by fire, but at the last moment the ordeal was given up, his enemies alleging that he refused to submit to it. Another form of trial by fire or heat was that in which the accused thrust his hand, or hand and arm, into a vessel filled with boiling water to take up some small object placed in the water. Sometimes boiling oil was used instead of water. If the accused escaped uninjured, he was deemed innocent; if burned, guilty; but in some cases it was the custom to bind and seal up the arm for three days, when it was examined, and innocence or guilt determined by the result. This ordeal survived as late as the middle of the fifteenth century.

In the *cold water* ordeal the accused was thrown, with the arms and legs tied, into a pond or river, and was adjudged guilty if he floated, innocent if he sank. If he was drowned before he was removed by the rope which was attached to his body, the innocent dead person became a saint. After this form of ordeal ceased to be in general use, it was much used in cases of women accused of witchcraft, and these witch ordeals did not disappear until the middle of the eighteenth century.

The ordeal of *bread or cheese* consisted in giving the accused a bit of bread or cheese over which prayers and adjurations had been performed, and if the accused were able to swallow it, he was adjudged innocent; if not, guilty. A special form of this was the ordeal of the *Eucharist*, used mostly among the clergy, which consisted in taking the holy sacrament under solemn imprecations of the vengeance of God if it were taken to cover a lie. It was believed that the guilty could not swallow the morsel without being choked; and it is possible that the consciousness of guilt might produce involuntary inability to swallow.

The ordeal of the *cross* was one of simple endurance between the accused and the accuser, the test being which could uphold his arms the longer before the cross. This ordeal became obsolete at an early day.

The ordeal of the *bier* was based upon the superstition that the body of a murdered person would bleed or move upon the approach or touch of the murderer. This ordeal survived until a comparatively late date as a superstition, although it early lost its authority as an ordeal.

Trial by *lot* was an early form of ordeal which was chiefly used as a means of discovering a thief or a murderer. Its insufficiency for this purpose was soon understood, however, but it continues as a superstitious means of decision in doubtful circumstances.

In the early periods many of the forms of ordeal were sanctioned by the councils of the Church, and administered by ecclesiastics; yet from the sixth century down they were generally condemned by the popes, but with little effect on the clergy, who continued to sanction and administer them. The papal authority, however, and the revival of the Roman law in the twelfth and thirteenth centuries, and the general growth of intelligence among the people, finally resulted in the overthrow of the institution of trial by ordeal. See Henry C. Lea's *Superstition and Force* (2d ed. Philadelphia, 1870). F. Sturges Allen.

Order [from Lat. *or'do*, *or'dinis*, row, series, order]: a name used by zoölogists and botanists for combinations of animals and plants. In zoölogy it is now always used for a group comprising one or more families and intervening between the Family (*q. v.*) and the class. In botany the term has generally been used much as family is used in zoölogy—that is, to denote a group above the rank of a genus; but in the botanical articles in this cyclopædia the usage agrees with that in zoölogy. F. A. L.

Orders: originally, organized bodies of men vowed to monastic rule as well as military life, especially for war against the Saracens and Moors; secondly, select bodies of knights and nobles having a peculiar title conferred upon each of them, and a badge of some sort to testify to it; thirdly, modern organizations, sometimes supposed to be confined to men (or in rare cases to women) who have shown especial courage or merit, and more often consisting partly of these and partly of men occupying high official positions; also the decorations or badges indicating membership in such organizations. Perhaps 300 orders have existed in Europe since the tenth century, and there are imitations of these established by Oriental sovereigns.

1. *Mediæval Fighting Orders.*—The Order of St. John of Jerusalem is thought to have been founded in the eleventh century, and was certainly organized as a great military and religious body about 1120. When the Christians were finally expelled from Palestine this order settled at Rhodes, and afterward at Malta, and they were called Knights of Rhodes and Knights of Malta accordingly. They are often called *Knights Hospitallers*, because their first organization was connected with a hospital in Jerusalem. The order still exists, and a grand-master was elected in 1879, but it is now *honorary*. The Templars, or Knights of the Temple, were a similar order, equally famous and powerful, but the order was entirely destroyed and the leaders put to death with torture during the pontificate of Clement V. and largely by the efforts of King Philip the Fair of France. The rich possessions of the order, which could easily be confiscated, probably had much to do with this act of authority, which may be compared with the dissolution of the monasteries under Henry VIII. of England. The Teutonic Order was another body of religious knights; this still exists in a much modified condition.

2. *Honorary Orders of the Middle Ages and of the Renaissance.*—The Order of the Garter was founded by Edward III. of England after his victories in France and against the Scots, and dates from 1349. It has existed ever since. The number of Knights of the Garter is limited to twenty-five besides the sovereign as its patron. As it is very small in numbers, and limited to nobles of very high rank and to members of foreign royal houses, it is one of the two or three most envied and admired orders of Europe. The Order of the Elephant of Denmark is another such; it dates from the fifteenth century and consists of thirty members, each of whom must be already a member of the Order of the Danebrog. The most famous of all these orders is that of the Golden Fleece, founded by the Duke of Burgundy, Philippe le Bon, in 1429. It was established with great splendor, and even more magnificently treated by Philippe's successor, Charles le Téméraire. After his death and the ruin of the duchy of Burgundy as an independent state, the order was claimed at once by Spain and by the house of Austria, and to this day there are two branches of it. No person but a Catholic of very high birth and dignity can become a member. The Order of the Thistle, founded by James II. of England and VIII. of Scotland, consists of sixteen knights only. The Teutonic Order, named above, is now an Austrian aristocratic and limited body having strong Catholic tendencies. The Black Eagle of Prussia, though not founded until 1701, ought to be named here as being purely aristocratic and limited to thirty persons besides foreign princes. These five orders, together with a Prussian branch of the great Order of St. John of Jerusalem and two orders for women, one of Prussia and one of Bavaria, are the only ones which the *Almanach de Gotha* mentions in connection with the names of princes and princesses who belong to them. This serves to show the peculiar importance ascribed to these eight among all the other orders of Europe, an importance depending entirely upon their honors being shared by so few persons.

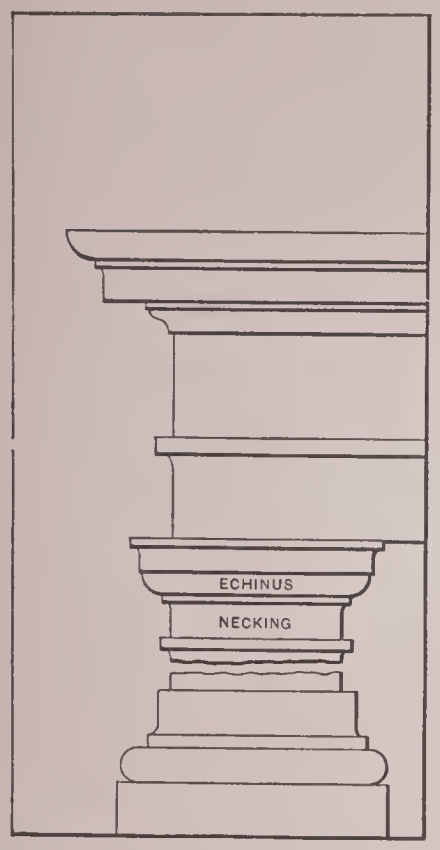
3. *Modern Orders.*—Of these much the most celebrated is the Legion of Honor, founded by the First Consul Bonaparte. It was maintained by the Restoration, but with Henry IV. substituted for Napoleon on the badges, and other similar changes, all of which were done away with when the second republic brought Louis Napoleon to the front. Under the Second Empire it consisted of 80 Knights Grand Cross, 200 grand officers, 1,000 commanders, 4,000 officers, and any number of knights, the chief of the state being the grand-master. The present organization is nearly the same. The rank of knight (*chevalier*) is given theoretically for merit in military or civil life, and for merit only, but some men receive the honor as a necessary consequence of some public office which they have discharged, apart from special merit, and of course there are sometimes complaints and charges of favoritism. The knights receive a very small annual stipend, the members of higher grade a little more, but the pay even of the *Grand Croix* is only 3,000 francs a year. All have, however, certain privileges much esteemed in France. Although there are perhaps 30,000 men entitled to wear the red ribbon or rosette, it is a most honorable and enviable distinction. The English Order of the Bath is somewhat similar, though much more rarely given; it consists of 75 Knights Grand Cross, who may put G. C. B. after their names, 200 or 300 knights commanders (K. C. B.), and about 700 "Companions of the Bath" (C. B.). The Order of the Star of India and that of St. Michael and St. George are British orders provided for distinction in the colonial service and in India. Every nation of Europe has such distinctions for military merit in the first place, and then for success as artist, author, engineer, or the like.

4. *Badges and Visible Distinctions.*—All the orders have their "crosses" or "jewels," and their ribbons of special colors; and for the higher grades *plaques* or stars, which are worn on the breast. The cross of the Legion of Honor is a five-pointed flat jewel of gold and enamel, worn at the buttonhole, or hanging from a ribbon at the neck according to grade, but it is worn only by soldiers or navy men in uniform, or by citizens when in evening dress. Citizens in their ordinary dress wear a small bow of ribbon of a peculiar red in the buttonhole for the grade of chevalier, and a rosette of the same silk for the higher grades; a broad ribbon is worn over the shoulder by the *Grand Croix*. A silver star is borne on the right breast by the grand officers and on the left breast by the *Grands Croix*. Similar laws govern the decorations of all the honorary orders. Russell Sturgis.

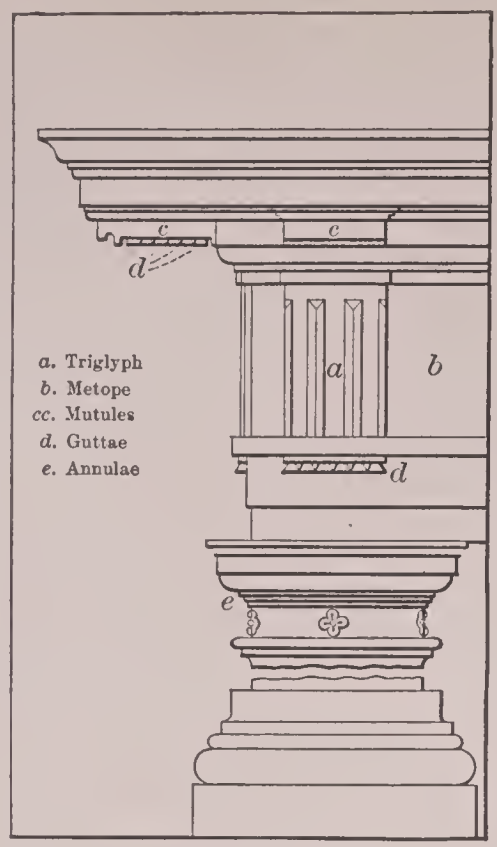
Orders in Council: See Privy Council.

Orders of Architecture: While the word *order* may be used in architecture to mean any systematic combination of

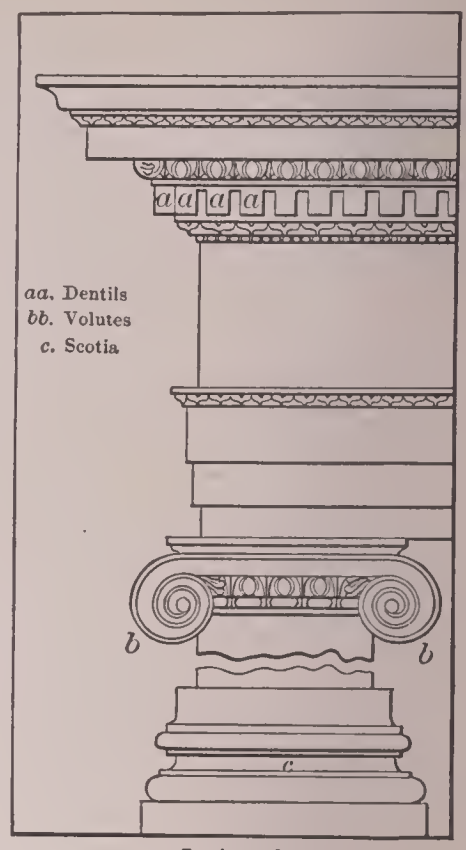
supporting and supported members, it is customarily understood, in the absence of qualifying context, to refer to the combination of a column or a pilaster with an entablature consisting of architrave, frieze, and cornice, according to an established system or canon of design. The five orders commonly referred to in architectural treatises, and known respectively as the Tuscan, Doric, Ionic, Corinthian, and Composite, formed the basis of Roman decorative architecture, and were copied by the architects of the Italian Renaissance of the fifteenth century, and their successors in Italy and elsewhere. At first the imitation was free and more or less fanciful. As the result of minuter study and comparison, their proportions and details were systematically formulated by various architects, who sought to establish, in spite of endless variations of detail, a canon of proportions for each order. Among these various efforts the *Treatise on the Orders*, by Giacomo Barozzi da Vignola (1507–73), has found the widest acceptance, and has survived down to our own day as the best text-book on the subject.



Tuscan order.



Doric order.



Ionic order.

The Egyptians had no orders in the accepted sense of the term; they employed an unvarying type of entablature over a great variety of columns of diverse proportions. The Greeks employed mainly two orders. The *Doric* was at first the only one known to them, but the *Ionic* was in the early fifth century imported, so to speak, from Asia Minor, and made use of in buildings calling for more elegant and slender forms than those of the sturdier Doric order. (See ARCHITECTURE.) In the fourth century a variant of the Ionic was devised, with a much enriched capital, and called Corinthian, though hardly forming a distinct order, except as to its capital.

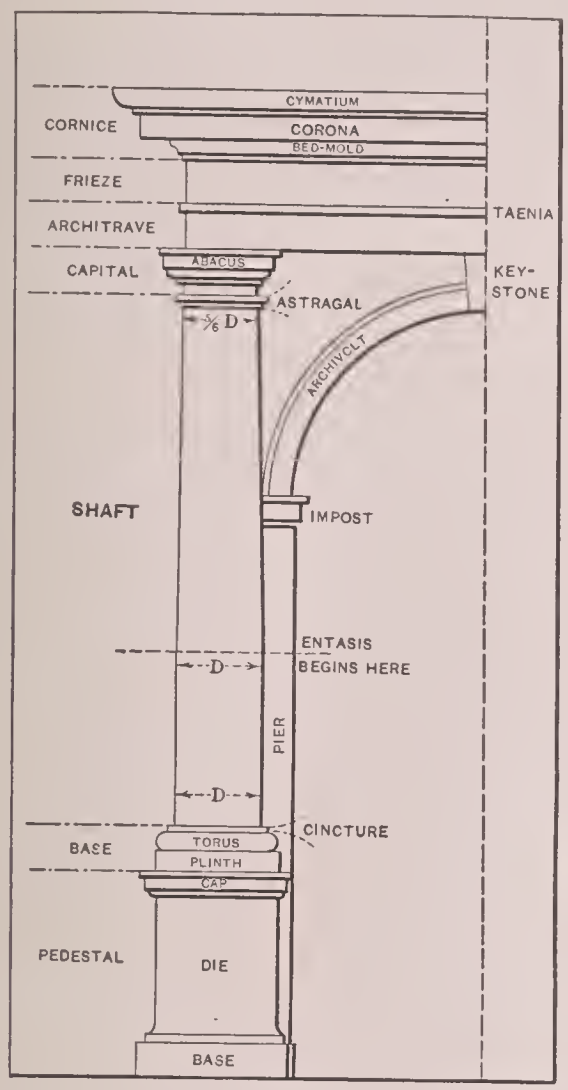
These orders, as used by the Greeks, varied widely both in proportions and details. The practical and systematic Romans, having conquered the Greeks and adopted the forms of their architecture, modified them radically in the direction of greater uniformity and of increased splendor of detail, perfecting and enriching all parts of the Corinthian, and retaining in addition their own uncouth Etruscan or Tuscan column and entablature as a fourth order. They also added a fifth, the Composite, a sort of hybrid combination of the Ionic and Corinthian. See COMPOSITE ORDER.

An order is composed of the *column*, having a *base* (except in the Greek Doric), *shaft*, and *capital*; and the *entablature*, resting upon the columns and comprising an *architrave*, *frieze*, and *cornice*. The base consists of circular mouldings (*tori* and *scotiæ*), resting on a square *plinth*. The shaft, flaring into a *cincture* at the bottom and an *astragal* at the top, has a slight taper, called *entasis*, for the upper two-thirds of its length. It may be smooth or fluted; the edges of the flutings are called *arrises*. The capital is composed of various parts (*necking*, *echinus*, *volutes*, *abacus*), according to the order, as shown in the diagrams. The architrave is moulded in two or three horizontal bands, and crowned by a *tænia* or upper moulding. The frieze has no special characteristic in any order except the Doric, where it is decorated with repeated vertical-grooved members called *triglyphs*, alternating with square spaces called *metopes*. The cornice always has a *bed-mould* (which may comprise a group of mouldings), an overhanging shelf-like *corona*, and a crowning moulding, the *cymatium*. In the Doric there are also *mutules*, the under surfaces of which are ornamented with *guttæ* resembling trenail-heads; in the Ionic there are *dentils* in the bed-mouldings; and the Corinthian and Composite cornices have in addition under the corona more or less rich brackets or *modillions*. When arches are used in conjunction with columns or pilasters, the arch springs from an *impost* which serves as cap to the *pier*, and is adorned with an *archivolt* (somewhat like a curved architrave) and *keystone*. The column is sometimes elevated on a *pedestal* composed of *base*, *die*, and *cap*.

Corinthian order.

Vignola's system involves an elaborate kind of measurement of the relative proportions of all the orders by means of modules, each module being divided into twelve or eighteen parts according to the order; but it is equally useful and more simple to express all measurements in terms of the lower diameter of the shaft (D and fractions of D).

The same orders, as given by Palladio, Scammozzi, and Sir William Chambers, vary slightly from Vignola's in minor details, but not in essentials. It may be stated that in all cases the base is $\frac{1}{2}$ D in height, as also the capital in the first three orders; that the shaft diminishes in each order exactly $\frac{1}{6}$ D in its upper as compared with its lower diameter; that the entablature always measures in height precisely one-quarter the total height of the column, or one-fifth the height of the whole order; and that the cornice always



One-half of an arcaded order, showing names of principal parts.

measures $\frac{1}{4}$ D more than the architrave. Taking the columns of the Dorie, Ionic, and Corinthian in that order, each is seen to exceed the one preceding it in the diagram by one diameter in height.

This formal canon of proportions, though generally accepted as the most perfect standard, was never strictly adhered to even by Vignola himself and his contemporaries. The apparent uniformity of the antique Roman orders was approximate, not absolute, and the value of Vignola's formulation of an exact canon is disciplinary and suggestive, rather than authoritative and binding. For further details, consult the editions of Vignola's treatise published in Paris, New York, and Boston. See ARCHITECTURE, COLUMN, MODULE, RENAISSANCE ARCHITECTURE, and the brief articles on the several orders; also *Treatise on Civil Architecture*, by Sir William Chambers (London). A. D. F. HAMLIN.

Orders, Religious: See MONACHISM.

Ordinance of 1787: The confederation of the U. S. was delayed and put in jeopardy more by a dispute as to what should be the fate of the unoccupied lands at the West than by anything else. The large States, which by their charters extended to the "South Sea," claimed to have the entire disposal of and jurisdiction over the territory within their boundaries as described in charters proceeding from the crown of England. Some of the States not thus richly provided with unsettled lands, as Maryland and New Jersey, claimed that the States which were proprietors of them ought to yield them up as common property for the benefit of all, since the efforts of all the States had secured the acknowledgment of independence from Great Britain. In 1780 New York gave authority to its delegates in Congress to fix a limit for its western boundaries, and to cede a part of its lands for such States as should become members of the Confederation. It was not until the next year that Maryland, last of all the States, joined the new league. Soon afterward the State of Virginia gave up her lands N. W. of the Ohio for the general benefit; but it was not until 1784 that an ordinance for the temporary government of the Northwest Territory, which emanated from a committee of which Jefferson was chairman, was passed by the Congress of the Confederation. Jefferson's act provided for the formation on this soil of States which might be organized whenever there should be 20,000 inhabitants on the territory to be formed into a State, and which might be admitted into the Confederation on certain terms whenever their inhabitants should be equal in number to those of the smallest of the original thirteen States. It also contained this provision in its original form as presented to Congress; "that after the year 1800 there should be neither slavery nor involuntary servitude in any of the said States, otherwise than for the punishment of crimes, etc." This anti-slavery clause was lost, and the ordinance without it was passed Apr. 23, 1784, but no settlements were made within the territory in question for some years.

Two other attempts at legislating for the Northwestern Territory were made in 1785 and 1786, and the committee appointed in the latter year to consider this subject made a report which was ordered to a third reading in 1787. Very fortunately the bill reported was laid aside, and a new committee, appointed July 9 of the same year, reported two days later the ordinance of 1787, which became a law in two days after it was submitted to Congress. It related to the whole of the Northwest Territory, and included what afterward constituted the States of Ohio, Indiana, Illinois, Michigan, and Wisconsin. This ordinance, besides defining the rights of the citizen, contained provisions of great importance. The fourth article prohibited slavery and involuntary servitude except in punishment of crimes. Another article provided that the navigable waters leading into the Mississippi and St. Lawrence, and the carrying-places between the same, should be common highways, free to the citizens of the U. S. The importance of this ordinance in shaping the destinies of the U. S. is beyond calculation. It can scarcely be doubted that if slavery, even a small percentage of it, had been able to creep into the territory where the great free States of the West, E. of the Mississippi and N. of the Ohio now lie, the U. S. would have become a slave republic. Another declaration of great importance was that in regard to education, in which it was declared that "religion and morality being necessary to the welfare of the State, therefore schools and the means of education shall for ever be encouraged." On the basis of this declaration the Constitutional Conventions, as well as the Legislatures of the several States formed of the Northwest Territory, have felt bound to make liberal provisions for all grades of educations. It has been generally supposed that Nathan Dane, of Massachusetts, then in the Congress of the Confederation and a member of the committee which reported the ordinance, was its principal author; but it has been shown by Dr. W. F. Poole and others, from documents which had not been used before, that the authorship of it belongs mainly to the Rev. Manasseh Cutler, who appeared in New York, where the last Congress of the Confederation was then sitting, and who was ready to purchase 1,500,000 acres in Ohio for a company composed of officers in the then recent war living in Eastern Massachusetts, and 4,000,000 acres for other parties in case the ordinance should be adopted. The history of Cutler's connection with the ordinance may be found in *The North American Review* for Apr., 1876, and in W. P. Cutler's *Life, Journals, and Correspondence of Manasseh Cutler* (1888).

T. D. WOOLSEY. Revised by C. K. ADAMS.

Ordinances: See BY-LAWS.

Ordinary [from Lat. *ordina'rius*, orderly, regular, deriv. of *or'do*, order]: In the later Roman empire the official who heard and decided in first instance the more important civil and criminal cases (the president of the province) was commonly described as the ordinary judge (*judex ordinarius*). In the mediæval Church judicial powers were vested, in first instance, in the bishop of each diocese; and the ecclesiastical law, which was largely based upon the Roman, transferred to the bishop, as a judicial officer, the Roman title of judge ordinary. The judicial powers of the bishop, however, were commonly delegated to and exercised by a deputy or surrogate (*subrogatus*).

The jurisdiction claimed and exercised by the mediæval

Church extended over marriage and family law in general, and over cases of testamentary and interstate succession, as far at least as the personal estate was concerned. In modern states this entire jurisdiction has been transferred to the civil courts, but in England, even after the Reformation, it was exercised by special tribunals (ecclesiastical courts), and in the U. S. probate business at least is still regularly assigned to special judicial officers, who in many of the States retain the designation of "ordinary" or "surrogate." MUNROE SMITH.

Ordinate [from Lat. *ordina'tus*, perf. partic. of *ordina're*, appoint, order, arrange, deriv. of *or'do*, *or'dinis*, series, order]: in co-ordinate geometry, one of the elements of reference used to determine the position of a point with respect to the co-ordinate axis. It is the distance of the point from the axis of abscissas, measured on a line parallel to the axis of ordinates. Every function of a single variable may be regarded as the ordinate of a point of a curve of which the variable is the corresponding abscissa. This curve is called the curve of the function.

Ordination [from Lat. *ordina'tio*, appointment, ordering, deriv. of *ordina're*, appoint, order, ordain]: the ceremony by which ministers of the Christian Church are dedicated to their office. It is performed in a somewhat different manner, and somewhat different ideas are attached to it, in the different Christian Churches, but the ceremony itself and its principal feature, the imposition of hands, are as old as the Church, and are mentioned in the New Testament (Acts vi. 1–7; xiii. 1–4; xiv. 23; 1 Tim. iv. 14; 2 Tim. i. 6). In the Greek and Roman Churches ordination is considered a sacrament; that is, a special divine gift, a new spirit, a fitness for the office, is believed to be conferred by the ceremony upon the candidate, and he is thus, at once and for ever, set apart from the laity and entered among the clergy, *ordo*. In order to be valid ordination must be performed by a bishop of the Church, and if once duly performed it can never be forfeited or made invalid by any act of the ordained in his after life, and it is not repeated when the candidate ascends from one rank in the Church to another. An ordination is not lawful, however, because it is valid: the Roman Catholic Church has enacted very strict and very minute laws concerning this point. A candidate can be lawfully ordained only by his own bishop—that is, the bishop to whom he belongs by birth, by domicile, by benefice, or by connection of personal service—and any irregularities render both the ordaining bishop and the ordained candidate liable to heavy ecclesiastical penalties. In the Protestant or Evangelical Churches ordination is not considered as sacramental or indelible, though it has been questioned in the Church of England whether a bishop could be lawfully deprived of his orders as bishop. The Church of England has generally retained the regulations of the ancient canon law, according to which no one could be ordained who was not provided with some appointment in the Church capable of maintaining him, or who was disqualified by bodily infirmity, immorality, etc., nor could the ordination take place until after an examination of the fitness of the candidate. The ordinal, as drawn up under Edward VI., then modified in the reign of Elizabeth, and finally fixed by the convocation of 1661, also resembles the ancient service, though it is simpler, and lays a particular stress on the examination. A clergyman may be suspended or deprived of his ecclesiastical benefices by his bishop without forfeiting his ordination. He is deprived of his status of priest or deacon only when he is deposed or degraded on account of his being convicted of treason, murder, or felony. In the Presbyterian Church when a minister is deposed he forfeits not only his office but his clerical status. Those who accept the idea of a universal priesthood of believers view the ministry as a calling rather than an office, and consider ordination simply as a solemn ceremony, conferring no special gift and establishing no special status, but beautiful by itself on account of its pious remembrance of the time of the apostles.

Revised by S. M. JACKSON.

Ordnance [an old form of *ordinance*, ordaining, arrangement, decree, preparation, provision, from Lat. *ordina're*, appoint]: guns, howitzers, and mortars. The term *ordnance* is synonymous with *artillery*, but less comprehensive in its meaning. It signifies cannon, and these simply as material and nothing more. Its application as a military term had its origin from an *ordinance* promulgated in the reign of Henry VIII. of England, regulating the caliber, figure, and dimensions of cannon. Under this a board—which subsequently took the name of the ordinance or ordnance board—was established, charged with the care of crown fortifications and their armaments. Prior to this, artillery, as well as arms of all kinds, had been fashioned according to the fancy of each manufacturer, and the object and effect of the ordinance was to establish uniformity. Arms made in conformity to the specifications of the board were termed *ordinance* or *ordnance*, in contradistinction to those of irregular pattern; and from this sprang the custom of designating all artillery as ordnance. In addition to cannon, strictly speaking, the U. S., following the English custom, has extended the term ordnance to include all firearms of every description, whether cannon or small-arms. The term *ordnance stores* comprehends every description of ammunition, all carriages used for artillery purposes and their equipments, and all other apparatus and machines required for the service and manœuvers of artillery, together with the materials for their construction, preservation, and repair; also all side-arms and accoutrements for artillery, cavalry, and infantry, together with utensils and stores for laboratories. For the various steps of development leading up to modern ordnance, see ARTILLERY.

Since 1860 the entire system of gun-construction throughout the world has been revolutionized. The chief, if not the primary, impulse to this was imparted by the battle between the U. S. ironclad Monitor and the Confederate ironclad Merrimac in Mar., 1862. Up to this period the art of constructing armor-clad vessels had not progressed beyond the experimental stage, and the battle referred to was the first practical test of armor *versus* guns. The maritime nations of Europe, taking alarm at this successful application of the armor principle, at once began remodeling their navies, and clad their vessels with a thickness of plating before unknown. To meet these new conditions guns were devised capable of piercing the heaviest armor then in existence. Then more powerful armor of steel was adopted, and still more powerful guns constructed. The contest yet continues. In its progress it has evoked much scientific study and mechanical ingenuity, leading through various stages to the present system of "built-up" guns. Pieces of this nature are constructed of an inner tube, forming the bore, and certain bands and hoops surrounding and strengthening it. This method of construction admits of the principle of initial tension, a chief factor in the strength of modern artillery. This principle is based upon the phenomena of elasticity, and in gun-construction is utilized by shrinking successive layers of metal one over the other, each being given an initial strain to assist it in supporting the layer underneath. (See under GUNNERY, *Interior Ballistics*.) The cost of guns constructed on the built-up principle is enormously great as compared with cast-iron pieces of equivalent calibers.

In 1883 the U. S. Government sent to Europe a mixed commission of army and navy officers to examine and report upon the most advanced methods there in use. Special inquiry was made as to the systems pursued by the leading European nations for supplying themselves with artillery. The board found the system in vogue in France (since the Franco-German war) the most promising of good results, and accordingly recommended it. In this system the Government depends upon the private industries of the country for foundry-work—i. e. for the rough forgings of the various parts of the guns; but for assembling and finishing work the Government has its own factories.

Acting upon these recommendations, the Government established two gun-factories—that for the army at the Watervliet arsenal, Watervliet, N. Y., and that for the navy at the Washington navy-yard. The board, in its recommendations, emphasized the necessity of proper encouragement to the private steel-manufacturers of the U. S. by such liberal appropriations for gun-forgings as would induce them to expand their plants and means of production. Liberal appropriations of money by Congress soon followed, and under this stimulus several steel-foundries expanded their plants to a capacity equal to any requirements. Chief among these works is that at Midvale, Pa., and that at Bethlehem, Pa., both of which are capable of fabricating forgings for guns up to and even beyond 12 inches caliber.

Description of Heavy Ordnance.—All guns, howitzers, and mortars of the built-up system consist essentially of a tube, surrounding bands, and the breech mechanism. They differ but little except in dimensions of parts and the number of bands. For a general description of the U. S. system the

8-inch rifle may be taken as a fair type. This piece (see Fig. 1) is composed of a tube, a jacket, 8 C, 3 D, and 7 A hoops, a breech-block receiver, and the various parts of the breech mechanism. The tube is 266 inches (22 ft. 2 in.)

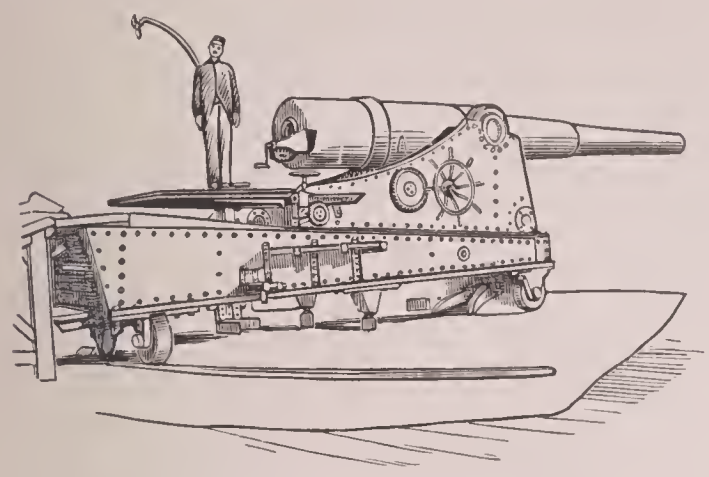


Fig. 1.—8-inch breech-loading rifle.

long, and has an exterior diameter of 15 inches at the breech and 11·5 inches at the muzzle. This tapering is by nine shallow steps or shoulders against which the jacket and certain of the hoops abut. The jacket is an elongated hoop embracing the rear part of the tube for a distance of 96·6 inches, and extending beyond the rear of the tube 12·5 inches. The front end of the jacket rests about 19 inches in front of the axis of the trunnions; from this point to the muzzle the tube is enveloped and strengthened by eight hoops, technically known as C-hoops. These have varying widths, the average being 21·2 inches; the rear one—that next the jacket—has an exterior diameter of 18·25 inches, while that at the muzzle has but 14 inches, this being the diameter of the finished piece at this part.

The jacket and C-hoops constitute the first layer over the tube. Then comes the layer of D-hoops, three in number, having an average width of 22·5 inches. The rear D-hoop overlaps an offset on the front end of the jacket; the other two break joints with the underlying C-hoops. The rear D-hoop—partly covered by the front A-hoop—has an exterior diameter of 24·5 inches; from here forward the D-hoops have a uniform taper to a diameter of 17·6 inches, when the end of the front one is rounded off, forming the first projection, or offset, on the finished piece.

Next come the A-hoops, seven in number, covering the entire length of the jacket and part of the rear D-hoop. They have varying widths, the total being 112·75 inches. The second from the front constitutes the trunnion band; the one in front of it tapers and is rounded in front, forming the second offset or shoulder on the exterior of the finished piece. The exterior of those in rear of the trunnion hoop have no taper.

The 10 and 12 inch guns have another layer of hoops covering the A-hoops from the breech to the front of the trunnions; the last, or front one, is the trunnion band, and

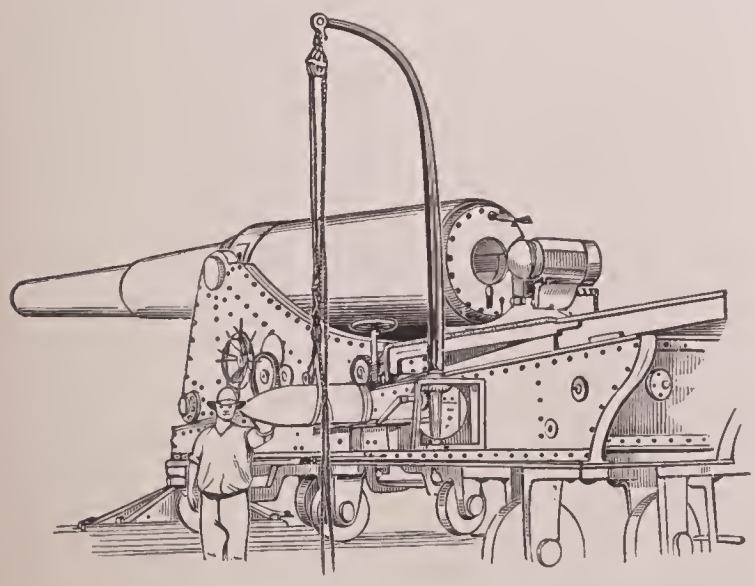


Fig. 2.—12-inch breech-loading rifle.

being rounded off in front forms a shoulder on the exterior of the piece. Fig. 2 represents a 12-inch rifle ready for loading.

The exterior of the muzzle of the tube is made slightly conical, with the base of the cone to the front; the interior of the front C-hoop being also conical—but in the opposite direction—prevents, when the latter is shrunk on, all possibility of slipping forward. The jacket sustaining the breech mechanism is prevented from slipping to the rear by a projection on its front end engaging a shoulder on the tube. The entire system—tube, jacket, and hoops—is thus united into one compact body.

The rifling occupies 200·76 inches of the bore, the remaining 60·74 inches being taken up by the seat for the shot, the powder-chamber, and the seat for the gas-check. The shot-seat and the powder-chamber are connected by a sloping surface, 10 inches in length, to give facility in shoving the shot home to its seat. The rear ends of the lands are sloped for the same purpose. The powder-chamber of modern guns is made larger than the bore, in order that the enormous charges now used may not take up so much of the length of the bore. This increase of diameter possesses also other advantages of a ballistic nature. (See Gunnery.) The powder-chamber of the 8-inch rifle has a capacity of 3,609 cubic inches, or of 130 lb. of powder.

The gas-check seat, 2·5 inches long, is a slightly tapering enlargement of the rear end of the powder-chamber, and is intended for the reception of the gas-check, hereafter described. The shot when in position for firing rests directly between the trunnions; its base, with the copper rings to take the grooves, rests in the shot-chamber.

The breech mechanism, although originally invented in the U. S., is a modification of what is known as the French system. The principal parts are the receiving-ring, the breech-block, the obturator, the console or loading-tray, and the breech-plate. The extension of the jacket beyond the rear end of the tube forms a recess for the reception of an inner hoop called the receiving-ring, which has the same thickness, viz., 2·75 inches, as the end of the tube against which it abuts. A screw-thread is cut on its exterior, which works in a thread on the interior of the jacket, the ring is then set home by powerful leverage, the junction between the ring and end of the tube being hermetically sealed by a thin ring of copper. The interior of the receiving-ring contains slotted screw-threads into which similarly slotted threads on the breech-block engage. There are three of these slots, each occupying one-sixth of the circumference of the interior of the receiving-ring, and running longitudinally. The breech-block is turned on its axis to engage or disengage the slotted screw-threads by means of a pinion and circular rack, for which recesses are cut in the upper part of the breech-plate. When disengaged, the slots of the receiver being opposite the threaded portions of the breech-block and *vice versa*, the breech-block may be moved back and forth with freedom; when engaged, the bore is closed ready for firing the same as though the threads were continuous.

The obturator consists of a steel head of mushroom shape, of the diameter of the powder-chamber, the rear part of which it occupies; this head is attached to a spindle which works with freedom through the axis of the breech-block, to the rear end of which it is secured by a screw and nut. In rear of the mushroom head are two annular cups of elastic steel surrounding the spindle. These cups inclose between them a canvas pad containing a mixture of tallow and asbestos. The spindle is fitted to allow a certain amount of longitudinal motion within the block, so that when the piece is fired the gas pressure on the mushroom head forces it back upon the annular cups, compressing the canvas pad until it swells out against the walls of the bore, thus making a tight packing, effectually preventing the escape of gas to the rear. After the explosion a spring at the rear end of the spindle forces it forward to its former position, thus releasing the cups and packing from pressure, and allowing the breech-block to be withdrawn without difficulty. One packing-pad will stand many rounds, and when no longer serviceable is readily replaced by a fresh one. The vent is bored longitudinally through the spindle and mushroom head. An automatic safety-cover keeps it closed except when the breech-block is in position ready for firing.

The console, or tray, is an irregularly shaped bronze casting attached to a hinge fastened to the breech of the piece, and is intended to receive the breech-block when withdrawn from the bore and swing it around on a hinge to one side. As the breech-block is heavy, it is moved back and forth on the tray by means of a translating roller, on which is cut a

screw-thread, of considerable pitch, into which engages a stud on the bottom of the block. On the under side of the tray is a latch securing it to the breech of the piece, when the block is being withdrawn from or inserted into the bore.

The breech-plate is a 4·5-inch thick steel disk attached by screw-bolts to the breech of the piece, covering and protecting the breech mechanism, and giving support to some of its parts. An opening is cut in the central portion of the plate, through which the breech-block enters to close the bore.

To operate the breech mechanism, suppose the breech closed as though ready for firing; to open it, turn the rotating crank in the direction marked "open"; this rotates the breech-block to the proper position to be withdrawn. While the block is making this one-sixth of a revolution it is moved slightly to the rear by the action of the screw-threads, and this loosens the gas-check from its seat. As soon as the motion begins the vent-cover slides into position, thus preventing the insertion of a primer until the block is again in position for firing. The translating stud of the block at the same time enters the thread of the translating roller, the crank of which is now turned to the left, causing the breech-block to slide back upon the tray. When the block is withdrawn to the proper point the tray-latch is disengaged automatically from its catch, allowing the tray and block to be swung around by hand to the right, until the securing latch catches and holds it in that position. The piece is now ready for loading.

The operation of closing the breech is almost the reverse of the foregoing.

Forging.—All of the parts of a gun, forged and fashioned in the rough, are furnished by the steel contractor. The metal is steel of a low percentage of carbon, commonly called low steel. This is melted and brought to a proper physical and chemical condition in an open-hearth furnace —the Siemens furnace. (See FURNACE.) From the furnace the liquid metal is drawn off into cylindrical moulds of great strength and peculiar construction. These are placed under a powerful hydraulic press, which expels all gas from the fluid mass and compresses it into a dense ingot. Some of the ingots thus treated weigh upward of 40 tons. After cooling the ingot is transferred from the mould to the lathe, where it is bored and cut to proper lengths for the parts to be forged from it.

To forge one of these sections to a required figure it is placed in a furnace heated by coal-gas—all the heating is done by gas—where it is brought to a glowing heat, and then transferred to the hydraulic forging-press, where it is fashioned into the desired shape, the soft metal being moulded into shape as putty is moulded in the fingers. Owing to the great weight of the ingots and forgings, the most powerful cranes and other machinery, set in motion by compressed air, are employed for handling them. Metallic templetes are used by the workmen in fashioning the forgings as the pressing progresses.

The forgings are now rough-bored, turned, and machined to the required dimensions, which is just sufficient to admit of proper tooling in the assembling and finishing process at the gun-factory. After this the parts are oil-tempered and then annealed. These two processes impart to the metal toughness with the required degree of hardness. In oil-tempering the tubes and jackets are heated vertically and as evenly as possible; they are then immersed in rapeseed oil, in the direction of their axes, in such manner that a current of the fluid flows through the bore. This operation must always be performed on the whole of each piece at one time.

For annealing, which removes any strains that may have been produced in tempering, the tubes and jackets are heated as evenly as possible; this operation also is performed on the whole piece at one time. The degree of heat, which is generally that producing a salmon color, is maintained uniformly for several days.

After the tempering and annealing treatment, should a part be found to have warped or bent to such a degree as to require straightening, it is returned to the forging furnace and press and tempered and annealed again. All the hoops and the forgings for the various parts of the breech mechanism are treated in like manner.

The forgings, stamped and numbered, are delivered to the Government on board of cars at the foundry, whence they are transported to the Government gun-factory. The present cost of a set of forgings for an 8-inch gun is $10,938, or 27½ cents per pound. For the 10-inch gun the cost is $24,865, or 30¼ cents per pound. For the 12-inch gun it is $42,218, or 30½ cents per pound.

During all of the foregoing operations each process is subject to the inspection of expert officers of the ordnance department, who are stationed at the foundries for that purpose, and for this it is stipulated in the contracts that they and their employees shall be allowed free access at all times to every part of the manufacturers' works; but the details of operations carried on are considered confidential so far as the manufacturers may desire. Each establishment has its own chemist, laboratory, and testing-machine. The latter is compared with and adjusted to the Government machine at Watertown arsenal, thus assuring uniformity of results among all establishments supplying forgings. The test specimens have a stem length of 3 inches, with a diameter of 0·564 inch, and the specifications are very precise as to their number and the part of the forging from which taken. They must show an elastic limit of not less than 42,000 lb. per square inch for tubes and 46,000 lb. for jackets, and a tensile strength of not less than 78,000 lb. for tubes and 86,000 for jackets. A tabulated record is kept of all these tests, so that the Government has a complete history of the fabrication of each piece and the strength and composition of each fiber of its body.

Assembling the Piece.—The first operation in assembling the forgings received from the founder is to place the tube in a lathe, where it is bored and reamed to within about a tenth of an inch of the exact diameter of bore; at the same time the exterior is turned to the proper dimensions for the hoops. It is then faced at the rear end, from which all measurements are made. The powder-chamber is next bored and reamed, as also the conical junction between the chamber and bore.

The jacket is then bored and reamed to fit the shoulder left on that part of the tube over which it is to fit. The interior diameter of the jacket is about 0·02 inch less than the exterior diameter of the tube. This is for the purpose of bringing an initial strain on the jacket after it has been shrunk to the tube. The shrinkage allowance for each part is taken from tables carefully prepared from a long course of experiments, conducted for the purpose of determining the most suitable strains.

The next operation is to shrink the jacket on the tube. The assembling-pit, about 30 feet deep and 8 feet in diameter, is so arranged as to receive and sustain the tube in a vertical position. The tube is adjusted muzzle upward in the pit; the jacket is brought to the proper temperature (about 600° F.) in the furnace, swung over the tube by means of a crane, and then let down over the tube a short distance, after which the tube is pulled up through it, by means of the crane, until the shoulders come together. A water-collar and water-rings are then adjusted to perform the function of jetting water upon the precise parts to be first cooled. The whole is then allowed to cool, after which the now united tube and jacket are removed from the pit to rest in a horizontal position. The first C-hoop is now heated for expansion, slipped over the tube, and tightly clamped up against the jacket by means of a powerful clamping device, when it is allowed to cool. After this the piece is returned to the lathe, and the shrinkage surface of the tube turned for the next two C-hoops, which are now shrunk on, following which the piece is again returned to the lathe, and the shrinkage surface of the tube is prepared for the remaining C-hoops, and also that portion of the jacket and of the C-hoops to be covered by the D-hoops, all of which are now shrunk on in succession. The exterior of the jacket is next turned and the A-hoops shrunk into position. While the exterior is being turned and finished, the bore (now diminished by the heavy pressure brought upon the tube by the shrinkage of jacket and hoops) is reamed out to the precise caliber of 8 inches. At the same time the powder-chamber, the seat for the shot and for the gas-check, are bored to the proper dimensions, the whole interior being given a well-polished surface. The threads for the breech-block receiver are now cut, and the latter is screwed home against the thin copper ring fitting between the receiver and the rear end of the tube, and intended to prevent all escape of gas in this direction. The next operation is to slot the receiver and cut the threads for the breech-block. The piece is now rifled. For the number and dimensions of grooves and lands, see table at end of article. The twist of the rifling is increasing, being one turn in 50 calibers at the breech, and 25 calibers at 16 inches from the muzzle, from which point

it is uniform. The various parts of the breech mechanism are now fitted on, and the gun is complete.

The Appropriation Act passed by the U. S. Congress in 1890, supplemented by that of the following year, directed the purchase of 100 completed guns, viz., 25 8-inch, 50 10-inch, and 25 12-inch, the total expenditure for which shall not exceed $4,250,000. The length of time required for the production of these guns, including the time required for the erection of a gun-factory plant, is estimated to be about ten years.

Mortars, as well as guns, are now constructed on the built-up principle, and are also breech-loading. A mortar thus constructed is, in general features, but a gun of the same caliber shortened. A mortar of the 12-inch type is made up of an interior tube, a jacket, and one layer of hoops. The breech mechanism is the same as for guns. For weight, dimensions, etc., see table at end of article.

Carriages.—The great weight and power of the new guns require proportional strength and mechanical appliances in the carriage. A thoroughly equipped carriage for a modern piece is a machine almost as complicated in construction as a locomotive. Owing to the very great accuracy of modern fire and the rapidity of discharge of machine-guns, it becomes an essential condition that the pieces and their carriages, as well as the cannoneers, should be protected. The tendency is therefore to resort to armor-shields and to disappearing carriages. In the latter case the gun is exposed to the fire of the enemy only for a brief period—at the time when it is hoisted above the parapet to its firing position. After discharge the piece disappears behind the parapet, where it is again loaded in security. One form of such an arrangement is a gun-lift, by means of which gun and carriage are hoisted and lowered on a platform by means of hydraulic power. The most general form, however, is some application of the counterpoise principle. Still another form, and one promising good results, is a pneumatic disappearing carriage.

Another difficult problem is a suitable carriage for the modern high-power, breech-loading mortar, the conditions for which embrace enormous strength to resist the great strain of vertical fire, together with the freedom and precision of motion demanded by this class of artillery. A mortar mounted on one form of such carriages—the hydro-pneumatic carriage—is illustrated by Fig. 3.

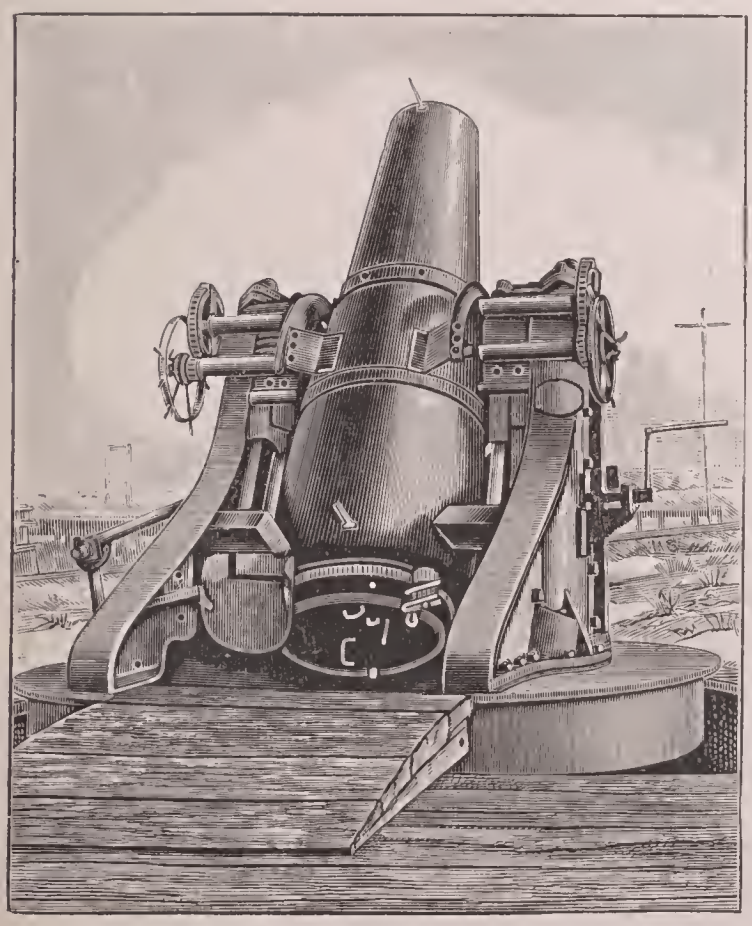


Fig. 3.—Modern breech-loading mortar.

Field Ordnance.—A new type of field-gun has been introduced by the U. S. Government. In this piece there are no hoops proper. The trunnion band and jacket are forged in one piece. The breech-block, being comparatively light, dispenses with the tray, and is supported by a ring hinged to the breech of the piece, which swings readily to one side. For dimensions, etc., of this piece, see table at end of article. The carriage and caisson for this piece are of steel so far as practicable; the only parts of wood being the felloes, spokes, pole, and the ammunition-chests. A swinging bar takes the place of the old-fashioned pole-yoke. The rigid splinter-bar of the old carriages is replaced by a movable double-tree, similar to that of ordinary carriages. The ammunition-chests, dispensing with trays, are much lower than formerly. Each one carries 42 rounds, making 168 per gun. For each battery of six pieces three extra caissons are allowed, making in all 33 chests carrying an aggregate of 1,386 rounds. The battery-wagon and forge of the old system have been united into one carriage, resembling in appearance a caisson.

The U. S. system of field artillery embraces a 3·6-inch breech-loading mortar—a short light piece (Fig. 4) intend-

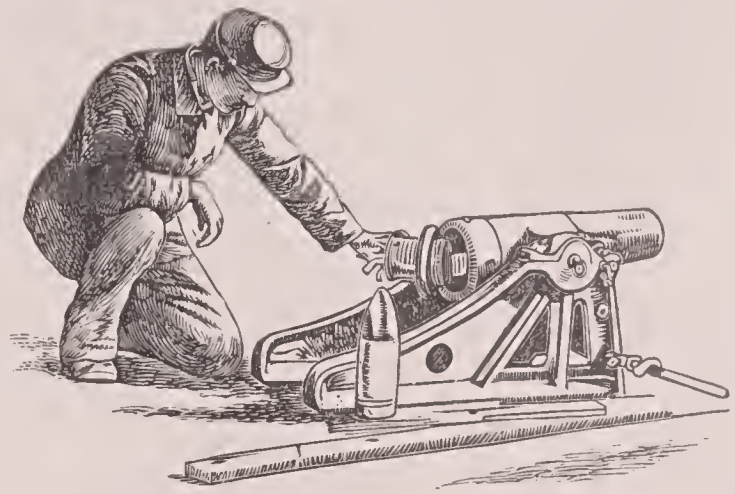


Fig. 4.—Breech-loading mortar for field use.

ed for vertical fire, chiefly against the *personnel* of an enemy protected by field intrenchments or inequalities of the ground against the direct fire of field-guns. It takes the place of the old Coehorn, but is much more powerful, accurate, and far-reaching. The body of the piece is made of a single ingot of forged steel, having the trunnions forged solid with the piece. The breech mechanism is similar to that of field-guns. The carriage is of bronze, cast chiefly in one piece, and when in position for firing rests directly on the ground; in transportation it, with the piece, is carried on a wagon especially devised for it—three on one wagon.

A 5-inch gun has been devised for light siege or heavy field service. In general construction it is similar to the 3·2-inch field-piece. For dimensions, etc., see table at end of article. The carriage supporting the piece is of steel, to be attached to a limber for traveling. The most noticeable feature about the carriage is the great height of the trunnions (72 inches) as compared with ordinary field-carriages. This is to admit of high elevation in firing. In the ordinary field-carriage the lowness of the trunnions is noticeable. Owing to the heavy charges used the recoil is excessive; to check this an hydraulic buffer, consisting of a cylinder and piston, is attached to the carriage and to a pintle firmly secured to the front of the platform on which the carriage stands. The piston-rod is attached to the under side of the stock, and the front end of the cylinder to the pintle.

The 7-inch siege-howitzer, the dimensions of which are given in the table at the end of this article, has about the same construction as the siege-gun just mentioned, except that it is very much shorter; the carriage for it is almost identical.

A 3-inch Hotchkiss rapid-firing gun has been adopted as a mountain-piece, to take the place of the small bronze mountain-howitzer of the old artillery.

Pneumatic Dynamite Gun.—Much ingenuity has been expended to devise some means of safely firing shells loaded with high explosives from ordinary powder-using guns. Although some experiments in this direction have been successful to a limited degree, the problem, as a whole, is as yet quite unsolved.

About 1885 a pneumatic gun capable of throwing heavy charges of high explosives was produced in the U. S. This machine, often called the Zalinski gun, consists essentially of a long steel tube, made as light as admissible, an air-reservoir, and a system of valves and other mechanism at

the breech for the control of compressed air, the propelling force of the projectile. The piece is provided with trunnions, supporting it on a carriage. one form of which resembles in general appearance the top carriage of an ordinary barbette gun. (See Fig. 5).

limited to about 5,000 yards. The piece is fired at a high elevation, giving the trajectory the character of that of the ordinary mortar shell.

The success attending the firing of an 8-inch piece of this character induced Congress to authorize the procurement of

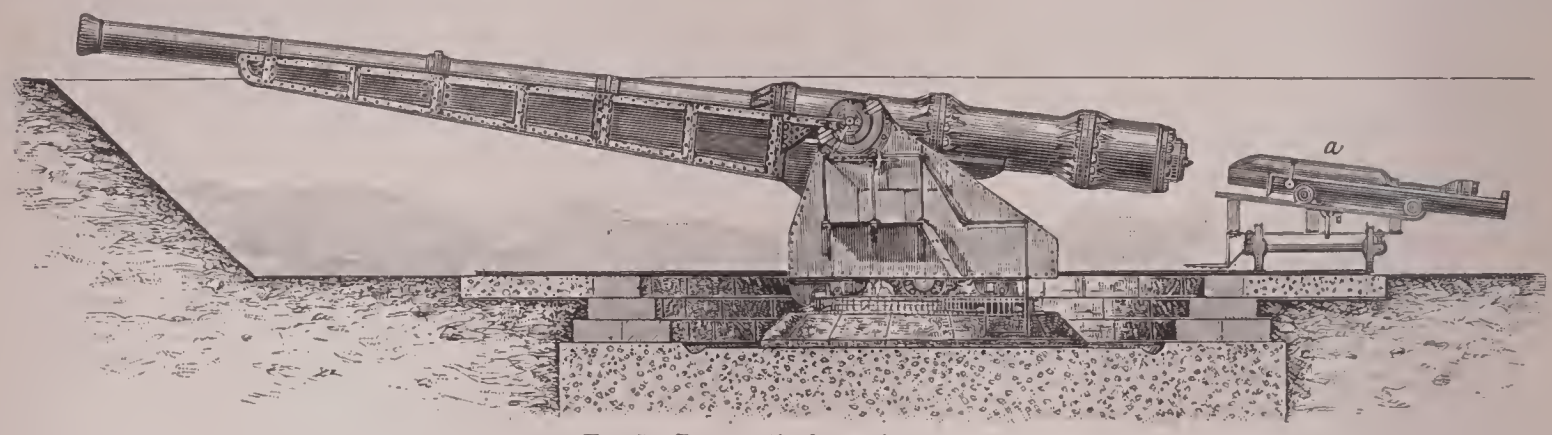


Fig. 5.—Pneumatic dynamite gun.

The tube is supported underneath by a cantilever steel truss, extending forward almost to the muzzle. The piece, as its name implies, is simply an air-gun. The air-compressor is a complicated system of cylinders, pistons, chambers, coolers, pipes, and valves. This apparatus is disposed of under and within the carriage, and is operated by a steam-engine, which may be at any convenient distance from the piece. The working capacity of the apparatus admits of about ten shots per hour, and the valve arrangements are so nicely adjusted as to admit the required amount of air with as much precision as gunpowder is weighed for ordinary guns. The projectile is simply a vessel to convey the explosive agent against or near the object to be destroyed, and consists of an elongated metallic cylinder to which is attached an ogival head containing the fuse mechanism. To the rear end of the cylinder is attached some form of oblique flanges, which, acting against the air, gives rotation to the projectile during its flight. Such a projectile is seen at *a* in Fig. 5. Dynamite and nitrogelatin are the usual explosives. As it is all-important that the explosion should take place with certainty, and at the proper moment, the fuses are an important feature of the projectile, each of which is usually provided with three—one to act by impact against the object, one to act by immersion when the water is struck, and the other to act in case of failure of the other two. The impact fuse is similar to the ordinary percussion fuse, but the other two act by means of a complicated electrical device.

ten others, nine of which are of 15-inch caliber. Three of these are to be mounted at San Francisco, and the remainder are to be mounted at important harbors on the Atlantic coast.

Wire-wound Guns.—In the U. S. considerable success has attended efforts to produce guns by this process. Pieces of this nature consist essentially of a steel tube for the bore, and of a series of layers of wire coiled around it. During the winding process a strong tension is given the wire, decreasing gradually from the interior to the exterior. The wire—which is tinned—has a rectangular cross-section. A jacket sustaining the trunnions covers the rear part of the piece, as likewise the breech mechanism. When the wire-winding process is complete, the piece is subjected to a low furnace-heat, to effect a soldering together of the wire strands through the agency of thin sheets of soldering foil inserted between the layers of wire during the winding process.

It is claimed that serviceable guns can be constructed by this method with but moderate plant as compared with built-up pieces—a feature of great importance to a nation of defensive unreadiness.

The following table shows the principal dimensions, weights, etc., of the system of rifled and breech-loading field, siege, and seacoast artillery, adopted for the U. S. land service, and now constructed at the Watervliet gun-factory:

DIMENSIONS, WEIGHTS, ETC.	FIELD ARTILLERY.			SIEGE ARTILLERY.		SEACOAST ARTILLERY.			
	3·2-inch steel breech-loading rifle.	3·6-inch steel breech-loading rifle.	3·6-inch steel breech-loading mortar.	5-inch steel breech-loading rifle.	7-inch steel breech-loading howitzer.	8-inch steel breech-loading rifle.	10-inch steel breech-loading rifle.	12-inch steel breech-loading rifle.	12-inch steel breech-loading mortar.
Weight, pounds	829	1,230	250	3,660	3,710	32,311	67,200	115,046	29,120
Total length, feet	7·5	7·5	2·0	12·1	8·0	23·2	30·6	36·6	11·7
Length of bore, calibers	26	22·7	5·25	23·5	12·4	32	34	34	10
Twist of rifling, calibers	30	35	30	35	35	50 | 25	50 | 25	50 | 25	30
Number of grooves	24	24	24	32	40	48	60	72	72
Width of grooves, inches	0·3	0·3	0·3	0·35	0·399	0·373	0·373	0·373	0·373
Depth of grooves, inches	0 05	0·05	0·05	0·06	0·06	0·06	0·06	0·06	0·07
Width of lands, inches	0·119	1·71	1·71	0·141	0·160	0·150	0·150	0·150	0·150
Length of powder-chamber, inches	10	14	3·9	19·7	10·64	41·25	53·25	62·5	20·0
Diameter of powder-chamber, inches	3·8	3·9	3·8	5·7	7·2	9·5	11·8	14·2	12·5
Length of axis of trunnions, inches	14·9	15·5	14·5	21·6	26	44·5	55·5	66·8	56
Diameter of muzzle, inches	5·1	6·0	5·4	8·00	10·00	14·0	16·8	21·0	21·0
Diameter of breech, inches	9·25	9·8	7·8	15·00	16·70	30	38·5	46·25	38
Number of hoops	2	1	0	3	3	14	18	30	6
Weight of forgings, pounds	....	1,738	347	....	....	40,091	82,002	138,732	....
Weight of tube forging, pounds	641	858	302	2,421	2,169	9,612	18,808	32,363	7,666
Weight of jacket forging, pounds	776	812	....	2,031	1,223	9,082	16,870	29,150	9,632
Weight of projectile, pounds	13·05	18·86	18·86	42	91	300	575	1,000	800
Weight of powder, pounds	3·75	4·63	1·00	12·5	9·75	130	256	440	100
Length of projectile, calibers	3	3·25	3·25	3	3	3·5	3·5	3·5	3·5
Initial velocity, foot-seconds	1,700	1,554	650	1,829	1,085	1,935	1,940	1,940	1,150
Muzzle energy, total, foot-tons	270	335	59	997	857	7,787	15,001	26,089	7,334
Muzzle energy per ton of gun, foot-tons	731	610	525	612	519	546	500	508	564
Muzzle energy per pound of powder	72	72	59	80	88	60	59	60	73
Penetration in Creusot steel at muzzle, inches	....	....	....	. ..	....	16·5	20·5	25	....
Approximate rauge at 20° elevation, in yards	....	....	....	....	....	11,000	13,650	14,700	....
Approximate cost of piece, in dollars	....	....	....	....	....	15,600	34,500	52,300	....
Approximate cost per charge, iu dollars	....	....	....	....	....	17·00	131·00	217·00	....

The ordinary projectile for the 15-inch gun has a total length of about 10 feet, exclusive of the directing apparatus attached to its rear end. Its weight when loaded with 500 lb. of nitrogelatin is approximately 1,000 lb. The muzzle-velocity is only about 500 feet per second, and the range is

John C. Tidball.

Ordnance Department: that branch of the U. S. army which supplies arms, ammunition, and equipments to the military force of the nation. In instituting this as a separate branch the U. S. has followed the traditions of Great

Britain. The European continental states do not have such distinct organizations for the supply of ordnance and ordnance material. These duties devolve upon the artillery, and are performed by officers detailed therefrom. Attached to its department of war, each government has a bureau of artillery, which regulates all matters connected with national armament. In Germany the fabrication of arms is directed by officers detailed from the foot-regiments of artillery; the labor is performed by civilian employees. Besides Government establishments, there are private armories supplying small-arms to the Government the manufacture of which is superintended by officers of infantry.

In the U. S. the department was created a distinct branch of the military establishment in 1812, a short period before the outbreak of the war with Great Britain. Prior to this ordnance and ordnance stores had been obtained from private establishments, and were received and inspected by civil or military agents without regard to any strict system.

The duties of the ordnance department were specifically set forth in the law creating it to be the inspection and proving of all pieces of ordnance, cannon-balls, shells, and shot procured for the army, and to direct the construction of all carriages and every apparatus of ordnance for garrison and field service, and all ammunition-wagons, pontoons, and traveling forges, and also the direction of the laboratories, the inspection and proving the public powder, and the preparing of all kinds of ammunition for garrison and field service. In 1815, at the close of the war with Great Britain, the department was reorganized and its duties and powers enlarged. The officers, with a colonel at the head, were given direct military rank, and it was made the duty of the chief to make estimates, and, under the Secretary of War, to make contracts and purchases for procuring the necessary supplies of arms, equipments, ordnance, and ordnance stores. The national armories were placed under control of the department, and authority was given to establish dépôts of arms, ammunition, and ordnance in such parts of the U. S. as might be deemed necessary. These are substantially the duties of the ordnance department at the present time, except that all that relates to pontoons has been transferred to the Engineer Corps of the army. In the following year an act was passed assigning ordnance officers to their duties with the staff of the army, in the same manner as for the Corps of Engineers. Ever since then they have continued to belong to the staff.

By the act of Congress of 1821, reducing the military peace establishment, the ordnance department, as an independent bureau, was abolished. It was merged into the artillery, and the President was authorized to select from the regiments of artillery such officers as might be necessary to perform ordnance duties. One supernumerary captain was provided for each of the four regiments of artillery to perform ordnance duty. In 1832 the department was reorganized and placed on an independent footing by an act of Congress which provided for one colonel, one lieutenant-colonel, two majors, ten captains, and as many enlisted men, not exceeding 250, as the public service might require.

From time to time, but especially during the civil war, the department has been enlarged until now it consists of 1 brigadier-general, chief of ordnance, 3 colonels, 4 lieutenant-colonels, 10 majors, 24 captains, 12 first lieutenants, 4 ordnance storekeepers, and 543 enlisted men of various grades, from sergeants to privates. The enlisted men serve in detachments as guards at the various arsenals and dépôts. All operations of construction and repair at these establishments are performed by the hired labor of civilians.

Since 1874 all officers entering the ordnance have come from the line of the army, entering as first lieutenants at the foot of the list, and by competitive examination. Previous to this vacancies at the foot of the list were filled by appointments direct from the military academy, the ordnance having second grade, the engineers the first.

In supplying the *fighting* material of war the ordnance department has recourse to both manufacturing and purchasing by contract. The chief establishments for the former are the national armory at Springfield, Mass., for the manufacture of small-arms of all kinds; the Watervliet arsenal at Watervliet, N. Y., at which is the gun-factory referred to in the article on Ordnance; the Watertown arsenal, near Boston, Mass., at which gun-carriages are constructed; the Frankford arsenal, Philadelphia, Pa., for the manufacture of small-arm ammunition; and Rock Island arsenal, Illinois, at which are manufactured saddlery and other horse equipments, targets and accessories for rifle-ranges, knapsacks, haversacks, and canteens, together with other stores required for current use.

In addition to the fourteen arsenals, most of which are mere depositories of obsolete material, the ordnance department has charge of the powder dépôt near Dover, N. J., and the one near St. Louis, Mo.

The Fortification Act of 1888, resuming measures for the national defenses, established a board of ordnance and fortifications, consisting of the commanding general of the army, an officer of the Corps of Engineers, an officer of ordnance, and an officer of artillery, and by subsequent legislation a civilian. This board is empowered to provide suitable regulations for the inspection of guns and materials at all stages of manufacture to the extent necessary to protect fully the interests of the U. S., and generally to provide such regulations concerning matters within its scope as shall be necessary to carry out to the best advantage all duties committed to its charge. It will be observed that this board is constituted to subserve the best interests of the Government—the engineer to plan and construct fortifications, the ordnance to plan and construct cannon, and the artillery to use the latter and defend the works. The board meets once a month, and, besides directing how appropriations shall be carried out, passes upon inventions and improvements proposed for guns, mortars, ammunition, implements, and other kindred matters. Liberal allotments are made for inventions that bid fair to be useful. All contracts and expenditure of money are made, as before, by the ordnance department, the officers of which conduct the work and make all tests and experiments under general instructions from the board.

A permanent board of ordnance officers has existed since 1882, and carries out the details of the operations prescribed by the ordnance and fortification board. Tests and experiments are made at the proving-ground at Sandy Hook, N. J.

Beginning with the year 1882, the department has published from time to time a series of papers bearing the title *Notes on the Construction of Ordnance*, containing the results of its own investigations and experiments in the development of heavy guns, carriages, powders, etc.; also such translations of papers published in Europe as are considered important in their bearing on the manufacture or treatment of steel or the construction of cannon, carriages, etc. See Ordnance.

John C. Tidball.

Ordnance Survey: the name given to the aggregate of persons employed by the British Government, or the operations undertaken by them, for the surveying and preparation of maps of the British islands; so called from having been originally under the control of the board of ordnance. It may be said to have had its beginning in the operations conducted by Gen. Roy in 1784 for the determination of the difference of longitude of the observatories of Greenwich and Paris, though it was only in 1791 that the systematic survey of the country with the view of producing a military map of the whole kingdom on the scale of an inch to a mile ($\frac{1}{63360}$) was begun. The first sheet of this map was published Jan. 1, 1801, and in 1824 the work was so far advanced as to include the whole of the south of England, with part of Wales and a small part of Scotland, when it was in a great measure suspended in order that the survey of Ireland on the scale of 6 inches to a mile might be proceeded with. In 1840, this survey of Ireland being completed, and the military map of England finished up to the southern boundaries of Lancashire and Yorkshire, the Government decided on adopting the scale of 6 inches to a mile for the survey of the remaining counties of England and the whole of Scotland. Lancashire and Yorkshire and six of the southern counties of Scotland were accordingly surveyed on the 6-inch scale. In 1855 the scale was again changed, and that of $\frac{1}{2500}$ (25·344 inches to a mile) ordered for the cultivated districts of the four northern counties of England and of the whole of Scotland. The uncultivated districts were at the same time to be drawn on the scale of 6 inches to a mile ($\frac{1}{10560}$), and the $\frac{1}{2500}$th plan to be reduced to the 6-inch scale, so as to make the plans of every county perfect on that scale. In 1862 the four northern counties were finished, and in 1863 the extension of the large scale to those portions of the country which had been previously surveyed on the scale of an inch only was ordered. In 1893 the state of the survey was as follows:

1. Scale $\frac{1}{500}$, or 10·56 feet to a mile, and $\frac{1}{1056}$, or 5 feet to a mile. On one or other of these two scales every town of the United Kingdom which has a population of 4,000 in-

habitants or upward has been surveyed. Most of the plans are on the $\frac{1}{500}$ scale.

2. Scale $\frac{1}{2500}$, or 25·344 inches to a mile. This is the scale for the agricultural or cultivated districts. The whole of the cultivated area of Great Britain was completed in 1893, except parts of Lancashire and Yorkshire and of six counties of Scotland, which were originally surveyed, as stated above, on the 6-inch scale; it was expected that these would be completed about 1896. The survey of Ireland on this scale was only begun.

3. Scale $\frac{1}{10560}$, or 6 inches to a mile. The plans of the whole of the United Kingdom have been published on this scale. Those of Ireland were completed in 1840, those of Great Britain in 1890. Most of the latter have been produced by reduction from the $\frac{1}{2500}$ scale.

4. Scale $\frac{1}{63360}$, or 1 inch to a mile. Maps of England and Wales, most of them drawn from a special survey on a scale of 2 inches to a mile, were completed on the scale of 1 inch to a mile about 1868. In 1872 it was decided to make a "new series" map on this scale, based on the large-scale surveys. In 1893 this was still in progress, both in outline and with hills; the outline edition was to be completed about 1896, the "hills" edition about 1900. The 1-inch map of Scotland, reduced from the large-scale plans, was completed in outline in 1886, and that of Ireland reduced from the 6-inch plans was completed in outline in 1861.

The $\frac{1}{500}$ and $\frac{1}{2500}$ plans are either zincographed, or, more recently, photozincographed. The 1-inch maps are engraved on copper. The 6-inch plans were also up to about 1880 engraved on copper, but this method was then found to be too slow to keep up with the progress of the survey, and they are now photozincographed by direct reduction from the $\frac{1}{2500}$ plans. The relation between the maps on these two scales is that a 6-inch plan contains $4 \times 4 = 16$ similar rectangles, and each of these rectangles corresponds to a plan on the $\frac{1}{2500}$ scale. The plans on the $\frac{1}{500}$ or town scale are formed by dividing a $\frac{1}{2500}$ plan into $5 \times 5 = 25$ similar rectangles, and each of the latter forms a plan on the $\frac{1}{500}$ scale.

The principal triangulation of Great Britain and Ireland consists of some 250 stations, the triangle sides being in some cases upward of 100 miles in length. The angles were measured with theodolites of 36, 24, and 18 inches diameter. The latitudes of 32 stations were determined by observation, and the direction of the meridian observed in 60 stations. The triangulation was reduced by the method of least squares. Six base-lines were measured in the course of the work, but the final results are made to depend on the two lines—one in the north of Ireland (8 miles long) and the other in the south of England (7 miles long)—which were measured with Colby's "compensation-bars."

Special surveys have been and are made from time to time for the War Department and other services, not only in the United Kingdom, but, for instance, in Canada and in Gibraltar, and trained parties from the Ordnance Survey have been employed at the Cape of Good Hope and in British Columbia and elsewhere, as well as on the delimitation of various colonial boundaries. The Ordnance Survey is under the control of the Board of Agriculture. The essential feature of the organization is the combination of military and civil elements. There are employed on the survey 24 officers of the Royal Engineers, including 1 director, 4 field officers, 18 captains, and a quartermaster. There are four companies of Royal Engineers, which, including non-commissioned officers, number 361 men, and are about to be increased to 454 men. The number of civil assistants and laborers is about 2,000. At Southampton there are from 60 to 70 non-commissioned officers and men of the Royal Engineers, with 9 officers and about 700 civil assistants and laborers. In this staff are included about 70 engravers on copper, 130 zincographic tracers and printers, 50 colorists, 170 draughtsmen and examiners of plans, 6 trigonometrical computers, from 20 to 30 artificers, including 2 opticians, and about 40 photographers and engravers on glass negatives. The sum voted annually by Parliament for the prosecution of the survey varies; in 1893 it was £218,000.

A. R. Clarke. Revised by John Farquharson.

Ordovician Period: See Silurian Period.

Ore [O. Eng. *ār*, brass: Goth. *ais* < Teuton. *ais*: Lat. *aes*, *ae'ris*, bronze (for older **aies*-): Sanskr. *ayas*, metal, bronze]: a metal chemically combined, or in a native state, mechanically mixed with other substances, which render treatment necessary to separate it. In a strictly technical sense, only those substances are ores which contain the metal in sufficient quantity and of sufficient purity to make the treatment profitable. Arsenopyrite, a combination of arsenic, sulphur, and iron, contains 34·4 per cent. of iron, but is not an ore of iron, because the metal made from it is not of sufficient commercial value to pay the expenses of treating it.

Thomas Egleston.

Ore Deposits: any natural occurrences of metalliferous minerals from which one or more of the heavy metals can be profitably extracted. The ore may be a single native metal, or a chemical or mechanical mixture of metals, or a single mineral consisting of a metallic oxide or a metallic salt, or it may be a mechanical mixture of several of these minerals. Generally, the ore is associated more or less intimately with other minerals, which are called the gangue. The ore and the gangue together form the deposit.

Texture.—Metalliferous deposits sometimes consist solely of one ore, as in some occurrences of magnetite, hæmatite, spathic iron ore, galena, more often of two or more ores, with one or more minerals forming the gangue. The different ores may be intimately associated with each other and with the minerals forming the gangue, or they may exist separately and with a greater or less regularity of distribution. The more common varieties of texture, chiefly as given by von Cotta, are—

Compact, when the texture is so fine that the separate particles are not visible to the naked eye: compact hæmatite.

Granular, when the particles are visibly in the form of grains: fine-grained, medium-grained, coarse-grained, are terms used to indicate the size of the individual particles: granular magnetite, granular pyrites, etc.

Micaceous or finely laminated, when the particles are in thin laminæ or scales: micaceous specular iron ore.

Disseminated, when the ore is distributed through the gangue in grains or laminæ.

Porphyritic, when the ore is distributed as integral crystals through the gangue.

Banded or combed, when the constituents—ores or gangue or both—are arranged in parallel layers. This variety, which is very common in certain kinds of deposits, is of signal interest from both scientific and economic standpoints. Deposits having this structure were formed in cavities, fissures, caves, chimneys, and the layers indicate gradual growth under more or less varying conditions. The oldest members or layers (*a a*) formed on the opposite walls (Fig. 1), then *b b* *c c*, till finally the two youngest members, *d d*, filled the narrowed space. Frequently two contemporaneous layers, which may alone fill the vein or may form the two youngest members, consist of crystals set perpendicularly to the walls of the vein, and with their terminal faces bristling toward each other from opposite sites or interlacing (*d d* in the sketch). This symmetrical repetition is sometimes interfered with by the interposition of other layers when the vein has reopened and formed a new vein between the walls of an older one. Fig. 2 represents three distinct veins, A B C, between the same walls.

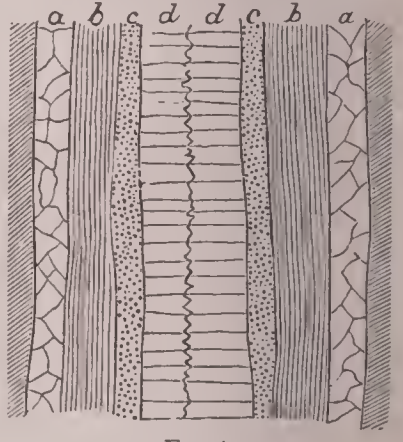


Fig. 1.

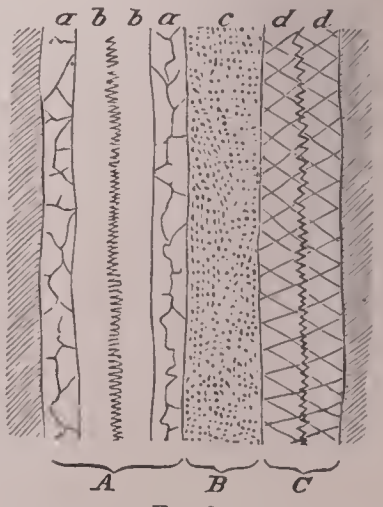


Fig. 2.

Concentric-banded, *Cocardenerze*, or *Ringerze*, when the bands are arranged symmetrically around a nucleus, which is often a fragment, as in Fig. 3.

Brecciated.—The deposits very often contain fragments of the inclosing rock or "country," or, also, pieces of still older ore-formations. When these are very numerous the texture is brecciated. Sometimes these fragments form nuclei, around which the

minerals of the ore and gangue have crystallized, forming a massive or banded or drusy cement. Very often, especially in veins, the highly altered fragments of the wall-rock form nearly the entire filling, in which the minerals of the ore and gangue are distributed in thin threads and seams. (See Fig. 4.) The texture is then generally earthy-granular or flaky and lenticular.

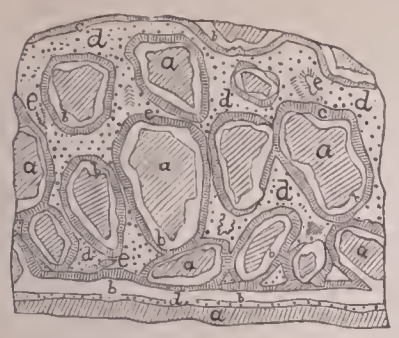


FIG. 3.—Concentric vein structure, Adalbert vein, Przibram (*Grimm*): *a*, greenstone; *b*, brown blende; *c*, galena; *d*, siderite; *e*, drusy cavities.

Drusy, when the deposit contains many cavities lined with crystals.

The boundaries of a deposit are called walls; when these are well defined, the plane between the deposit and the wall-rock is called the selvage (*Salband*); this is sometimes very smooth and highly polished (*Slickenside*).

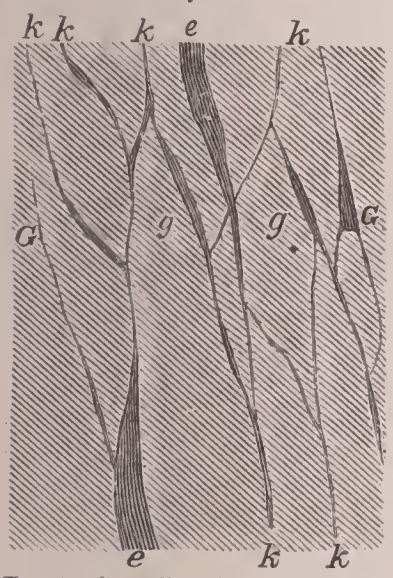


FIG. 4.—G, wall-rock; *k*, clefts; *g*, wall-rock in the lode; *e*, ore.

Succession of Minerals.—The formation of any deposit was due to slowly acting causes working during long periods of time, and often under more or less varying conditions. The progress of growth is often marked by the banded structure when present, the varying conditions by the alternating constitution of the bands, and the relative ages of the constituents by their relative positions in the separate bands or by the superposition of one upon another, forming what is called a paragenetic series, as in Fig. 5. Frequently the constituents of one of the minerals have been removed in part or wholly, and other substances have taken their place, forming a new mineral, which, however, retains the external crystalline form of its predecessor; this process, called pseudomorphism, has sometimes gone so far that a new series of minerals has taken the place of the older deposit. Limonite, pseudomorphous after spathic iron ore, is one of the more frequent instances of deposits changed as regards mineral composition.

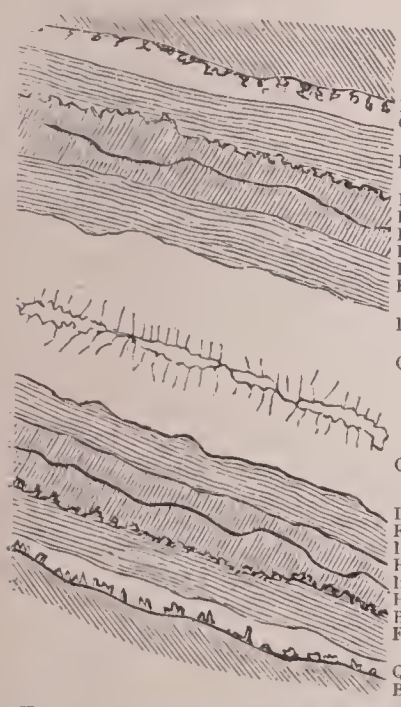


FIG. 5.—Paragenetic series (*von Weissenbach*).

Grouping of Minerals.—Certain metalliferous substances have a tendency to occur together, either chemically combined or associated as separate minerals; for instance, ores of lead and zinc, of copper and iron, of cobalt and nickel, of iron and manganese, of tin and wolfram. A similar tendency to association exists with regard to certain gangue minerals, among themselves and with certain ore groups.

Classification.—Numerous attempts have been made to arrive at a classification of ore deposits which would at the same time meet strictly scientific requirements and serve a useful technical purpose. A. Werner, von Cotta, and later, in the U. S., J. D. Whitney, R. Pumpelly, R. W. Raymond, J. S. Newberry, and W. O. Crosby, and in Europe, von Groddeck, J. A. Phillips, de Launay, and F. Posepny brought forward suggestions. The last-named proposes two principal groups—deposits contemporaneous with the country rock (*idiogenous*) and those subsequently formed in it (*xenogenous*). He adds a third class, in harmony with the older systems, which includes deposits of *débris*, calling it *hysterogenous*. With reference to the country rock he distinguishes between deposits caused by filling spaces of diseission (fissures, etc.), by filling of spaces of dissolution in soluble rocks, and metamorphic deposits in soluble rocks.

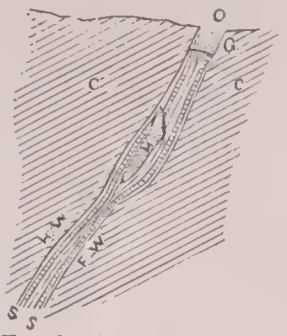


FIG. 6.—C, country rock; O, outcrop; G, gossan; H, horse; H W, hanging wall; F W, footwall; S S, selvage.

The ore deposits in spaces of diseission include those generally known as "fissure veins." The country rock has been torn asunder, the movement often being complex. Veins so formed often send out minor cracks, usually at an acute angle, into the wall-rock, which are called feeders or branches. Very often the vein incloses large masses of the wall-rock or "country," which are called "horses." (Fig. 6.) The extension of a vein horizontally is called its strike, direction, course, or bearing, and is expressed in points of the compass as N. E. by N., or in degrees of the quadrant, as N. 33° 45′ E. The vertical angle which it makes with the horizon is called the dip; thus the dip varies from 0° in a horizontal vein to 90° in a vertical one. The thickness of veins varies from a mere crack to hundreds of feet. Veins often divide into several smaller ones, which keep proximately the original strike; they are then said to split up. (Fig. 7.) In districts which contain ore-bearing veins there are almost always a number of them, and they are then often grouped in a zone of nearly parallel veins, which sometimes run together or are united by leaders. Some districts have several zones, each roughly parallel to a different direction, and the different zones are then generally of different ages and more or less different in character. It is a common occurrence to find that a vein has been subjected to an upward or downward movement of the country on one of its sides, leaving the opposite walls in different relative positions to those existing before the movement. This motion has had more or less crushing, especially of the projecting portions of the wall, for a result, and has often left highly polished wall-surfaces. Where the fissure lay in a warped plane, the tendency of a movement was to produce a vein of irregular thickness by bringing the alternating convex portions of the two walls into opposition. An important result of this is the permanent enlargement of the fissure as a whole. (Fig. 8.) The evidence of movement having taken place in a given vein is found in the relative displacement of the opposite sides. This is marked by interruption of the continuation of individual strata if the country rock is stratified (Fig. 8), or, if the vein intersects dikes or other veins which are older, by the displacement of these.

FIG. 7.

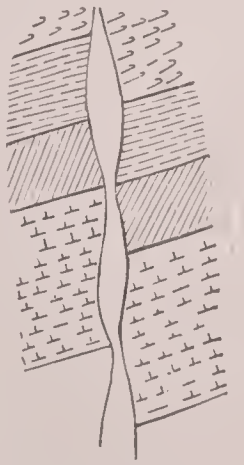


FIG. 8.

The second group, that of deposits which are fillings of spaces of dissolution, includes, according to Posepny, the majority of the deposits in limestone. Conspicuous among them are those of Leadville and of Eureka, Nev. An ideal section of the latter, after J. S. Curtis, is shown in Fig. 9, in which *a* represents the quartzite, *b* crushed limestone, *c* limestone, *d* shale, *f* stratified limestone, *x y* the ore body, and *m* the Richmond shaft. Posepny includes in this group also the lead and zinc deposits of Missouri and Wisconsin.

Among the "metasomatic" deposits which made room for themselves by the expulsion of an earlier mineral, Posepny includes the copper shales of Mansfeld, the lead-carrying sandstones of Mechernich, Germany, the silver deposits of Silver Reef, Utah, and the copper deposits of Arizona.

Through the dislocation of the strata, or the country rock, by *faults*, and through the intrusion of eruptive rocks, great complexities are often brought about. As an exam-

ple, Fig. 10 shows a vertical cast and west section, after A. A. Blow, through the McKean shaft, Iron Hill, Leadville, W P being white porphyry, B L blue limestone, G P gray porphyry, W L white limestone, L Q lower quartzite, and

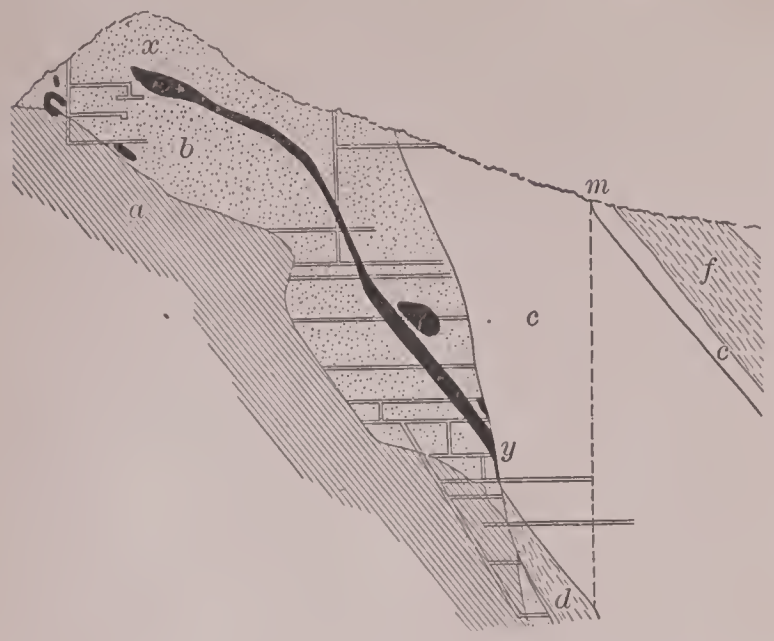


Fig. 9.

G granite, the ore deposit being indicated by heavy black. Elaborate rules have been worked out to aid the miner in the search for the displaced ore body, which it would lead too far to follow up.

The contents of a vein are the ore and the gangue. Some veins have a very simple character as regards the filling, containing one ore, or this and one kind of gangue. Others, again, are exceedingly complex, containing in the same part of the vein or in different parts a great variety of metallic compounds, associated with numerous gangue minerals. Veins are generally filled compactly with their contents, though druses sometimes exist. As has been already mentioned, the constituents—ore and gangue minerals—are often distributed in symmetrical layers parallel to the walls; they are often also heterogeneously mixed. The distribution of ore and gangue minerals is generally more or

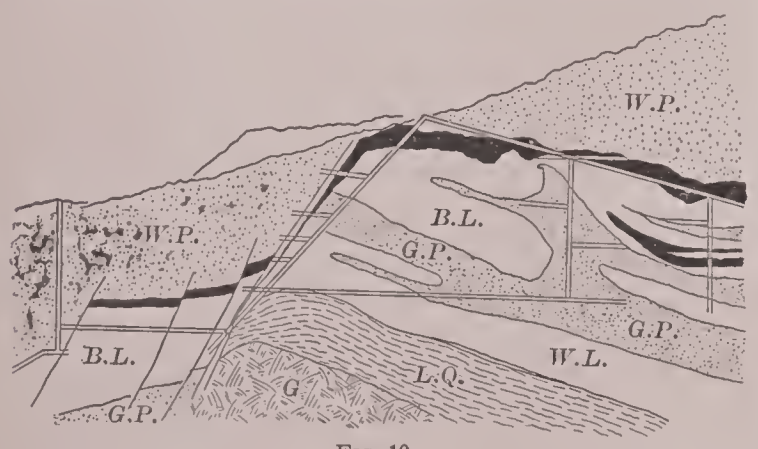


Fig. 10.

less irregular within the same vein. Sometimes the ore is concentrated at different points into bodies called bonanzas, nests, chimneys, pockets, masses, etc., while the rest of the vein is barren or contains only disseminated ores of the same kind or of different kinds to that of the bonanzas. This inequality of distribution is sometimes traceable to a cause. Thus in some veins changes in the character of the wall-rock are accompanied by change in the character of the vein-filling—changes which may in one place be due to certain portions of the country rock contributing metallic solutions, in another place to parts of the country contributing a reagent capable of precipitating metals from solutions in the vein. Again, in veins of varying thickness, if the ore is one of the younger members, the older filling of the narrower parts by poor or barren material would leave room only in the wide parts for the richer member. The intersection of veins is often accompanied by enrichment. Besides changes due to local influences, there is observed in some districts a difference of character in depth. Thus the veins of Oruro in Bolivia, which were rich in silver in their upper levels, contained ores barren of silver in depth. Veins containing both tin and copper have often the tin ores above and copper ores below. Sometimes a dike of eruptive rock has been altered to a considerable depth in such manner as to roughly simulate a fissure-vein.

Surface-deposits, or, as Posepny calls them, "hysterogenous" deposits, have formed the source of enormous quantities of gold, platinum, and tin ore. When, by disintegration and erosion or by being dissolved, a rock-mass containing ore deposits of any form is removed, and the removing cause is not competent to carry away the ore, this remains in a more concentrated form and is a residuary deposit. The often important masses of magnetic iron sand which are concentrated by the wave-action on beaches from the disintegrated *débris* of rock-masses are of this form. Iron Mountain, in Missouri, was wholly mantled to a depth of from 2 to 20 feet with a loose mass consisting entirely of fragments of iron ore of all sizes. These representatives of the broken-up reticulated veins are all that remain of a large amount of porphyry, which has disappeared, leaving only the insoluble iron ore.

Stream-deposits consist of loosely aggregated material in modern or ancient water-courses. They are generally the lowest member of a river-deposit, and owe their existence to the specific gravity and insolubility of the metals or ores. The annexed sketch (Fig. 11) from Whitney (*Geological Sur-*

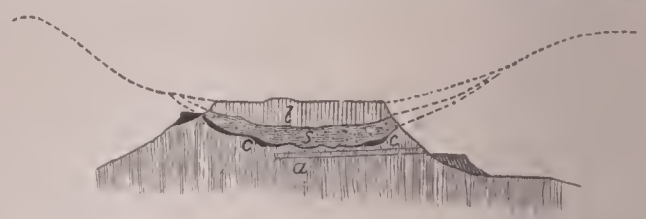


Fig. 11.—Table Mountain: *l*, lava; *s*, sandstone; *c c*, auriferous channels; *a*, slate.

vey of California) represents an auriferous stream-deposit formed in a valley which, after being filled with a lava stream, became a mountain-crest by the erosion of the softer hills on either side.

In many localities iron ore is deposited in marshes and on the bottoms of lakes. The ore is a variety of limonite called bog ore, and owes its origin to the action of decaying organic matter on ferric oxide, producing soluble ferrous carbonate, which, on entering the aërated waters of a lake, is oxidized and sinks. Such a deposit is worked in a lake near Radnor Forges, Canada.

Concerning the genesis of ore-deposits, renewed interest has been aroused through the researches made by Fridolin Sandberger, of Würzburg, who advanced what is known as the lateral secretion theory. He found by painstaking chemical analyses that the mica, olivine, augite, and hornblende of country rock contain minute quantities of the useful metals, and claimed that the filling of ore deposits is derived through chemical solution from the surrounding country rock. Other economic geologists, notably Posepny, hold that the chief agency for the accumulation of useful minerals is the underground circulation of water. He makes a sharp distinction between what he calls vadose, or shallow underground circulation, and deep underground circulation, relying upon the solvent power of water, with increasing temperature and pressure.

Relative Values of Deposits.—Fissure-veins, as a rule, are more trustworthy, because of the continuity of the fissures and the consequent facility offered the miner for underground prospecting. The same may be said of certain beds, while the other forms are of the most uncertain character; any given one may be an isolated occurrence or one of many, but from their nature they rarely offer clews by which the miner can work from one to another. The most productive mines of iron ore are beds and irregular masses. The most productive copper mine is at present the Calumet and Hecla on Lake Superior, which is a bed of conglomerate impregnated with native copper. The largest production of lead has probably been from the quickly exhausted but innumerable deposits in limestones and dolomites. The greater proportion of tin and native gold is derived from surface deposits. On the other hand, a great part of the silver of the world is wrought from true fissure-veins; and, if we except deposits of iron and some isolated deposits of other metals, the instances of permanent ore-mining industries are found to be established on fissure-veins.

Literature.—General: Von Cotta, *Treatise on Ore Deposits* (1869), transl. by Fred. Prime from Cotta's *Erzlager-*

OREGON

Scale of Miles
0 10 20 30 40 50 60
County Towns ⊙ Railroads
This type indicates a population of 1,000 or over.

Longitude West from Greenwich

stätten Lehre; Joh. Grimm, *Die Lagerstätten der nutzbaren Mineralien* (Prague, 1869); von Cotta and H. Müller, *Gangstudien*; J. D. Whitney, *Metallic Wealth*. Special for U. S.: *Mining Industry*, vol. iii. of the *Geol. Surv. of the 40th Parallel, for the Comstock Lode and many Deposits in Nevada, Utah, and Colorado*; R. W. Raymond, *Mineral Resources West of the Rocky Mountains*; Fridolin Sandberger, *Untersuchungen über Erzgänge* (Wiesbaden, 1885); A. von Groddeck, *Die Lehre von den Lagerstätten der Erze* (Leipzig, 1879); J. A. Phillips, *Ore Deposits* (1884); Kemp, *Ore Deposits of the United States* (New York, 1892); Fr. Posepny, *The Genesis of Ore Deposits* (*Transactions of the American Institute of Mining Engineers*, vol. xxiii.); John A. Church, *The Comstock Lode: its Formation and History* (New York, 1879). Numerous descriptions of American and foreign deposits are published in the *Transactions of the American Institute of Mining Engineers* (New York, vols. i. to xxiii.), the publications of the U. S. Geological Survey, and of the Geological Surveys of Pennsylvania, New Jersey, Ohio, Michigan, Missouri, Wisconsin, and Minnesota.

R. Pumpelly. Revised by C. Kirchhoff.

Oregon: one of the U. S. of North America (Western group); the twentieth State admitted to the Union; capital, Salem.

Location and Area.—It lies between lat. 42° and 46° 18′ N. and lon. 116° 33′ and 124° 25′ W.; is bounded N. by Washington, E. by Idaho, S. by California, and W. by the Pacific Ocean; length E. to W. about 360 miles, breadth N. to S. 290 miles; coast-line about 300 miles; area, 96,030 sq. miles, of which 1,470 are water.

Seal of Oregon.

Physical Features.—Three ranges of mountains divide the State from N. to S., the Coast Range, from 10 to 30 miles from the ocean; the Cascade Mountains, from 110 to 150 miles inland; and the Blue Mountains, near the eastern boundary. The Cascades and Coast Range are united by four lateral ranges—the Callapooia, Umpqua, Rogue River, and Siskiyou Mountains. The Coast Range has an extreme altitude of 4,000 feet, and is covered to its summit with dense forests. The Cascade Mountains are a continuation of the Sierra Nevada Mountains; the extreme height is 7,000 feet, with a number of peaks rising from 2,000 to 5,000 feet higher. The most noted of these are Mt. Hood, 11,500 feet; McLoughlin or Pitt, 11,000; Jefferson, 10,500; and Three Sisters, 9,500. The Cascades are densely timbered to the snow line. The Blue Mountains have an extreme height of about 3,000 feet, with no high peaks, and are well covered with timber, especially at the north end of the range. Toward the S. the mountains recede and shoot off in lateral spurs W. to the interior table-land. Along the river courses and between the various mountain ranges and spurs are numerous fertile valleys. The largest is the Willamette, lying between the Coast Range and Cascade Mountains and the Columbia river and the Callapooia spur. It is 150 miles long and from 90 to 70 wide, is extremely fertile, and contains the densest population of the State. S. of it, between the lateral ranges, are the Umpqua and Rogue River valleys. The region E. of the Cascade Mountains, embracing two-thirds of the State's area, is known as Eastern Oregon. That portion of it between the Cascade and Blue Mountains is in the main a high table-land, with little rainfall, and is sparsely populated. There are fertile valleys along the water-courses and in the vicinity of the numerous lakes in the southern part, the largest being Harney and Goose Lakes, while at the northern extremity, near the base of the Blue Mountains, the land is rolling and extremely fertile. In the Blue Mountains and between it and Snake river, the eastern boundary, are numerous fertile valleys, the largest being Grand Ronde and Wallowa on the N., Powder and Burnt rivers in the middle, and Malheur and Owyhee on the S. The mountains are well covered with soil, especially the Coast Range, and large areas are being brought under cultivation by removal of the timber.

The rivers flowing into the ocean are the Nehalem, Nestucca, Yaquina, Alsea, Siuslaw, Umpqua, Coquille, Rogue, and Chetco; those flowing into the Columbia are the Lewis and Clarke, Young's, Clatskanie, Willamette, Sandy, Hood, Deschutes, John Day, and Umatilla; and those flowing into Snake river, itself a branch of the Columbia, are Grand Ronde, Powder, Burnt, Malheur, and Owyhee. The chief tributaries of the Willamette are the Clackamas, Tualatin, Yamhill, Santiam, Molalla, Luckiamute, Mary, Long Tom, the river itself dividing into the Mackenzie and Middle and Coast Forks. The large lakes are all in the southern portion of the central division, some of them being saline. They are the Klamath, upper and lower, Goose, Warner, Salt, Christmas, Abert, Summer, Silver, Harney, and Malheur. Crater Lake lies in the Cascades, 8,000 feet above sea-level, in the crater of a huge extinct volcano 10 miles in circumference and surrounded by bluffs 2,000 feet high. It is the deepest fresh water in America. The chief harbor is the Columbia river, improved by the U. S. Government so that its entrance has 28 feet at extreme low tide. Minor harbors are Tillamook Bay, Yaquina Bay, Alsea river, Siuslaw river, Coos Bay, Coquille river, Rogue river, and Port Orford. The principal capes and headlands are Point Adams, at the mouth of the Columbia, Tillamook Head, Cape Foulweather, Cape Lookout, Cape Perpetua, Cape Blanco, and Umpqua Head. The coast-line is very abrupt and rocky, and but slightly indented.

The fauna embraces the huge grizzly, black, and cinnamon bears, cougar (mountain-lion or panther), catamount (wild-cat), polecat, raccoon, porcupine, beaver, otter, muskrat, several varieties of wood and ground squirrels, silver and red foxes, martens, hares or "jack rabbits," rabbits, deer, elk, antelope, mountain-sheep, and mountain-goat. Seals and sea-lions enter the Columbia, and the latter have rookeries off the coast. Salmon enter all the streams in great quantities, and millions are caught annually. The chinook, or quinnat, is the leading variety. Sturgeon are caught in great numbers in the Columbia and Willamette. The streams teem with salmon-trout and mountain-trout. In the spring swarms of smelt and herring enter the rivers. Many less valuable fish, including transplanted carp, are found in the rivers and lakes. Transplanted shad are becoming plentiful. Oysters of a small but finely flavored variety are found in Yaquina Bay, and crabs and lobsters along the coast. The birds include the golden and baldheaded eagle, several varieties of hawks, cormorant, sea-gull, pelican, albatross, vulture, buzzard, pigeon, mountain-quail, grouse, imported Chinese pheasants of five varieties, American and trumpeter swans, brant, Canada goose, many varieties of ducks, including canvasback, the robin, field-lark, skylark, jay, woodpecker, yellowhammer, blackbird, grosbeak, bullfinch, greenfinch, chaffinch, nightingale, goldfinch, song-thrush, starling, and several other varieties of song-birds.

Mineral Productions.—Oregon has a great variety of minerals. Gold, both placer and quartz, is mined in Jackson, Josephine, Douglas, Linn, Grant, Baker, and Union Counties. Placer-mining began in Jackson and Josephine Counties in 1851, and in Baker and Grant Counties in 1861–62. Hydraulic mining is carried on extensively in both Southern and extreme Eastern Oregon. The most recent quartz discoveries are in the Cascade Mountains near the Santiam river, and in the Pine Creek Mountains, between the Blue Mountains and Snake river. Gold is found also in the sands of the ocean beach at various places. Silver ore is found almost coextensive with the gold, though predominating in Eastern Oregon; copper and lead occur frequently with the silver; and cinnabar is found and worked in Josephine County. Douglas County has the most extensive deposit of nickel ore yet discovered in America. Iron ore of a superior quality is mined near Portland, yielding upward of 50 per cent. of magnetic iron. It is reduced at a blast furnace at Oswego. Unworked deposits of iron ore exist in other counties. Coal is found in various places in Western Oregon, and is extensively mined on Coos Bay. Outcroppings have also been discovered on the western slope of the Blue Mountains. Other minerals are chalcedony, agate, carnelian, and jasper. Salt is extracted for local use in Jackson and Douglas Counties.

Soil and Productions.—The soil of Oregon is volcanic in origin and the valleys are alluvial. It is extremely fertile. The entire region W. of the Cascades and the northern portion E. of them have ample rainfall for crops. Large areas

of the central and southeastern portion of the State depend largely upon irrigation in farming. The chief product is wheat. The Oregon prunes are acknowledged to be the largest and finest in the world. Vineyards produce abundantly. The wool-growing industry is very large.

The following summary from the U. S. census reports of 1880 and 1890 shows the extent of farming operations:

FARMS, ETC.	1880.	1890.	Per cent.*
Total number of farms	16,217	25,530	57·4
Total acreage of farms	4,214,712	6,909,888	63·9
Value of farms, with buildings and fences	$56,908,575	$115,819,200	103·5

* Increase.

The following table shows the acreage, yield, and value of the principal crops in the calendar year 1900:

CROPS.	Acreage.	Yield.	Value.
Corn	13,789	317,147 bu.	$180,774
Wheat	1,173,769	16,198,012 "	8,908,907
Oats	177,447	3,282,770 "	1,345,936
Rye	5,841	94,040 "	57,364
Barley	31,347	905,928 "	380,490
Potatoes	15,382	1,692,020 "	761,409
Hay	713,653	1,677,085 tons	11,404,178
Totals	2,131,248	....	$23,039,058

The farm animals on Jan. 1, 1900, comprised 183,986 horses, value $5,516,923; 5,441 mules, value $210,241; 115,415 milch cows, value $3,583,636; 522,018 oxen and other cattle, value $12,192,775; and 2,446,695 sheep, value $6,532,676—total head, 3,446,695; total value, $28,036,251.

Climate.—Each of the three natural divisions of the State has a climate peculiar to itself, and throughout the State the seasons are distinguished as the wet and dry. The dry season usually extends from May 1 to Oct. 15, and during the wet season about 75 per cent. of the precipitation occurs. In Eastern Oregon the temperature ranges from 90° in summer to 10° in winter, with an occasional summer rise to 100° and a winter fall to 0°. The summer is drier and the winter colder than in Western Oregon. The rainfall averages about 20 inches. In Western Oregon the average spring temperature is 52°, summer 67°, autumn 53°, and winter 39°. The rainfall averages 44 inches in the Willamette valley, and is sufficient to prevent drought in the other valleys. In Southern Oregon the mean average temperature of July is 68°, of January 45°, and the temperature seldom exceeds 95° in summer and 16° in winter. The average rainfall is 22 inches.

Divisions.—There are 33 counties, as follows:

COUNTIES AND COUNTY-TOWNS, WITH POPULATION.

COUNTIES.	* Ref.	Pop. 1890.	Pop. 1900.	COUNTY-TOWNS.	Pop. 1900.
Baker	3-I	6,764	15,597	Baker City	6,663
Benton	3-B	8,650	6,706	Corvallis	1,819
Clackamas	2-C	15,233	19,658	Oregon City	3,494
Clatsop	1-B	10,016	12,765	Astoria	8,381
Columbia	1-B	5,191	6,237	St. Helen	248
Coos	6-A	8,874	10,324	Coquille	728
Crook	4-E	3,244	3,964	Prineville	656
Curry	7-A	1,709	1,868	Gold Beach	118
Douglas	6-B	11,864	14,565	Roseburg	1,690
Gilliam	2-F	3,600	3,201	Condon	230
Grant	3-G	5,080	5,948	Canyon City	345
Harney	5-H	2,559	2,598	Burns	547
Jackson	7-C	11,455	13,698	Jacksonville	653
Josephine	7-B	4,878	7,517	Grant's Pass	2,290
Klamath	7-D	2,444	3,970	Klamath Falls	447
Lake	6-F	2,604	2,847	Lakeview	761
Lane	4-C	15,198	19,604	Eugene	3,236
Lincoln†	3-B	.....	3,575	Toledo	302
Linn	8-C	16,265	18,603	Albany	3,149
Malheur	6-I	2,601	4,203	Vale	127
Marion	2-C	22,934	27,713	Salem	4,258
Morrow	2-G	4,205	4,151	Heppner	1,146
Multnomah	2-C	74,884	103,167	Portland	90,426
Polk	2-B	7,858	9,923	Dallas	1,271
Sherman	1-F	1,792	3,477	Moro	335
Tillamook	2-B	2,032	4,471	Tillamook	834
Umatilla	2-H	13,381	18,049	Pendleton	4,406
Union	2-I	12,044	16,070	Union	937
Wallowa	1-J	3,661	5,538	Enterprise	396
Wasco	2-E	9,183	13,199	The Dalles	3,542
Washington	2-B	11,972	14,467	Hillsboro	980
Wheeler†	3-G	.....	2,443	Fossil	288
Yamhill	2-B	10,692	13,420	McMinnville	1,420
Totals	.....	313,767	413,536		

* Reference for location of counties, see map of Oregon.
† Formed since 1890.

Principal Cities and Towns, with Population for 1900.—Portland, 90,426; Astoria, 8,381; Baker, 6,663; Pendleton, 4,406; Salem, 4,258; The Dalles, 3,542; Oregon, 3,494; Eugene, 3,236; Albany, 3,149; La Grande, 2,991; Ashland, 2,634; Grant's Pass, 2,290; Corvallis, 1,819; Medford, 1,791; Roseburg, 1,690; McMinnville, 1,420; Marshfield, 1,391.

Population and Races.—In 1860, 52,465; 1870, 90,923; 1880, 174,768; 1890, 313,767 (native, 256,450; foreign, 57,317; male, 181,840; female, 131,927; white, 301,758; colored, 12,009, including 1,186 persons of African descent, 9,540 Chinese, 25 Japanese, and 1,258 civilized Indians).

Industries and Business Interests.—The census returns of 1890 showed that 1,523 manufacturing establishments reported. These had a combined capital of $32,122,051, employed 18,798 persons, paid $11,535,229 for wages and $21,793,578 for materials, and had products valued at $41,432,174. The State is exceptionally favored in the provision of water-power for manufacturing purposes, there being hardly a section in which it does not exist in almost unlimited amounts. The census reports on the fisheries of the State showed: Capital invested, $2,396,632; persons employed, 4,682; vessels and boats employed, 1,558; value of apparatus used, $437,943; and value of products, $1,033,574. The salmon-canning industry had 34 canneries, employed 1,584 persons, and had an output of 21,390,648 lb. of canning valued at $889,772, and 320,822 cases of prepared canned salmon valued at $1,901,617.

Commerce.—Besides a large internal traffic, the State has a considerable direct foreign trade through the ports of Oregon and Willamette. In the fiscal year ending June 30, 1899, the imports of merchandise amounted in value to $1,522,097 and the exports to $9,116,973, and in 1900 the imports to $1,810,987 and the exports $8,344,144.

Finance.—The constitution prohibits the State from becoming interested in the stock of any corporation, and the Legislature from loaning the credit of the State or creating a debt which singly or in the aggregate with previous debts shall exceed $50,000, excepting in case of war, to repel invasion, or to suppress insurrection. Counties, towns, and other municipal corporations are under similar prohibition, excepting that the maximum of county indebtedness is fixed at $5,000, with the above exceptions. As a result of these restrictions Oregon has practically no public debt. The assessed valuation in 1900 as equalized by the State board was $125,738,761.13, and the amount to be raised by taxation in 1901 was $671,487.78.

Banking.—Owing to the panic in 1893 sixteen banks suspended in the first eight months. Sept. 5, 1900, there were 27 national banks with combined capital of $2,370,000, surplus and profits of $1,464,847.84, and deposits of $11,782,009.39. The State banks on June 30 numbered 19, with capital of $614,450, surplus and profits of $180,232, and deposits of $3,301,580. There were also 2 private banks with a capital of $87,000 and deposits of $87,061.

Post-offices and Periodicals.—On Jan. 1, 1901, there were 892 post-offices, of which 34 were presidential (1 first-class, 7 second-class, 26 third-class) and 858 fourth-class, with 337 money-order offices, and 3 money-order stations. Of newspapers and periodicals there were 17 daily, 7 semi-weekly, 144 weekly, 1 bi-weekly, 2 semi-monthly, and 22 monthly publications—total, 193.

Means of Communication.—The transportation system consists of railways and navigable rivers. Steamers ply on the Columbia and Willamette and for short distances on some of their tributaries. Navigation on the Columbia is broken at the Cascades, 140 miles from the ocean, and again at The Dalles, 50 miles farther. Around the Cascades the State has built a portage railway, and the U. S. Government has nearly completed a canal and locks there, upon which it has been working since 1876 and has expended about $2,000,000. No plan for overcoming the obstructions at The Dalles has yet been adopted. The Willamette is obstructed at Oregon City by falls 41 feet high, around which a canal and locks have been constructed by the State. The railway system consists of the lines of the Southern Pacific from Portland S. to California, there being four distinct lines running up the Willamette valley: the Oregon Railway and Navigation Company's line, leased by the Union Pacific, running up the Columbia from Portland to the boundary-lines of Washington and Idaho; the Northern Pacific, running down the Willamette and Columbia from Portland 39 miles and crossing into Washington, and a leased line of the same road from the Washington boundary S. to Pendleton; the Oregon Pacific, running E. from Yaquina Bay to the Cas-

cade Mountains; and a railway under construction from Coos Bay to Roseburg. The mileage of the railways in the State in 1894 was as follows: Southern Pacific, 698·87; Oregon Railway and Navigation, 533·53; Northern Pacific, 38·82; Oregon Pacific, 141·36; Astoria and South Coast, 15·78; Rogue River Valley, 5·50; and Independence and Monmouth, 2·50—total, 1,481·04. Total in 1899, 1,612·89 miles.

Churches.—The census of 1890 gave the following statistics of the religious bodies having a membership of 800 and upward in the State:

DENOMINATIONS.	Organizations.	Churches and halls.	Members.	Value of church property.
Roman Catholic	95	95	30,231	$290,090
Methodist Episcopal	203	201	9,436	614,625
Baptist	108	108	5,306	317,325
Disciples of Christ	74	42	4,067	76,700
Presb. in the U. S. of America	73	70	3,935	416,500
Congregational	35	38	2,037	160,200
Methodist Episcopal South	70	62	1,936	50,850
Protestant Episcopal	31	26	1,849	361,930
United Brethren, Old Constitution	49	46	1,203	24,700
Evangelical Association	25	24	1,199	63,900
Cumberland Presbyterian	23	21	897.	22,200
Unitarian	5	5	890	139,500

Schools.—The number of children of school age in the State in 1899 was 132,408; the number enrolled in the public schools, 88,485; average daily attendance, 61,234. The number of teachers employed was 3,693—1,250 men and 2,443 women; average monthly salaries—men $42.96, women $34.81; number of schoolhouses, 2,060; value of school property, $2,871,718; revenue for school purposes, $1,270,568; expenditure, $1,159,125. Normal schools were maintained by the State at Ashland, Drain, Monmouth, The Dalles, and Weston. There were seventeen endowed academies and private secondary schools. The institutions for higher education comprised Blue Mountain University at La Grande (non-sectarian, opened 1876); Christian College, at Monmouth (Christian, chartered 1865); Corvallis College, at Corvallis (Methodist Episcopal South, opened 1865); McMinnville College, at McMinnville (Baptist, chartered 1859); University of Oregon, at Eugene City (non-sectarian, chartered 1872); Pacific University, at Forest Grove (Congregational, opened 1848); Philomath College, at Philomath (United Brethren, chartered 1865); Willamette University, at Salem (Methodist Episcopal, opened 1844); and Portland University, at Portland. The State Agricultural College is a part of Corvallis College.

Libraries.—According to a U. S. Government report on public libraries of 1,000 volumes and upward each in 1891, Oregon had 17 libraries, containing 68,544 bound volumes and 18,519 pamphlets. The libraries were classified as follows: General, 3; school, 5; college, 5; college society, 2; scientific, 1; and Masonic, 1.

Charitable, Reformatory, and Penal Institutions.—These include the Oregon School for Deaf Mutes, Oregon Institute for the Blind, Oregon State Prison, Oregon State Reform School, Oregon State Insane Asylum, county and city jails, and county almshouses. According to a provision of the State constitution all public institutions provided for by the Legislature must be at the seat of government. In 1893 the Legislature provided for the establishment of a State Soldier's Home and for a branch asylum for the insane in Eastern Oregon.

Political Organization.—Oregon was admitted into the Union in 1859, and its constitution, adopted in 1857, remains unchanged. State officers are elected for terms of four years and county officers for two, the election occurring in June. The Legislature consists of thirty senators, holding office for four years, one-half elected every two years, and sixty representatives, holding office two years. They draw pay only for forty days for each biennial session. Suffrage is enjoyed by every citizen or person who has declared his intention to become such, who has resided in the State six months. The secretary of State acts as auditor. All State institutions are governed by boards of three State officers, selected from the Governor, secretary, treasurer, and superintendent of public instruction, except the deaf and dumb school, agricultural society, State university, normal schools and soldier's home, which have special boards of trustees or regents. The penitentiary, insane asylum, blind school, and reform school have superintendents appointed by the State boards.

History.—The first recorded exploring voyages along the coast of Oregon were those of the Spaniard Ferrelo, in 1543; Sir Francis Drake, the English freebooter, in 1578; the probably mythical De Fuca, in 1592; Aguilar, the Spaniard, in 1603; the certainly mythical Fonte, in 1640; the Spaniard Perez, in 1774; the Spaniard Heceta, in 1775, when the mouth of the Columbia was first observed; Capt. Cook, an Englishman, in 1777; and numerous other Spanish, English, and American explorers and traders in the ensuing fifteen years. Yet none set foot on land or knew much about even the coast-line, until Capt. Robert Gray, a trader from Boston, in the ship Columbia, entered the mouth of the Columbia May 11, 1792, and laid the foundation of the American title to Oregon. The U. S. purchased Louisiana in 1803, and acquired all the French title W. of the Missouri river, and in 1819 secured the entire Spanish title N. of lat. 42° by the Florida purchase. In 1804–05 Lewis and Clarke explored the country from St. Louis to the mouth of the Columbia for the U. S. Government. Nathan Winship, from New England, entered the Columbia in the Albatross May 10, 1810, and built a trading-post at Oak Point, 40 miles inland, the first settlement in Oregon, but abandoned it in a few weeks. Astoria was founded by the Pacific Fur Company Mar. 22, 1811, and named after John Jacob Astor, president of the company. It was captured by the British and named Fort George Dec. 12, 1813, and was restored to U. S. jurisdiction in Oct., 1818. In 1818 the U. S. and Great Britain made a treaty of joint occupation of Oregon, which was terminated in 1846 by a treaty confirming the title of the U. S. The Hudson Bay Company was in practical possession after 1813 until enough citizens of the U. S. arrived to create a provisional government in 1843. A Methodist mission was founded by Jason Lee in 1834, and a Presbyterian mission by Dr. Marcus Whitman in 1836. The first large immigration was in 1843, overland from the Mississippi valley. Oregon was made a Territory Aug. 12, 1848, and the territorial government superseded the provisional government Mar. 3, 1849, Gen. Joseph Lane being the first territorial Governor, the provisional Governor having been George Abernethy. A State constitution was framed in 1857, and the State admitted to the Union Feb. 14, 1859. There were Indian wars in 1849, 1851, 1852, 1853–56, 1866–67, 1872–73, 1877, and 1878. There are now but few Indians in the State, and these are peacefully settled on reservations.

GOVERNORS OF OREGON.

Provisional.	
George Abernethy	1845–49
Territorial.	
Joseph Lane	1849–50
John P. Gaines	1850–52
Joseph Lane	1853
George L. Curry	1853
John W. Davis	1853–54
George L. Curry	1854–59
State.	
John Whiteaker	1859–62
Addison C. Gibbs	1862–65
George L. Woods	1866–69
Lafayette Grover	1870–77
S. F. Chadwick	1878
William W. Thayer	1879–82
Zenas F. Moody	1883–86
Sylvester Pennoyer	1887–95
William P. Lord	1895–99
Theodore T. Geer	1899–

AUTHORITIES.—Irving, *Astoria*; Greenhow, *Oregon and California* (1845); Thornton, *Oregon and California in 1848*; Johnson, *California and Oregon* (1851); Bulfinch, *Oregon and Eldorado* (1866); Ludlow, *Heart of the Continent* (1870); Victor, *All over Oregon and Washington* (1872); Nordhoff, *Northern California, Oregon, and the Sandwich Islands* (1874); Bancroft, *Oregon* (2 vols., 1886–89); *Transactions of the Oregon Pioneer Society* (1872–94).

H. W. SCOTT.

Oregon: city; capital of Ogle co., Ill. (for location, see map of Illinois, ref. 2-E); on the Rock river, and the Chi., Burl. and Quincy Railroad; 100 miles W. of Chicago. It is a summer resort, is principally engaged in agriculture and manufacturing, and has a national bank with capital of $50,000, a private bank, and three weekly newspapers. Pop. (1880) 1,088; (1890) 1,566; (1900) 1,577.

Oregon City: city; capital of Clackamas co., Ore. (for location, see map of Oregon, ref. 2-C); on the Willamette river and the S. Pacific Railroad; 12 miles S. of Portland, with which it is connected by steamboats and by an electric railway. The city is the center of a rich agricultural region, with a prolific fruit country tributary to it. The river here falls 40 feet, affording unlimited water-power, and boats pass from one level to the other by means of locks constructed in 1874. Among the large manufacturing establishments are woolen, flour, paper, pulp, and sawmills, sash and door factories, and ice-works. There are the U. S. land-office for the northern district of Oregon, a State bank,

with capital of $100,000, a private bank, and three weekly newspapers. Pop. (1880) 1,263; (1890) 3,062; (1900) 3,494.

EDITOR OF "ENTERPRISE."

Oregon River: See COLUMBIA.

O'Reilly, JOHN BOYLE: journalist and poet; b. at Dowth Castle, County Meath, Ireland, June 28, 1844. At the age of eighteen he went to England and enlisted in the British army, where he acted as a secret agent of the Fenian Society. He was convicted of high treason in 1866, and sent to Australia under a twenty years' sentence, but escaped after a year's imprisonment, and went to the U. S. in 1869. In 1870 he became editor of the Boston *Pilot*, with which he was connected till his death. D. at Hull, Mass., Aug. 10, 1890. His published writings include *Songs of the Southern Seas* (1873); *Songs, Legends, and Ballads* (1878); *Moondyne* (1879); *Statues in the Block* (1881); *In Bohemia* (1886); *Stories and Sketches* (1888). H. A. BEERS.

Orel': government of Russia, between lat. 51° 50′ and 54° N., and lon. 33° and 39° E. Area, 18,042 sq. miles. The surface is mostly level. The soil is fertile and well watered by the Desna, an affluent of the Dnieper, the Oka, an affluent of the Volga, and the Sosna, an affluent of the Don, all of which are navigable. The climate is mild. Agriculture is the chief industry. Large quantities of wheat are exported, in grain and flour, to Riga and St. Petersburg. About one-third of the surface is covered with forests. Hemp is extensively cultivated, and oil of hempseed, sailcloth, rope, and yarn are manufactured. Some iron mines are worked and many horses and cattle are reared. Pop. (1897) 2,054,609.

Orel: town of Russia; capital of the government of the same name; on the Oka; 222 miles S. S. W. of Moscow (see map of Russia, ref. 8–D). It is mostly built of wood, and was almost destroyed by fire in 1848 and again in 1858. It has many educational institutions, breweries, distilleries, ropewalks, tallow-houses, and other manufactories, and an important trade in grain with St. Petersburg and Riga. It formerly formed a stronghold against Tartar invasions. Pop. (1897) 68,557.

O'Rell, MAX: See BLOUET, PAUL.

Orellana, ō-rāl-yaa′naă, FRANCISCO, de: first explorer of the Amazon; b. at Truxillo, Spain, about 1490. He was intimate from boyhood with the Pizarros, and joined them in Peru about 1535; in 1537 he founded Guayaquil. Later he was the lieutenant of GONZALO PIZARRO (*q. v.*) in his expedition to the "Land of Cinnamon," about the head-waters of the Coca and Napo. The expedition left Quito (according to lately discovered documents) in Feb. or Mar., 1541, and crossed the Andes to the Coca; here a small vessel was built to descend the river, while the army followed along the shore to the junction of the Napo. Thence Orellana and fifty men were sent ahead in the boat, with orders to bring back provisions from the villages farther down. Floating on the swift current they reached the junction of the Napo with the Amazon in a few days, but Orellana could find no provisions and, unable or unwilling to return, he resolved to go on down the Amazon. This scheme was carried out after a new and better vessel had been built. In the course of their voyage the Spaniards had many skirmishes with the Indians. They heard of a tribe of female warriors, or Amazons, and claimed to have fought with them near the mouth of the Trombetas. Probably the story of these women was an aboriginal myth or wonder-tale, traces of which are still found in South America. The account of the Amazon tribe was readily believed in Europe, however, and eventually gave its name to the river. Orellana reached the sea after a voyage of eight months, made his way to the Spanish settlements of Venezuela, and thence went on to Spain. In 1544 he received a grant to conquer and govern the regions he had passed through. He sailed for the Amazon in 1545 (or in 1549, according to Acuña) with 500 men; but many soldiers perished during the voyage; the enterprise was abandoned after they had ascended the river for a short distance, and Orellana died soon after, probably on the island of Margarita. HERBERT H. SMITH.

Orel'li, JOHANN KASPAR: classical scholar; b. at Zurich, Switzerland, Feb. 13, 1787; studied theology, but especially ancient and modern languages and literature, and was appointed *professor eloquentiæ* in 1819, and Professor of Classical Philology in the newly founded University of Zurich in 1833. Author of a celebrated edition of *Cicero* in 8 vols., including the *Scholia* and an *Onomasticon Tullianum* (3 vols., 2d ed. by Halm and Baiter, 1861); a justly esteemed commentary of *Horace* (4th ed. 1892, with *Lexicon Horatianum*), and of *Tacitus* (new edition by various scholars, 1879–94). His *Inscriptionum Latinarum Selectarum Collectio* (3 vols., 1856; 2d ed. by W. Henzen, with copious indexes) is still a valuable aid for the study of Roman history, antiquities, and language. See Adert, *Essai sur la vie et les travaux de J. G. Orelli* (Geneva, 1849); Bursian, *Gesch. der class. Philol. in Deutschland*, pp. 850–857. D. at Zurich, Jan. 6, 1849. Revised by A. GUDEMAN.

O'renburg: government of European Russia; bounded N. and N. W. by Perm, Ufa, and Samara. Area, 73,816 sq. miles. The central part of the government is mountainous, covered with branches of the Ural Mountains which are very rich in iron, copper, and gold; the crown mines yield over 1,000 lb. of gold annually, and the private double as much. On both sides of the mountains are extensive steppes, in many places barren and dotted with salt lakes, but in others presenting good pasture-grounds, where immense herds of cattle, sheep, horses, and camels are reared. Besides the breeding of cattle, in which the Ural Cossacks are engaged, and mining, fishing and preparation of caviare form an important branch of industry. Pop. (1897) 1,608,388.

Orenburg: town of European Russia, capital of the government of Orenburg; on the Ural; 727 miles E. S. E. by rail from Moscow (see map of Russia, ref. 8–H). It was founded as a frontier fortress in 1743, but is now of importance for its trade only. Tea from China, shawls and silks from Persia, skins, tallow, and cattle from the Khirgheez and Cossacks, and metals from the Ural Mountains are brought here and exchanged. Pop. (1897) 72,740.

Oren'se: town of Spain, capital of the province of Orense; on the left bank of the Minho, which is crossed here by a magnificent bridge, 1,400 feet long, 145 feet high, built in 1230, spanning the river with seven arches (see map of Spain, ref. 13–B). At the foot of the hill on which the city is built are the famous hot sulphur springs, Las Burgas. The town is the seat of a bishopric and is celebrated for its chocolate, hams, and wine. Pop. (1887) 14,168.

Oreodon'tidæ [Mod. Lat., named from *Ore'odon*, the typical genus; Gr. *ὄρος*, *ὄρεος*, mountain + *ὀδούς*, *ὀδόντος*, tooth]: a family of extinct mammals belonging to the order *Ungulates* and sub-order *Artiodactyles*, intermediate between the typical ruminants and hogs.

Ores'tes (in Gr. *Ὀρέστης*): in Grecian mythology, a son of Agamemnon and Clytemnestra; avenged the murder of his father by killing his mother and her paramour, Ægisthus, but was immediately attacked by the Erinyes, who drove him mad, pursuing him from place to place. He sought refuge with Apollo in Delphi, but the manner in which the Erinyes were finally appeased is variously related by the Attic tragedians, who frequently treated this myth and developed it differently. According to one version, Orestes went to Athens, where the court of the Areopagus declared him innocent through the influence of Athene. According to another, Apollo sent him to Tauri, whence he succeeded, by the aid of his sister, Iphigenia, who was a priestess there, in carrying away the image of Artemis. Of the tragedies which treated the myth, the trilogy *Orestea* by Æschylus, *Electra* by Sophocles, and *Electra*, *Orestes*, and *Iphigenia in Tauris* by Euripides, are extant.

Revised by J. R. S. STERRETT.

Oreus: See HISTIÆA.

Orfa, Orfah, or **Urfah** (Gr. *Edessa*; Arab. *Rouha*): city in Asiatic Turkey; in the vilayet of Aleppo; lat. 37° 8′ N.; about 40 miles E. of the Euphrates (see map of Turkey, ref. 6–H). Improbable tradition makes Nimrod its founder. The Jews identify it with Ur of the Chaldees; this was apparently the opinion of St. Stephen, who located Ur in Mesopotamia (Acts vii. 2). The Arabs also associate it with Abraham, calling their chief sanctuary in the city the Mosque of Abraham, while the pond containing the sacred fish is the Pool of Abraham. As EDESSA (*q. v.*), it was important in the crusades. The town, surrounded by a wall, is partly built on the side of a hill, 1,650 feet high, overlooking an extensive plain. Its gardens are large and luxuriant and its narrow streets unusually clean. The river Kara Kuzu, spanned by three bridges, flows through it. As the central station on the great route between Aleppo and Diarbekir, its transit trade is extensive. Pop. about 30,000, nearly a quarter of whom are Christians and Jews.

E. A. GROSVENOR.

Orford, Earls of: See Walpole.

Orford, Cape: See Cape Blanco.

Organ [O. Eng. *organ*, from Lat. *or'ganum* = Gr. ὄργανον, implement, tool, organ of the body, a musical instrument; cf. ἔργον, work, Eng. *work*]: a musical instrument in which sounds are produced by the passage of wind through pipes. Its capabilities are due to three principal properties. First of all, it includes a large number of distinct pipes, each of which is, in a sense, an independent instrument. Second, it contains peculiar arrangements, of which the chief is the keyboard (clavier), by which numbers of these pipes very remote from one another may be simultaneously operated on. Third, it substitutes for the natural production of the moving force (namely, air-currents) by the human lungs an artificial production of the same by means of a bellows, which substitution not only relieves the performer of the most fatiguing part of his work, but also increases in a vast measure the power of the instrument. By means of this large bellows, of a structure similar to that which is seen in an accordion, and worked by a lever-handle, water motor, or electric motor, air is forced into a closed chest or reservoir, where it can be stored up in a compressed state. In the modern bellows, the horizontal as distinguished from the old-fashioned diagonal, there are two divisions—a feeder and a temporary air-chest. The air is unable to return by the way it came, and can only find vent above through its upper floor, called the sounding-board. This sounding-board separates the air-chest from the organ-pipes, which are arranged above it. The air is admitted to the pipes by the action of certain slides and valves which are set in motion by drawing out the registers and by pressing down the keys or pedals. The drawing out of a slide partly opens up to the air a whole set of pipes of one peculiar quality or tone, so that when any of the keys is pressed down the air finds its way into the appropriate pipe of this particular series. Of course, when more than one stop is drawn out the air is admitted simultaneously into several distinct groups of pipes. The larger organs consist of three or more distinct partial organs, each of which has its peculiar keyboard, and a separate air-chest and sounding-board for its pipes.

The sound of an organ is produced by the vibrations of the column of air within the pipe. The compressed air of the air-chest, as soon as obstacles are removed by the action of the stop and of the key, rushes upward into the pipe, and so produces the tone. The shape of a metal organ-pipe is very much the same as that of a common tin whistle. The stem or "body" of the pipe is cylindrical. The lower part or "foot" is an inverted cone with its apex cut off. At the juncture of the body and the foot there is an opening in the side of the pipe called its "mouth." There is also a horizontal plate termed the "languid" or "language," which partially divides the foot from the body, and leaves a narrow egress for the air coming from below close to the mouth of the pipe. The wooden pipes are of a slightly different structure, being commonly square instead of round, but their mode of action is not materially different. When the air rushes up into the pipe it is driven against the upper edge or "lip" of the mouth-hole. Breaking against the sharpened edge, it produces a peculiar hissing or rushing noise, which is all we hear when the pipe does not "speak." The agitation thus set up at the mouth communicates itself to the column of air within the body of the pipe, which is thus made to vibrate with a rapidity determined by its length. The shorter the pipe the more rapid the series of vibrations, and the higher consequently the pitch of the note produced. Organ-pipes are of a great many varieties, according to the material used and the shape of their several parts. Metal pipes are made of tin, "metal" (a mixture of tin and lead), zinc, etc., while wooden pipes are generally constructed of cedar, deal, or pine. The shape of pipes also varies considerably. Thus among metal pipes we have the forms of cylinder, cone, and inverted cone, while among wooden pipes we have the forms of quadrilateral, trilateral, cylinder, pyramid, and inverted pyramid. Further, there is a distinction between pipes which are open and those which are stopped or plugged at their upper extremity. An open pipe produces a tone with a wave of air twice as long as the body of the pipe, and a stopped pipe produces a tone with a wave four times the length of its body. Thus a stopped pipe is always an octave deeper than an open pipe of the same length.

The peculiar quality of sound belonging to an organ-stop is due to the structure of the pipes belonging to the stop. According to the researches of Prof. Helmholtz, the *timbre* of a musical instrument is determined solely by the number and strength of the upper partial tones which enter into the tones of the instrument. Thus he found that wide-stopped organ-pipes have scarcely any upper partial tones at all, and that all stopped pipes are wanting in the even members of the series of upper tones. Hence stopped pipes give a soft hollow sound, while open pipes produce a sharp brilliant style of tone. The number of partial tones, and so the timbre of a pipe, vary with the shape and size of the pipe, and also with the material of which it is made. Certain stops called "reeds" owe their peculiar character to the addition of a vibrating tongue, like those of a harmonium, to the pipe. This tongue is a thin, oblong brass plate fitted into the aperture of a cylindrical tube called a reed. The tongue in its oscillations alternately opens and closes the aperture of the tube through which the air seeks to pass. The consequence is that the stream of air is separated into a series of individual pulses. The sound of a reed pipe is the result of these interrupted pulses of air, together with the vibrations of the metal tongue itself. Other stops having a peculiar quality of tone are in reality compound stops; that is, they bring into simultaneous action a plurality of pipes of different pitch. The twelfth, fifteenth, sesquialtera, and mixture are among the best-known compound stops. The notes of these combined pipes have the same relation to one another as the partial tones of a single musical tone. Thus it is usual to connect the upper octave with the prime tone, and after that the twelfth. Some of these compounds give as many as the first six partial tones. The number and strength of the combining tones in the note of one of these compound stops give to it a peculiarly bright, and in some cases a dazzling and overpowering character.

The names of the several organ-stops point partly to the quality of the sound produced, partly to the range or compass of the pipes belonging to it, and to other circumstances. Thus the trumpet and the oboe, which are both reed-stops, are so named from the resemblance of their tones to those of these instruments. The diapason-stops again are so called because their pipes extend through the whole compass of the organ. The stop "principal," which is an octave higher than the open diapason, is so named from the fact that it is the first stop tuned, and the standard, therefore, for the pitch of the remaining stops.

Many mechanical aids to registration have been furnished, whereby the organist may radically change his stop-combinations to a degree never before attainable by simply touching a knob or pedal. The application of electricity is also beginning to do away with much cumbersome machinery connecting key with pipe. The principle of the swell is being largely developed and applied to extensive portions of the organ formerly lacking in this respect—this to the great gain of the instrument from the standpoint of *expression*.

History.—The history of the organ forms an important branch of the history of music as a whole. We are able to trace back the pedigree of this instrument to an humble ancestry: the pipes of Pan and the bagpipe. It is difficult to fix the date of the first organs referred to in ancient writers, owing to the ambiguity of the word *organ* (ὄργανον), which was properly fitted to denote any musical instrument. The organ, properly so called, originated among the Greeks of Alexandria in the second century B. C. The first species of organ of which we have a description is the water-organ, ὕδραυλος (literally, water-flute). It is described by Vitruvius and Athenæus as sweet, though not powerful. This instrument was designed for domestic amusement. On a Roman monument we have a bas-relief representation of a domestic organ. It contains sixteen pipes, and the performer, a lady, plays with both hands on the keyboard. It is placed on a table, and looks easily portable.

The organ is said to have been introduced into the Church by Pope Vitalian in the seventh century, but its employment in church services probably dates from a much earlier period. Organs were certainly used in churches very commonly in the time of the Carlovingians. We read of organs being sent to King Pepin and Charlemagne as presents by the Byzantine emperors. The first of these is described as a wonderful structure of the form of a tree, in the branches of which were birds of various species, each bird giving forth the note peculiar to its species. At a much later period than this we find the structure of the organ to be exceedingly rude. The keys were often from 4 to 6 inches broad, and

were struck with the closed fist or in some cases with the elbow, so that only two tones could be produced simultaneously. The compass was sometimes as great as twenty-one notes, the series being that of our diatonic scale (the white notes of a piano). In addition to these more common instruments, we read of gigantic organs, such as that built for Winchester in the year 951, which is said to have contained 400 pipes and 26 bellows, requiring 70 strong men, and to have been played by two performers or four fists. From the twelfth century on we read of a light portable organ named "portative," which was distinguished from the fixed organ or "positive." The performer, who carries the instrument by means of a belt, plays with one hand, and manages the bellows with the other. Italian painters of the fourteenth and fifteenth centuries were fond of representing the instrument in the hands of saints and angels. In the fourteenth century the structure of the organ underwent certain improvements. A step had been taken before this toward enabling the organist to produce a larger number of simultaneous tones. By the invention of mixture or compound stops —which seem to have been arrived at at a very early date— two or three notes could be sounded by means of one key, the combinations being selected according to the strange ideas respecting sequence of accords prevalent at this age (as illustrated in the *Organon* or mode of harmony of Hucbald and his successors). In the fourteenth century this capability of uttering simultaneous tones was much further increased by the reduction of the size of the keys, so as to make them workable by means of the fingers. This change also involved a large extension of the compass of the keyboard. We read of organs of this period having three octaves, including semitone intervals.

The period of the supremacy of the polyphonic music of the Netherlands (1450–1550) was marked by considerable improvements both in the structure and in the art of performance of the organ. The development of the contrapuntal or fugue style of music, which was diffused from the Netherlands through Germany, Italy, England, etc., gave a great impetus to the art of organ-playing. There are still preserved volumes of organ compositions used by the German performers of this time, from which we see that organ pieces were now growing into independent productions. In Germany the art of organ-playing was diligently cultivated by a series of musicians, of whom the family of the Bachs were among the most distinguished. Thus were laid the foundations of the art which Sebastian Bach was afterward to carry to so high a degree of perfection. In Italy, during the sixteenth century and at the beginning of the seventeenth, organ compositions very ornamental in design and containing the germs of our modern harmony became common. The seventeenth century, too, was marked by great progress in organ-building and in organ-playing. Germany and Holland trained builders of great eminence, whose works may be found in other countries besides, including England. Some of the finest old organs of England, including those of Westminster Abbey, the Temple church, and Durham Cathedral, were erected by a German named Schmidt. The style of organ composition was greatly elevated in that century by the addition of harmony in the modern sense, of which Palestrina had laid the foundations in Italy.

From the beginning of the eighteenth century the organ has undergone a vast though gradual improvement of structure, which has served to increase its scope and variety by lessening the mechanical difficulties of performance. In this way it became possible to execute such rich and elaborate works as later composers have produced. The principal mechanical additions to the instrument have been directed to a more varied combination of pipes by compound stops, to a diminution of the labor of the manual performance by means of arrangements which facilitate the drawing of stops and the depression of keys. Among the methods used to lessen this last ingredient in the labor of the organist are pneumatic action which is commonly adopted in the best modern organs.

Among the largest European organs still to be seen, the following may be mentioned: The Weingarten organ (66 stops and 6,666 pipes). the Haarlem organ (60 stops), the organ of the Church of the Cavalieri di San Stefano at Pisa (over 100 stops), that of the Church of S. Alessandro in Colonna (100 stops, circa), the Crystal Palace organ. London (65 stops), and the transept organ of St. Paul's, London (60 stops). In Paris, the organs of St. Eustache, St. Sulpice, the Madeleine, the Trocadéro, etc. In the U. S. there are now a number of large and fine organs well worthy of comparison with anything of European construction. The concert-organ in the Chicago Auditorium is one of the largest in the world.

The reader is referred to the following works on the structure and history of the organ: *The Organ, its History and Construction*, by Edward J. Hopkins, with a new history of the organ by Edward F. Rimbault (London). This is by far the most complete treatise on the subject. The nature of the sounds of organ-pipes is elucidated by Prof. Helmholtz in his great work on *The Sensation of Tones* (*Die Tonempfindungen*), translated by A. J. Ellis (London). Many curious chapters in the history of the organ and of organists may be found in the histories of music of Dr. Burney and Sir John Hawkins, and of the German historian Kiesewetter, Forkel, and especially A. W. Ambros.

Revised by Dudley Buck.

Organic Chemistry: a term that came into use formerly to express that branch of chemistry which dealt with the substances that occur in living things. A distinction was then made between these constituents of animate things and the mineral substances, the constituents of the inanimate portions of the earth. That branch of chemistry which had to do with the latter was called inorganic chemistry. As investigation advanced it was found that there is no essential difference between the compounds treated of in the two branches. They are all chemical compounds; and many of the substances found in plants and animals can be made artificially in the laboratory without the intervention of the life-process. (See Chemistry.) That which chiefly characterizes organic compounds is the fact that they all contain carbon, and therefore the term chemistry of the compounds of carbon has been generally adopted in place of organic chemistry. This name is not strictly correct, for the reason that the carbonates, such as limestone, marble, dolomite, etc., would be included, and it is not usual to treat of them under the head of compounds of carbon. Another name that has been proposed is chemistry of the hydrocarbons and their derivatives. This is based upon the conception that the great majority of so-called organic compounds are either hydrocarbons or are derived from these hydrocarbons. The truth is, the separate treatment of the compounds of carbon is merely a matter of convenience. The large number of these compounds and their great variety make special treatment necessary. It would, perhaps, be best to include *all* compounds of carbon, no matter what their origin, and keep the name chemistry of the compounds of carbon. In the same way there is a chemistry of silicon and of oxygen, and of every other element, but thus far there has been no occasion for making other subdivisions of the subject of chemistry.

Ira Remsen.

Organic Radicals: See Radicals.

Organism: See Biology.

Organ Mountains (Port. *Serra dos Orgãos*): a group of mountains facing the northern end of the bay of Rio de Janeiro, Brazil. They are the culminating portion of the Serra do Mar, attaining an altitude of 7,322 feet. In clear weather they are plainly visible from the city of Rio de Janeiro, and their grandeur and singularity are noted by every traveler. One of the numerous sharp pinnacles is called the Dedo de Deos (finger of God); it resembles a gigantic finger, pointing upward. Petropolis, Theresopolis, and other favorite summer resorts are in or near these mountains, and are easily accessible for tourists. H. H. S.

Organ of Bojanus: a name formerly applied, from its discoverer, to the excretory organ of Molluscs and Tunicates. These organs are now known to be homologous with those of most other animals, and the term Nephridium (*q. v.*) should be used for them.

Organ of Corti: See Histology (*Organs of Special Sense*).

Organ-point [cf. Fr. *point d'orgue*]: in music, a series of harmonious combinations having for its bass one long, sustained, and unvarying note. As the organ is the only instrument on which these passages can be performed with full effect, the origin of the name and of its substitute, "pedal" or "pedale," is readily explained. This holding or pedal note is usually either the dominant or the keynote of the piece, and the upper parts consist partly of harmonies related to the bass, and partly of accidental or passing chords, serving as links in the general course of the harmony. Organ-points are of great variety in structure and duration, occupying sometimes as many as twelve or sixteen bars, and seldom less than three. They generally

terminate with the perfect or imperfect cadence, or with a chord of the seventh and a pause, and may be classified as follows: (1) Those consisting of a train of simple chords, chiefly derived from the bass; (2) those formed of plain harmonies with suspensions; (3) those which consist of a number of deceptive or interrupted cadences; (4) those formed of sequences variously elaborated; and (5) those of a more abstruse character, in which harmonies of a foreign, and even discordant, nature are introduced. An organ-point is sometimes *double*, the former part having the dominant for its bass, and the latter part the tonic or keynote. Instances are occasionally found of *inverted* organ-points, or those in which the holding-note is not in the bass, but in one or more of the upper parts.

Organum: See NOVUM ORGANUM.

Orgetorix: a Helvetian of noble birth, who instigated the migration of the Helvetii, described by Cæsar in the first book of his *Gallic War*.

Oriani, ō-reĕ-aa'nĕĕ, BARNABA: astronomer, count, and senator of Italy; b. at Garegnano, near Milan, July 17, 1752. His teacher in mathematics was Lagrange, to whom he succeeded as astronomer, and he continued the *Effemeridi Astronomiche*, which had been begun by his great master. He prepared a map of the kingdom of Italy, and the observatory of Milan is largely indebted to him. Oriani was a man of very noble character, was honored with various decorations and the membership of many learned societies, and was especially noticed by Napoleon. His principal publications are *Lettera ad un Amico Astronomo*, etc.; *Lettere Astronomiche*, etc.; *Risposta alle Note che l'Abate Frisi fece*, etc.; *Obliquità dell' Eclittica dedotta dalle Osservazione solstiziali*, etc.; *Distanza dallo Zenito del Sole e delle Stelle fisse presso il Meridiano*; *Rifrazione osservata*, etc.; *Elementi di Trigonometria Sferoidica*. D. in Milan, Nov. 12, 1832. Revised by S. NEWCOMB.

Oriba'sius (in Gr. 'Ορειβάσιος) **of Pergamus**: physician to Julian the Apostate, whom he accompanied on his fatal expedition against the Persians (363). He was banished by the successors of Julian, but afterward recalled with honor, and lived to the end of the century. Of his medical encyclopædia (in seventy books), 'Ιατρικῶν συναγωγῶν ἑβδομηκοντάβιβλος, considerable portions remain. His two abridgments have been published only in Latin translations. There is an edition by Boussemaker and Daremberg, with a French translation (6 vols., Paris, 1851–76).
Revised by B. L. GILDERSLEEVE.

Oribe, ō-ree'bā, MANUEL: soldier and politician; b. in Uruguay about 1802. He was a leader of the *gauchos*, attained high military rank under Frutos Rivera, was his Minister of War and Marine 1833–35, and succeeded him as president Mar. 1, 1835. About this time the parties called *Colorado* and *Blanco* were formed, Oribe being chief of the latter, while Rivera led the former. Rivera and the Colorados revolted in 1837, and, though at first unsuccessful, eventually defeated Oribe and forced him to leave Montevideo (Oct. 25, 1838) four months before the end of his term. Oribe took refuge with the dictator Rosas, at Buenos Ayres, and soon after agreed to support a scheme for redueing Uruguay to his rule. Rosas furnished him with troops and arms; he invaded Uruguay and besieged Montevideo intermittently from 1842 to 1851, holding a large part of the interior of the country. This is known as the nine years' siege. For a time France supported the legal or Montevidean government, and in 1851 Brazil and Entre Rios interfered in its favor. Oribe finally capitulated Oct. 10, 1851, and Rosas was defeated and deposed soon after. In Sept., 1855, Oribe led the revolt which drove Flores from Montevideo, but he was prevented from seizing the presidency by the interference of foreign powers. D. at Montevideo, Nov., 1857. HERBERT H. SMITH.

O'riel Window; called also **Bow** (or **Bay**) **Window** [*oriel* is from O. Fr. *oriol*, gallery, corridor < Late Lat. *ori'olum*, portico, hall; cf. Lat. *aure'olus*, golden, gilded]: a window which projects from the side of the house, has three glazed sides, and is often divided by mullions. It is one of the most picturesque features in the domestic architecture of the Middle Ages and the age of Elizabeth. Some writers discriminate between the oriel window, carried on corbels and projecting from an upper story, and the bay window resting on the ground. Revised by RUSSELL STURGIS.

Orien'te: a province of Ecuador, embracing all the territory E. of the Andes. As claimed by Ecuador, it has an extent of 96,000 sq. miles; but the greater part of this is also claimed by Colombia and Peru, and the southern portion, along the upper Amazon, is actually held by the latter. The province includes the lower slopes of the Andes, and vast, forest-covered plains bordering the Napo and other branches of the Amazon; the only roads are almost impassable mule-tracks and footpaths, and the inhabitants, nearly all Indians, do not exceed 80,000. The streams are said to be rich in gold, and a little is obtained by primitive methods. Capital, Archidona. H. H. S.

Orien'tius: a Christian Latin poet from Gaul, of the fifth century; perhaps to be identified with the Bishop of Auch, who about the year 439 acted as ambassador of Theodoric I. to the Roman generals Aëtius and Litorius. His poem, in two books, containing 1,036 elegiacs, is entitled *Commonitorium*, an earnest admonition to the Christian to avoid besetting sins, which are enumerated. Of twenty-four prayers only two, in Senarii, are preserved. The authenticity of other poems attributed to Orientius is doubtful. There is an edition by Robinson Ellis (Vienna, 1888). See Manitius, *Geschichte der Christlich-Lateinischen Poesie* (pp. 192–201). M. WARREN.

Or'iflamme [= Fr. < O. Fr. *oriflambe* < Late Lat. *auriflamma*; *au'rum*, gold + *flam'ma*, flame]: the ancient battle-standard of France, once a banner belonging to the abbey of St. Denis. After 1124, when it was adopted as a royal standard by Louis VI., it was often borne in battle, but seems never to have been employed after the battle of Agincourt in 1415. The accounts of its form and color differ considerably, but it was of flame-colored silk beautifully adorned.

Or'igen, surnamed ADAMANTIOS, from his untiring energy: one of the most learned and spirited of the Christian Fathers; b. at Alexandria in 185 A. D.; was early initiated both in Christianity by Clemens Alexandrinus and in Greek wisdom by his father, Leonides, who was a teacher of rhetoric. During the persecutions which took place in the reign of Severus, Leonides suffered martyrdom, and the son undertook to maintain the family by opening a school, in which at first he simply taught the Greek language and literature, but soon also began to expound the doctrines of Christianity with great success. Bishop Demetrius appointed him master of the famous catechetical school of Alexandria, and in order to maintain himself in this position he sold his library and subjected himself to the severest asceticism, at the same time pursuing his mental development with unflagging vigor. He made an exhaustive study of Greek philosophy, and became a pupil of Ammonius Saccas, and during a visit to Rome he acquired a mastery of the Hebrew language. His school, which he still continued, prospered in spite of occasional disturbances by the pagans, and his fame increased. In 228 he was called to Greece to dispute some heresy which had lately arisen there. On his way he visited Palestine, was everywhere received with great attention and invited to preach, and at Cæsarea he was ordained a presbyter. This ordination Bishop Demetrius of Alexandria refused to recognize as valid, partly because it was not given by himself as Origen's proper diocesan bishop, and perhaps partly because he knew that Origen, misunderstanding the passage in Matt. xix. 12, had mutilated himself. Two synods held in Alexandria supported the bishop; and as the broad and liberal views which Origen held on many points, and the critical examination and allegorical explanation to which he subjected the Scriptures, had made him many enemies, the second synod even condemned several of his ideas as heretical, and excommunicated him (231). In the West, where his writings were very little known, the case attracted no attention, but the bishops of the East—of Palestine, Phœnicia, Achaia, and Arabia—declared for him, and he found refuge in Cæsarea, where he reopened his school with still greater success. During the persecutions under Maximinus he fled to Cappadocia, where he lived for two years. Under Gordianus he returned and continued his beneficial activity, but the sufferings and torture to which he was subjected during the Decian persecution broke his strength, and he died at Tyre in 254. Origen is considered unsound in his eschatology, and his teaching of restorationism, even of demons, is the chief count against him, but he ranks with the best of the Fathers and the holiest men of the Church. Of his many writings (6,000, it is said) only a few have come down to us. Of his *De Principiis* (Of the Principles) there exists only a free and even interpolated translation into Latin by Rufinus, edited by E. R. Redepenning (Leipzig,

1836) and by K. F. Schnitzer (Stuttgart, 1836). Of his HEXAPLA (*q. v.*), an edition of the Old Testament in six parallel columns in Hebrew, Hebrew text in Greek letters, and in the four versions by Aquila, Symmachus, the Septuagint, and Theodotion, and in parts other versions in parallel columns, we have only fragments, edited by B. de Montfaucon (2 vols. fol., Paris, 1713), but best by F. Field (Oxford, 1875). The beautiful treatise on martyrdom and the celebrated eight books against Celsus, which are an apology for Christianity, are entire. His works were among the earliest printed; his homilies appeared in 1475, and editions of his complete works appeared at Paris (2 vols. fol., 1512–19, and another in 1522–30); later and better editions in Basel, edited by Erasmus (2 vols. fol., 1545); in Paris (1572–74, 2 vols. fol.); by C. and V. de la Rue (4 vols. fol., Paris, 1733–59; also in Migne's series, vols. xi.–xvii.); by C. H. E. Lommatzsch (25 vols., Berlin, 1831–48); and an English translation of his treatises *On the Principles* and *Against Celsus*, with a few other writings, in Clark's Ante-Nicene Christian Library. See E. R. Redepenning, *Origenes, eine Darstellung seines Lebens und seiner Lehre* (Bonn, 1841–46).

Revised by SAMUEL MACAULEY JACKSON.

Original Burgher Synod: a Scottish Presbyterian body. See PRESBYTERIAN CHURCH.

Original Sin (Lat. *pecca'tum origina'le*): in theology, that act or state of sin from which all other sins originate. It is distinguished into *original sin imputed*—e. g. the guilt of Adam's apostasy charged to his descendants (see IMPUTATION)—and *original sin inherent*—that innate subjective moral corruption which is inherited by all men at birth, and which is the immanent cause of all actual transgression. The term is taken in the latter sense in this article, the *peccatum habituale* as distinguished from the *peccatum actuale*. It is proposed to state in historical order the principal opinions which have been entertained, first, as to its *nature* and *extent*, and, second, as to the manner of its propagation.

I. *Its Nature and Extent.*—(A) *Opinions prevalent before the Controversies of Augustine with Pelagius.*—There prevailed no definite and generally accepted views as to the nature and extent of the moral ruin wrought in human nature in consequence of Adam's sin. All agreed in the fact of a sinful taint, and of the need of redemption. The Eastern portion of the Church generally, and more particularly the Alexandrian school founded by Origen, in extreme reaction alike from Gnostic and from Neo-Platonic dualism, emphasized the self-determining power of the human will and man's responsibility, and consequently his ability to co-operate with any divine assistance vouchsafed for his recovery. On the other hand, the Latin Fathers, especially Tertullian, Hilary, and Ambrose, the immediate teacher of Augustine, emphasized hereditary sin and guilt, and the absolute dependence of the soul upon grace.

(B) *The Opinions entertained by the several Parties to the Anthropological Controversies of the Fifth Century.*—(1) Pelagius and his party held that Adam's sin injured only himself; that men are now born in the same moral state in which they were created; that *liberum arbitrium*, the power to choose indifferently good or evil, is essential to moral responsibility in every stage of action, and an inalienable prerogative of human nature. Hence man is morally well. (2) The *Semi-Pelagians* held that human nature is seriously injured by Adam's sin, and that hereditary corruption is a fault or disease, rather than a sin properly so called, since it involves no guilt (either *reatus pœnæ* or *culpæ*) previous to actual transgression. Man can choose and attempt the good, but through weakness is unable to effect it. Hence they denied *gratia preveniens*, predisposing grace, but admitted the necessity of *gratia co-operans*, which is rendered efficient by the spontaneous co-operation of the human will. (3) Augustine taught that the apostasy of Adam, in whom all men sinned, is the common guilt of all his natural descendants, who, while retaining freedom in the sense of rational spontaneity, come into being spiritually dead, unable either to begin or to effect any really good act before God—free only to sin, and dependent for salvation upon unmerited, sovereign, omnipotent grace. Before regeneration the soul can only resist grace; afterward, by the assistance of grace, it may co-operate with grace. Hence the necessity of *gratia preveniens*, disposing grace, *gratia operans*, regenerating grace, and *gratia co-operans*, grace assisting the regenerated to every holy act. See G. F. Wiggers, *Hist. of Augustinianism and Pelagianism*, part i. and part ii. For the history of the condemnation of Pelagianism and the adoption of Augustinianism in the Roman Catholic Church see ARMINIUS and CALVINISM.

(C) *The Tridentine doctrine*, or the later Catholic doctrine formulated by the Council of Trent (1545–63). It is admitted that human nature bears the guilt of Adam's sin, is morally corrupted, and without grace helpless. It distinguishes, however, between the *dona naturalia*, the soul with its constitutional faculties, and the *dona supernaturalia*, the superadded gift of supernatural righteousness. In the original creation all Adam's faculties, physical, intellectual, and moral, were in perfect equilibrium, the lower held in due subordination to the higher. To confirm this equilibrium, God added the gift of original righteousness. This supplementary gift Adam lost for himself and his descendants, and this loss (1) involves guilt; (2) leaves the natural powers in a state of instable equilibrium, so that the free will certainly falls into actual transgression as soon as moral agency begins. Yet man may seek the grace offered in baptism, which effects justification *ex opere operato* in all non-resistants (*non ponentibus obicem*). "Original sin" in the Roman Church consists, therefore, in the loss of "original righteousness," which nevertheless involves "obliquity of will from God"; and yet free will must co-operate with grace. See *Counc. of Trent*, sess. 6, 1, 3, 5, 7; Bellarmine, *Amiss.*, gr. iv. 3 and v. 17.

(D) *All the original Protestant Churches, Lutheran and Reformed*, agree, as to "original sin," that it includes (1) moral corruption of the whole man as well as the loss of "original righteousness." (2) This implies no physical change in the substance of the soul, but a depraved moral habit. (3) All the faculties, intellectual as well as emotional or volitional, as far as they relate to moral objects, are depraved. (4) This depravity, although admitting many civil virtues, is called total, because (1st) the whole man is involved; (2d) the breach with God is complete, and, without supernatural aid, irremediable; (3d) the tendency is ultimately to all sin. (5) This condition involves guilt (both of blame and punishment). Some say, because all sin is inherently blameworthy; others say, because it originated in Adam's abuse of free will, for which we are all responsible. (6) Man is morally impotent to change his own general disposition to evil. Hence he can not co-operate with grace before regeneration, but afterward by the continued operation of grace the free will acts graciously. See *Form of Concord* (Hase), pp. 639, 640, 645, 662, 681; *Gal. Conf.*, art. ii.; *Heidel. Cat.*, ques. 7–10; *West. Conf. Faith.* chs. vi., ix.; *Thirty-nine Articles*, art. 9.

(E) *The Arminian doctrine*, as held by the Dutch Remonstrants, regarded "original sin" rather as a fault or defect of nature than a sin. As held by the Wesleyans, it admits that man's nature is corrupted, indisposed, and disabled from all spiritual good; but both parties differ from the Lutheran and Reformed Churches in holding (1) that it involves no guilt, since it is not brought upon us by our own agency; and (2) that every soul retains power to co-operate with the grace with which God for Christ's sake endows every soul. *Conf. Remonstr.*, pp. 84 and 162, and Dr. D. D. Whedon in *Bib. Sacr.*, Apr., 1862.

(F) *The Socinian and Rationalistic doctrine* is nearly the same with that of Pelagius, above stated. There is no innate corruption. Sin is propagated by example. Man always retains plenary power to do all God requires of him. There is no grace beyond providential advantages and objective instruction. *Racov. Cat.*, pp. 294 and ques. 428–430.

II. *The Mode of its Propagation.*—(1) Origen taught the doctrine of the pre-existence of human souls, and their personal sin and *self*-corruption in a previous state of probation. This view, which denies the propagation of inherent corruption from Adam altogether, was revived by Dr. Edward Beecher in his *Conflict of Ages* (1853). (2) Tertullian taught the doctrine that souls as well as bodies are derived by generation from parents, and that sin, like every essential quality and many acquired accidents of nature, is propagated *ex traduce*. Augustine hesitated to decide between this origin of souls and their immediate creation. Many of the Greeks were creationists, and many of the Latins traducianists. Since the Reformation most of the Lutherans have been traducianists, and most of the Reformed creationists. (3) Jerome held that each soul was immediately created by God. Creationists account for inherent moral corruption either (*a*) *per corpus*—that is, from the union of the soul with a body in which sin is propagated by generation (*Lampe* (Utrecht, 1683–1729), vol. i., p. 572)—or (*b*) *per culpam* —from the judicial withholding from the new-created soul

of the life-supporting influence of the Holy Ghost, as the punishment of Adam's first sin. See Dr. R. Ridgeley (London, 1667–1734); Turretine (L. ix., ques. 12).

Revised by F. H. Foster.

Orihuela, ō-rē̆e-wā'lăă: town of Spain; in the province of Alicante; on the Segura; 36 miles S. W. of the city of Alicante, in the middle of a most fertile plain (see map of Spain, ref. 18–H). It has a cathedral, a college, and manufactures of hats, linen and silk fabrics, and paper, and many flour and oil mills. Pop. (1887) 24,364.

Oril'lia: post-village of Simcoe co., Ontario, Canada; on Lake Couchiching, and on the Grand Trunk Railway; 90 miles from Toronto (see map of Ontario, ref. 3–D). It is the seat of a provincial asylum for lunatics. The town is connected by steamboat with Lake Simcoe and the Muskoka country. It has a good trade, important manufactures, and two monthly and three weekly papers. Pop. (1891) 4,752.

Orino'co: one of the largest rivers of South America; lying entirely in Venezuela, but with branches in Colombia. In the article America, South (*q. v.*), it was shown that three great river-depressions extend from the Atlantic far into the interior of the continent, becoming confluent toward the W. The Orinoco depression is the northernmost and smallest of the three; separating the highlands of Guiana from the Venezuelan coast mountains, it runs into the Amazonian depression southwestward, thus leaving Guiana like an island, cut off from the rest of South America by comparatively low lands. (See Guiana.) The southwestern part of the Orinoco depression is about 1,000 feet higher than the eastern part, forming an interior basin largely covered with forest, and quite different in character from the broad open plains near the Atlantic. On leaving this upper basin the river flows down in a series of rapids, which occupy a comparatively small space, and separate the navigable upper part from the wide lower channels. The Orinoco rises on the southeastern side of the highlands of Venezuelan Guiana, and follows their edges around in a broad curve northward, finally turning E., still near the edges of the highlands, until it reaches the Atlantic. Hence the right bank of the river is generally high, or the lowlands on that side are of small extent, and the tributaries are navigable for comparatively short distances; the great plains and the most important navigable branches are on the left side. Near and above the rapids there are isolated hills or mountains in the upper basin, on the left side of the river. We know almost nothing of the vast tract to the S. W., about the Meta and Guaviare branches; and it is quite possible that the upper basin in this direction is broadly continuous with the Amazonian depression. That the two river-basins are confluent, at least for a small space, is shown by their actual water connection through the Cassiquiare and Rio Negro; but this connection is 920 feet above sea-level. The sources of the Orinoco (discovered by Chaffanjon in Dec., 1886) are in the Sierra de Parima, close to the frontier of Brazil. Descending rapidly to the W. N. W. the river enters the upper basin, where it becomes navigable for small vessels. In this region is the remarkable and unique channel which connects it with the Rio Negro and Amazon. The Orinoco bifurcates; about one-sixth of its water takes the left-hand channel, which is here about 50 yards wide, and after a course of 190 miles enters the upper Rio Negro. Below the Cassiquiare the Orinoco receives the Ventuario on the right and the Guaviare on the left. It then turns N., and enters the region of the *raudales* or rapids. The most important of these are the Raudales de Maypures, 4 miles long, and the Raudales de Aturés, 6 miles long. The river, straitened by opposing hills, rushes foaming through numerous small channels between rocky islets, forming a scene of almost unsurpassed grandeur. The Indians drag their canoes through these rapids with great difficulty and danger, but they are impassible for large vessels. From the Raudales de Atures downward the river is freely navigable, though its shifting sandbanks and bewildering channels require an experienced pilot. It receives the Meta and Apure, its two most important tributaries, from the W., then turns directly E., flowing between the highlands of Guiana and the broad open plains of the Llanos (*q. v.*). The river here is so near sea-level that its waters rise and fall regularly with the tide as far up as Ciudad Bolivar, 270 miles from the mouth. On approaching the sea it forms an immense swampy and forest-covered delta, dividing into more than fifty channels, which spread out over 180 miles of coast. The islands are haunted by fevers, and swarm with mosquitoes. The few Indian inhabitants often build their houses on platforms to escape the river floods. Only one of the channels is used by large vessels. The whole length of the Orinoco is about 1,550 miles; it is navigable for 870 miles to the rapids, and above them to within 150 miles of its source. It receives eight large tributaries and an immense number of smaller ones; the Meta and Apure are navigable to the base of the Andes. The area drained by it is roughly estimated at nearly 400,000 sq. miles of very thinly inhabited country. Steamers from Trinidad ascend the main river regularly, and some attempts have been made to open up the tributaries. Diego de Ordaz navigated the Orinoco to the junction of the Apure in 1531–32, and subsequently the region was traversed by many adventurers in search of El Dorado. Humboldt (1800) was the first to describe the Cassiquiare channel, though it had long been known to missionaries. The latest and best survey is that of Chaffanjon (1885–87). See Orinoco River in the Appendix; Humboldt's *Travels*; Michelena y Rojas, *Exploración Oficial* (1867); Schomburgk, *Reisen en Guiana und am Orinoko* (1841); Chaffanjon, *Découverte des sources de l'Orénoque* (in *Comptes rendus de la Société de Géographie de Paris*, Dec., 1887).

H. H. Smith.

O'riole [from O. Fr. *oriol* > Fr. *loriot* (for *l'oriol*, the oriole) < Lat. *aure'olus*, dimin. of *au'reus*, golden, deriv. of *au'rum*, gold]: a name properly belonging to bright-colored Old World birds of the genus *Oriolus* and the family *Oriolidæ*; but in the U. S. the name is given to birds of the family *Icteridæ*. The name was probably transferred to these birds of the New World on account of their color, which is usually black and yellow, like that of the true orioles. (See Baltimore Oriole.) The only European oriole is the *O. galbula*, or golden oriole. Its name it derives from its color, which in the adult male is bright yellow over the whole of the head, neck, and body, with the exception of the wings, the two central tail-feathers, and the basal portions of the remaining feathers, which are jetty black, the two colors contrasting finely with each other. Across the eye runs a dark stripe, and the eyes themselves are reddish. The bird has a very peculiar note, loud, flutelike, and so singularly articulate that the Italian peasantry believe it speaks their language. Its nest is a very elegantly formed and well-constructed edifice of a shallow cup-like shape, and is usually placed in a horizontal fork of a convenient branch. The materials of which it is made are mostly delicate grass-stems so firmly interwoven with wool that the whole structure is strong and warm. The eggs are generally four or five in number, and their color is purplish white, sparely marked with blotches of a deep-red and ashen gray. Its food consists chiefly of insects; and, as the bird is rather a voracious creature, it is very serviceable in clearing away caterpillars and other fruit-devouring insects. It is an exceedingly shy and timorous bird, and, as it always takes the trouble to set sentries on guard, it can not be approached without the greatest patience and wariness on the part of the sportsman or the observer. It is quite common in Italy, and it is also found in the other countries of Southern Europe. It is gregarious in its habits, generally associating in little flocks and frequenting lofty trees and orchards, where it finds plenty of food.

Revised by F. A. Lucas.

Ori'on [= Lat. = Gr. Ὠρίων, Orion, fabled to have been a hunter transferred to the sky]: one of the constellations. It is mentioned (Job ix. 9; xxxviii. 31) by the Hebrew word *cesil*, which signifies a "fool," and also an "impious, godless man," called by the Arabs "the giant." The giant of ancient astronomy was Nimrod, who was fabled to have been bound to the sky for his impiety. The Greek mythology in various ways represent him as a giant who was slain by Diana, who in remorse placed him among the stars. The constellation is represented by the figure of a man with a sword by his side. Though a southern constellation with regard to the ecliptic, the plane of the equator passes through its middle. Its contains seven conspicuous stars; the three forming the belt are also called "Jacob's staff" and the "yard wand." One of the most remarkable nebulæ of the heavens is situated in the sword-handle of Orion.

Orissa [Sanskr. *Odra*, northern]: formerly the northern part of the old province of Kalinga, now the southeast portion of the province of Bengal, India. Its coast region is an extremely fertile, alluvial delta formed by the numerous branches of the Mahánadi, Bráhmani, and Baitarani rivers. Behind this densely populated coast region is the hill country, rather sparsely peopled and comprising two-thirds of

the total area of the district, which is 24,140 sq. miles. Rice is the chief product, agriculture is almost the only pursuit, and nearly all the inhabitants are Hindus. Pop. (1891) 3,865,020. C. C. Adams.

Orizaba, ō-rē̆e-thaa'bă̆a (called *Citlaltepetl*, or Mountain of the Star, by the Aztecs): a mountain of Mexico, on the confines of the states of Vera Cruz and Puebla, near the eastern edge of the plateau. The summit is covered with snow, and the ascent is difficult and dangerous. According to the careful measurements (partly by triangulation) made by Scovell and Bunsen in 1891–92, the highest point is 18,314 feet above sea-level; it is therefore the highest mountain in Mexico, and possibly the highest in North America. Orizaba is a quiescent volcano. In clear weather it is visible from the Gulf of Mexico, near Vera Cruz, presenting a magnificent sight. The railway from Vera Cruz to Mexico passes by its base. Herbert H. Smith.

Orizaba [corrupted from the Nahuatl *Ahauializapan*, liter., pleasant waters]: a town of the state of Vera Cruz, Mexico; on the railway from Vera Cruz to the capital; 17 miles S. E. of the mountain to which it has given its name (see map of Mexico, ref. 7–I). It is beautifully situated in a broad valley, 4,025 feet above sea-level; its delightful climate and magnificent scenery make it a favorite resort both for Mexicans and for foreigners. Maize, tobacco, and sugar-cane are extensively cultivated in the vicinity, and the town has several cotton-mills and other manufactories, the motive-power being derived from the Rio Blanco. Orizaba was an ancient Indian town. It was the headquarters of the French in 1862. Pop. (1894) about 25,000.

Herbert H. Smith.

Orkhan, Ghazi, the Victorious: first Ottoman sultan (1326–60); b. 1290; captured Broussa (1326) shortly before his father's death, and as his elder brother Alaeddin refused the throne, he succeeded to it. The brothers were devotedly attached to each other, and Alaeddin, who was a statesman and scholar, aided him as his grand vizier. Orkhan was an able soldier, and captured Nice, Nicomedia, and Pergamus, and by these and other conquests more than trebled his states, which Alaeddin organized. By the conquest of Tzympe and Gallipoli (1357) the Ottomans gained their first foothold in Europe. Orkhan married (1347) Theodora, daughter of John VI. Cantacuzenos, Byzantine emperor, but did not force her to adopt his creed. He died (1360) of grief at the death of his brother and his son Suleïman.

E. A. Grosvenor.

Ork'ney Islands: a group of sixty-seven islands, of which twenty-nine are inhabited, lying off the northern coast of the mainland of Scotland, from which they are separated by the Pentland Firth. They comprise an area of 375 sq. miles, with a population in 1901 of 27,723. The largest is Pomona or the Mainland; the most remarkable among the others are South Ronaldshay, Hoy, Flotta, Rousay, and Sanda. With the exception of the Hoy, which is rocky and mountainous, its western coast reaching a height of 1,600 feet, the Orkney islands are low, presenting an irregular coast-line—in some places rocky, in others sandy. The climate is mild, considering the northern latitude, frosts are very rare, but the summers are often chilly, and always moist. The soil is remarkably fertile. The chief agricultural products are barley, oats, potatoes, and turnips, and sheep and cattle are extensively reared. Fishing, hunting for wild birds and eggs, rearing of poultry, and distilling are important occupations. There is regular steam communication between Kirkwall, the chief town, and Wick, Aberdeen, and Leith, and between Stromness (the next most important town) and Thurso on the mainland, and a small steamer connects Kirkwall with the North isles. Communication with the other islands is by "packet." The tides rush with great rapidity through the numerous sounds and channels formed by the islands, and navigation is dangerous. In 1889 the Orkney islands were separated from the Shetlands and erected into a separate county. Orkney and Shetland together send one member to Parliament. The Orkney islands are mentioned by the ancient geographers Pliny and Ptolemy, and by other classical writers, under the name Orcades, whence the modern adjective "Orcadian." Little, however, is known of the inhabitants till the dawn of the Middle Ages. They were probably of the same stock as the British Celts. The islands, together with the Hebrides, were conquered by the Norwegians in 876, and formally annexed to the Norwegian crown in 1098. In 1397 they were united to Denmark, and in 1468 the Danish king, Christian I., gave them to the Scottish king, James III., who married his daughter, as a security for her dowry. The dowry was never paid, and in 1590 the islands were formally turned over to Scotland. During their long connection, however, with Norway and Denmark all traces of the primitive Celtic population disappeared, and the present inhabitants are of pure Norwegian stock.

Revised by R. Lilley.

Orlando: city; capital of Orange co., Fla. (for location, see map of Florida, ref. 5–J); on the Fla. Cent. and Peninsular and the Savannah, Fla. and West. railways; 90 miles S. of Palatka. It is in the heart of the orange, pineapple, and grape region; has 6 churches, street-railways, gas and water-works, large foundry and machine-works, 2 State banks, and a daily and 2 weekly newspapers; and is a noted winter resort. Pop. (1890) 2,856; (1900) 2,481.

Editor of "Reporter."

Orléanais, ōr'lā'ă̆a'nā': an ancient province of France; situated nearly in the center of the country, bounded by the provinces of Île de France, Champagne, Burgundy, Berry, Touraine, Maine, Perche, and Normandy. It consisted of Orléanais proper, with the capital of Orleans; Beauce, comprising Pays Chartrain, Dunois, and Vendômois, with the capital of Chartres; Blaisois, with the capital of Blois; and Gatinais-Orléanais, with the capital of Montargis. Its territory constitutes the three departments of Loire-et-Cher, Eure-et-Loire, and Loiret, and parts of Indre, Indre-et-Loire, Nièvre, and Yonne.

Or'leans: city of France; capital of the department of Loiret; 75 miles by rail S. S. W. of Paris, on the right bank of the Loire, which is crossed here by a magnificent bridge of nine arches (see map of France, ref. 4–E). It has many fine promenades, handsome public squares, and elegant buildings, among which the cathedral is one of the most magnificent Gothic edifices of France; but generally the town is ill-built. Its educational institutions, especially its medical schools, and its museums are excellent, and its sugar-refineries and manufactories of vinegar and woolen fabrics are very extensive. The University of Orleans, founded in 1312, was suppressed in 1789. The city contains three beautiful statues of Joan of Arc, the Maid of Orleans, and its museums have numerous antiquities and monuments relating to her. During the Franco-German war Orleans was the center of the preparations made by the government of defense for the purpose of raising the siege of Paris, and for some time in 1870 the city was occupied by the Germans, though without suffering any harm. Pop. (1891) 63,705; (1896) 66,699.

Orleans, Duchy of: an old division of France, consisting of Orléanais proper, with the capital, Orleans. It formed a countship under the Carlovingian and Capetian dynasties, but was erected into a duchy in 1344 by Philip VI. of the house of Valois, and given to his son as an appanage. Subsequently it was held in the same way by different younger branches of the reigning families of Valois and Bourbon. Thus Louis, the second son of Charles V. of Valois, and for a time lieutenant-general of France during the insanity of his brother the king, Charles VII., received the duchy of Orleans in 1392 as a fief, and after his death, in 1407, his son Charles held it to 1465; but when, in 1498, his grandson, Louis, ascended the throne of France as Louis XII., it returned to the French crown. In 1626 it was bestowed on Jean Baptiste Gaston, brother of Louis XIII., the youngest son of Henry IV. of the house of Bourbon, famous in history for the unflagging steadfastness with which he formed one conspiracy after the other against Richelieu, and the cynical treachery with which he every time sacrificed his accomplices; he died in 1660, leaving no male heirs. The most remarkable of the several families which have held the title and possessions of the duchy is that descending from the younger brother of Louis XIV., Philip, a son of Louis XIII., b. in 1640, married in 1661 to Henrietta of England, and after her death, in 1671, to Charlotte Elizabeth of Bavaria; d. in 1701. This branch of the family, by virtue of its descent from Louis XIII., played a very prominent part in subsequent French history. In the Treaty of Utrecht (1713) the Duke of Orleans waived all rights to the throne of Spain, and the Duke of Anjou (Philip V.) all hereditary rights to the French succession. These provisions determined the rights of the Count de Chambord and the Count of Paris in the nineteenth century. During the administration of Richelieu as well as during the reigns of Louis XIV. and Louis XV. the family occupied a position of special prominence. Revised by C. K. Adams.

Orleans, Prince Louis Philippe, Duke of: eldest son of the Count of Paris; b. Feb. 6, 1869. On attaining his majority (Feb. 6, 1890) he entered Paris, and expressed his desire as a Frenchman to perform his military service; was arrested in accordance with the Expulsion Act of 1886, which forbids the soil of France to the direct heirs. He was liberated after a few months' imprisonment.

Orleans, Louis Philippe Joseph, Duke of, better known as Philippe Égalité: revolutionist; b. at St.-Cloud, Apr. 13, 1747; married in 1769 Adelaide of Bourbon-Penthièvre, who brought him immense wealth; entered with zeal into the revolutionary agitation, and became on account of his rank and influence the center of the opposition to the court. He renounced his rank and titles, assuming the name of Citizen Égalité, and aspired to be the leader of the republican movement, but lacked the ability and force of character to command respect. Influenced by fear he voted for the death of the king, but neither this nor his subserviency as the tool of the Jacobins saved him from the suspicion of complicity with his kinsmen, and he was tried and guillotined on Nov. 6, 1793.

Orleans, Philippe, Duke of: regent of France during the minority of Louis XV.; b. Aug. 4, 1674; distinguished himself as a soldier, especially while in command of the French army in Spain, where in 1707 and 1708 he conducted brilliant and successful campaigns; became sole regent on the death of Louis XIV., and showed himself in some respects an able ruler. The Stuarts left France, and an alliance was formed with Great Brit'n. On the other hand, his Government countenanced the nancial folly of the Mississippi scheme. In his private .'e he was grossly licentious, and his excesses hastened his death, which occurred Dec. 2, 1723.

Orleans, Maid of: See Joan of Arc.

Orley, Bernard van: painter; b. in Brussels in 1490. Having studied art with his father and cousin, he went to Rome, where he became a pupil of Raphael, who employed him in his great compositions. After Raphael's death he returned to Brussels, where Charles V. commissioned him to paint several pictures of hunting scenes. He made cartoons for tapestries for the palaces of the emperor and of the princes of the house of Austria and of the Duchess of Parma. He painted a fine picture of the *Last Judgment* for the chapel of the Almoners in Antwerp, and a *St. Luke painting the Virgin* for the society of painters of Mechlin. He also made designs for the tapestries of the Castle of Breda for William of Nassau. D. in 1560. W. J. S.

Or'loff: name of a Russian family, prominent since the seventeenth century, remarkable rather for courage and physical characteristics than for intellectual and moral qualities. (1) Ivan: one of the rebellious strelitzi, pardoned on the scaffold (1689) by Peter the Great, who was pleased by his undaunted bearing. He assumed the name Orloff.—(2) Orloff, Gregory: soldier; son of (1), father of five sons and one daughter, the latter commonly revered as St. Catherine.—(3) Orloff, Ivan: author; son of (2); b. 1733; d. 1791.—(4) Orloff, Gregory: general; son of (2); b. 1734; chief of the conspirators who deposed Peter III. (July 9, 1762) and made Catherine II. sole ruler. In consequence, he and his four brothers were made counts. By him Catherine had a son, Count Bobrinski. His brutality and arrogance finally alienated the empress; he was banished, then recalled, and on account of his courage during the pest at Moscow, partially restored to favor. Failing in a diplomatic mission and again disgraced, he became insane and died (1783) at Moscow.—(5) Orloff Tcheshmenski, Alexis: general; son of (2): b. 1736; d. 1808; a man of gigantic stature but little intellect. Joining his brother's conspiracy, he is said to have strangled Peter III. with his own hands. He commanded the Russian squadron which won the great naval battle of Tcheshme (1770), whence he received the title of *Tcheshmenski*. That victory was due, however, to his British officers, Elphinstone, Gregg, and Dugdale. The Princess Tarakanoff, daughter of the dead Empress Elizabeth, was then residing in Italy, and caused anxiety to Catherine II. Professing himself the lover of the princess, he won her hand, enticed her on board his fleet, and carried her to Russia, where she was put to death. He was banished soon after the accession of the Emperor Paul.—(6) Orloff, Vladimir: scientist; son of (2); president of the Academy of Sciences of St. Petersburg.—(7) Orloff, Gregory Vladimir: author; son of (6); b. 1777; d. 1826; wrote numerous works on history and art.—(8) Orloff, Feodor: general; son of (2); b. 1741; d. 1796; notable only through his four illegitimate sons, from whom the present members of the family descend.—(9) Orloff, Alexis: general; son of (8); b. 1786; d. 1861; saved the life of Emperor Nicholas in 1825; skillfully negotiated Treaty of Adrianople (1829), and Treaty of Hounkiar Iskelessi (1833), but was afterward generally unsuccessful in the many high offices he held; represented Russia at the Congress of Paris (1856), and was made a prince.—(10) Orloff, Nicolas: diplomat; son of (9); b. 1827; d. 1885; Russian ambassador to Paris in 1872; wrote on campaign of 1806 in Prussia.—The Orloff-Denissoff family, unconnected with the persons above mentioned, are prominent on the Don, and have hereditary right to furnish the hetman of the Cossacks.

E. A. Grosvenor.

Ormazd, or **Ormuzd** [Pers. < O. Pers. *auramazdā*: Avest. *ahura mazdāh*; cf. Sanskr. *asura*, spirit, divinity, (later) demon, and *médhas-*, wisdom]: the supreme god in Zoroastrianism, or the religion of ancient Persia. The meaning of the name *Ahura Mazdāh* in Avestan (*q. v.*) is the Lord Wisdom, and he is the omniscient, omnipresent source of all that is good in the world; his opponent, Ahriman (Avest. *Anra Mainyu*, the Enemy Spirit), affords a parallel to Satan. Zoroastrian dualism recognizes the two principles of Ormazd and Ahriman as primeval and coeval, but not coeternal: Ormazd in the end shall triumph and destroy Ahriman. A later Persian sect, the Zervanists, regarded both these principles as sprung from *Zarvan Akarana* (Time Eternal); one Iranian sect, called Gayomarthians, conceived Ahriman to be an evil spirit sprung from Ormazd. The exalted and spiritual conception of Ahura Mazda with his ministering angels that is found in the Zoroastrian scriptures is the nearest approach to Jehovah that can be found in ancient religions. See Zoroaster.

A. V. Williams Jackson.

Ormiston, William, D.D., LL.D.: clergyman; b. at Symington, Lanarkshire, Scotland, Apr. 21, 1821; removed to Canada in 1834; was educated at Victoria College, Cobourg, Ontario, afterward Victoria University, Toronto, where he completed his theological course, was classical tutor four years and Professor of Moral Philosophy one year; was pastor at Newtonville, Ontario, 1849–53; superintendent of the township schools 1849–63; mathematical master and lecturer in science in the Normal School, Toronto, 1853–57; examiner at Toronto University 1854–57; pastor of the Central Presbyterian church, Hamilton, Ontario, 1857–70; of the Collegiate Reformed church, New York, 1870–88; stated supply at Pasadena, Cal., 1889–90; since 1890 was an evangelist in Southern California. He wrote copiously for periodicals; prepared series of textbooks; edited with notes *The Acts of the Apostles* (New York, 1883); was author of *An Exposition on a Part of the Epistle of James* in *The Homiletical Monthly*; and long prepared the Sunday-school lessons for *The Sunday-school Times*. D. in Aruza, near Los Angeles, Cal., Mar. 21, 1899.

Ormolu, or **Mosaic Gold** [*ormolu* is from Fr. *or moulu*, liter., ground or milled gold; *or*, gold (< Lat. *aurum*) + *moulu*, perf. partic. of *moudre*, mill, grind (< Lat. *molere*)]: an alloy of zinc and copper, containing from 25 to 75 parts of zinc in 100 of the alloy, a considerable proportion of the zinc being volatilized, unless the lowest possible temperature be employed in fusing the metals. The fused mass is kept until it takes on a white color, when it is cast at once, for if remelted it becomes a comparatively worthless kind of brass. It is largely employed in making household ornaments, which are colored by pickling in dilute oil of vitriol and then washed and varnished. In France the name is applied to gold-leaf prepared for gilding surfaces such as bronze or brass.

Ormond, James Butler, First Duke of: soldier and statesman; b. in London, England, Oct. 19, 1610; educated by Archbishop Abbot as a ward of the king; succeeded to the earldom of Ormond on the death of his grandfather 1632; was commander of the royal troops in Ireland as lieutenant-general during the insurrection of 1641; was created marquis 1642; was forced to make a disadvantageous armistice with the rebels 1643; became lord-lieutenant 1644; resigned his office to the Parliamentary commissioners, and retired to France 1647; proclaimed Charles II. in Ireland, and made an unsuccessful attempt to capture Dublin 1649; was driven from Ireland by Cromwell Dec., 1650; was created duke by Charles II. 1660; was Viceroy of Ireland 1661–69;

chancellor of the University of Oxford 1669; narrowly escaped assassination by Col. Blood 1670; again Viceroy of Ireland 1677–85; was made a duke in the English peerage 1682. D. at Kingston Hall, Dorsetshire, July 21, 1688.

Ormus: an island, 12 miles in circumference, in the Strait of Ormus, at the entrance to the Persian Gulf; now important only for its salt-works. At its northeastern extremity a miserable village of a hundred huts occupies the site of the once splendid city. This was captured by Albuquerque (1507), who made it the entrepôt of European-Indian commerce, but was utterly destroyed (1622) by Shah Abbas and the British East India Company. It is held by the Imam of Muscat, who pays tribute for it to Persia. E. A. G.

Ormuzd: See Ormazd.

Orne, ōrn: department of France; part of the old province of Normandy; area, 2,354 sq. miles. It is traversed by a range of wooded hills rising 1,370 feet above the sea, and rich in iron, copper, marble, and granite. To the N. and S. of these hills large pasture-grounds extend, where numerous cattle and horses are reared. Hemp is extensively cultivated, and there are large apple and pear orchards. About 22,000,000 gal. of cider are made annually. Manufactures, especially of metal-ware, are carried on. Pop. (1896) 339,162. Capital, Alençon.

Ornithology [from Gr. *ὄρνις*, *ὄρνιθος*, bird + *λόγος*, discourse]: that branch of zoölogy which treats of birds and the literature respecting them. Although it includes all that relates to birds, their external appearance, pterylosis, anatomy, and habits, it is very largely concerned with their classification, or their division into groups, and the arrangement of these groups with respect to each other. In fact, a history of the attempts at the classification of birds is practically a history of the progress of ornithological science, and it is the purpose of this article to note some of the more important systems which have been brought forward and the characters on which they were based.

We look in vain in the ancient authors for any clear idea of the relations of the various groups of this class; birds are chiefly considered (e. g. by Aristotle) with relation to their food and the means by which they obtain it, or (e. g. by Belon and Aldrovandi) with respect to their adaptation for progression and their habitat. Willoughby,* and his commentator Ray,† first gave a reasonable arrangement of the constituents of the class dividing it, primarily, into land and water birds; the former were then differentiated into those organized as birds of prey and those adapted for a less carnivorous or for a frugivorous diet; the latter were divided into waders and swimmers.

Linnæus‡ is celebrated as a systematist, and is looked up to as the father, to a great extent, of the modern methods; it is necessary, therefore, that his system should be alluded to. In the final edition of the *Systema Naturæ* (ed. 12, 1766) he divided the class into six orders—viz.: (1) *Accipitres*, in which the bill is hooked and decurved; the upper mandible projecting beyond the lower, and on each side dilated or armed with teeth; and the feet provided with acute arched claws. (2) *Picæ*, in which the bill is cultriform and with the dorsal outline convex, and the feet short and quite strong. (3) *Anseres*, in which the bill is smooth, covered with an epidermis, and enlarged at the tip; the feet webbed, and with the tibiæ compressed and short. (4) *Grallæ*, in which the bill is subcylindrical, the feet elongated and adapted for wading, and the femora partially naked. (5) *Gallinæ*, whose species have the bill convex, the upper mandible arched above the lower, and the nostrils overarched by a cartilaginous membrane, the feet adapted for walking, and the toes rough beneath; and (6) *Passeres*, in which the bill is conical and pointed, and the feet slender, with the toes separated and adapted for hopping. It will be thus seen that these groups were based entirely on the consideration of the structure of the bill and feet, the other characters enumerated by Linnæus, but not here reproduced, relating to the body, food, and nesting habits, being quite subsidiary; but this classification was generally accepted, and the views involved therein prevailed with naturalists generally until very recent times. Cuvier§ in 1797 slightly modified the classification of Linnæus in its details, but the orders were essentially the same as those of his predecessor. Lacépède in 1799 divided the birds into two classes—differentiated because in the one case the leg is furnished with feathers, and in the other destitute of them. Fourteen orders were recognized. Meyer and Wolff* in 1810 primarily divided the birds into terrestrial and aquatic species: (*a*) the former into the orders (1) *Accipitres*; (2) *Coraces*; (3) *Picæ*; (4) *Oscines*, or singing birds; (5) *Chelidones*, including the swallows, swifts, and goatsuckers; (6) *Columbæ*, or the pigeons; and (7) *Gallinæ*; (*b*) the latter into the orders (8) *Grallæ*, or waders, and (9) *Natantes*, or swimming birds.

Illiger,† who attempted to reform the classification as well as nomenclature of the mammals and birds, presented an arrangement of the latter in which he grouped the various genera of birds into 41 families combined under 7 orders. The orders were distinguished, as by his predecessors, chiefly on account of the feet; the families by various characters, but more especially by the form of the bill and minor details of structure of the feet and wings. As the families were for the first time systematically introduced into this work, a synopsis of the system is worthy of reproduction:

Order I. Scansores, with families—1, Psittacini (parrots); 2, Serrati (toucans, plantain-eaters, etc.); 3, Amphiboli (cuckoos, etc.); 4, Sagittilingues (woodpeckers); 5, Syndactyli (jacamars).

Order II. Ambulatores, with families—6, Angulirostres (kingfishers, bee-eaters); 7, Suspensi (humming-birds); 8, Tenuirostres (sunbirds, hoopoes, etc.); 9, Pygarrhichi (creepers, Dendrocolaptes); 10, Gregarii (orioles, starlings, etc.); 11, Canori (song-birds); 12, Passerini (sparrows); 13. Dentirostres (motmots, hornbills); 14, Coraces (Corvidæ, birds of paradise, grakles, etc.); 15, Sericati (Ampelis, Procnias); 16, Hiantes (swallows, swifts, goatsuckers).

Order III. Raptatores, with families—17, Nocturni (owls); 18, Accipitrini (Falconidæ); 19, Vulturini (vultures).

Order IV. Rasores, with families—20, Gallinacei (fowls, etc.); 21, Epollicati (Ortygis, Syrrhaptes); 22, Columbini (pigeons); 23, Crypturi (tinamous); 24, Inepti (dodos).

Order V. Cursores, with families—25, Proceri (ostriches); 26, Campestres (bustards); 27, Littorales (shore-birds).

Order VI. Grallatores, with families—28, Vaginati (Chionis); 29, Alectorides (mixture); 30, Herodii (cranes, etc.); 31, Falcati (Tantalidæ); 32, Limicolæ (Scolopacidæ, etc.); 33, Macrodactyli (jacanas, rails); 34, Lobipedes (lobe-footed birds); 35, Hygrobatæ (incongruous mixture).

Order VII. Natatores, with families—36, Longipennes (Laridæ); 37, Tubinares (Procellariidæ; 38, Lamellosodentati (Anatidæ); 39, Steganopodes (swimmers with four anterior toes); 40, Pygopodes (swimmers with legs far back); 41, Impennes (penguins).

In 1812 a German zoölogist, Blasius Merrem,‡ proposed a new arrangement, which was destined to be ignored by his contemporaries, but, in its primary features at least, after being almost dormant for half a century, to be revived and quite generally accepted. Instead of differentiating the class into orders distinguished by differences of bill, wings, and feet, he took the sternum as the essential feature, and divided the class primarily into two groups—(1) *Aves carinatæ*, in which the sternum was produced at the median line and provided with a keel; and (2) *Aves ratitæ*, in which the sternum was flat toward the middle and entirely destitute of a keel. The former (1) included all the ordinary birds, which were further differentiated into aërial birds (*Aves aëreæ*), including the *Raptores*, *Pici*, and *Passeres*; terrestrial birds (*Aves terrestriæ*), embracing the gallinaceous forms; water-birds (*Aves aquaticæ*), represented by the swimming types; and marsh-birds (*Aves palustres*), corresponding with the waders of other authors. The latter division (2) was limited to the ostriches, nandus, cassowaries, emus, and kiwis. The only really important modification introduced into the classification was the distinction of the two primary groups.

N. A. Vigors in 1823 read a memoir before the Linnean Society of London§ on the classification of the class,

* *Ornithologiæ libri tres* (London, 1676)—a posthumous work edited by Ray.

† *Synopsis Methodica Avium et Piscium* (London, 1713).

‡ *Systema Naturæ*.

§ *Tableau élémentaire de l'Histoire naturelle des Animaux* (Paris, 1797).

* *Taschenbuch der deutschen Vogelkunde* (Frankfort-on-the-Main, 1810).

† *Caroli Illigeri Prodromus Systematis Mammalium et Avium* (Berlin, 1811).

‡ *Tentamen Systematis Naturalis Avium* (in *Abhandl. K. Pr. Akad. Wissensch.*, 1812).

§ *Observations on the Natural Affinities that connect the Orders and Families of Birds*, in *Trans. Linn. Soc. London* (vol. xiv., pp. 395–517, 1825).

which deserves special mention, less because of any improvements in classification than because in it was for the first time given a uniform nomenclature of families ending in *-idæ*. Vigors applied the fanciful quinarian system introduced by MacLeay to the arrangement of the birds, and divided the class into five orders—two (*Raptores* and *Insessores*), "endowed with feet formed for grasping," and three (*Rasores, Grallatores*, and *Natatores*), "endowed with feet incapable of grasping." These were subdivided into families, and in one case (*Passeres*) into five tribes. The leading groups are as follows:

ORDER I. Raptores, with the families—(1) Vulturidæ, (2) Falconidæ, (3) Strigidæ, (4) unknown, and (5) Gypogeranidæ.

ORDER II. Insessores, with 5 tribes (1–2 of normal group; 3–5 of aberrant group) and 25 families—viz.:

(1) Dentirostres, with the families of normal group Laniadæ, Merulidæ; of aberrant group Sylviadæ, Pipridæ, Muscicapidæ.

(2) Conirostres, with the families of normal group Sturnidæ, Corvidæ; of aberrant group Buceridæ, Loxiadæ, Fringillidæ.

(3) Scansores, with the families of normal group Psittacidæ, Picidæ; of aberrant group Certhiadæ, Cuculidæ, Rhamphastidæ.

(4) Tenuirostres, with the families of normal group Cinnyridæ, Trochilidæ; of aberrant group Promeropidæ? Meliphagidæ? Nectariniadæ?

(5) Fissirostres, with the families of normal group Hirundinidæ, Caprimulgidæ; of "typical group" Todidæ, Halcyonidæ, and Meropidæ.

ORDER III. Rasores, with the families of normal group Phasianidæ, Tetraonidæ; of aberrant group Struthionidæ, Cracidæ, Columbidæ.

ORDER IV. Grallatores, with families of normal group Ardeidæ, Scolopacidæ; of aberrant group Rallidæ, Charadriadæ, Gruidæ.

ORDER V. Natatores, with families of normal group Colymbidæ, Alcadæ; of aberrant group Pelecanidæ, Laridæ, Anatidæ.

Vigors thus groups the families into normal and aberrant, in pursuance of the views of M. S. MacLeay; for it is, says he, "certainly a more scientific mode of exhibiting the series of affinities" (*op. cit.* p. 426); but he preferred "to view it with more perfect or typical form in the center," "and with its less perfect forms on each side." In this way the last of the "scientific" mode became always the first of the "convenient" mode, the sequence being otherwise the same, save that it was unbroken in the latter. The arrangement, it will be seen, practically starts with the assumption that all the types, down to families at least, were known, and consequently no provision or room was made for the extinct types that were to be afterward discovered. In other respects, too, whatever may be the "philosophical" value of the scheme, it is a most inapt expression of the morphological facts of avine structure, the only true basis for scientific classification.

In 1826 Sundevall,* an eminent Swedish naturalist, introduced an entirely new idea in his proposed arrangement of the class and introduced a physiological consideration. Recalling that some species when hatched were almost featherless, blind, and incapable of taking care of themselves, while others were covered with down or feathers, fully endowed with sight, and able to run about at once, he proposed to consider these characteristics as of primary importance in the determination of the relations of species, and therefore divided the class into two legions: (1) *Altrices*, including those whose young were callow and incapable of taking care of themselves; and (2) *Præcoces*, comprising those competent of caring for themselves.

This division into *Altrices* and *Præcoces*, based on the physiology of the newly hatched young, was quickly adopted by several authors. Bonaparte especially, in one of his numerous new classifications (that published in 1853 †), adopted the divisions in question, and ranked the several orders of birds in parallel columns under the heads *Altrices* and *Præcoces*, considering that the orders of the one group or sub-class were, to a certain extent, represented by those of the other. Inasmuch as this is the most perfected form of the arrangement, and will give a very good idea of the relations of altricism and præcocism to structure, the classification is reproduced in the following:

AVES.

ALTRICES.	PRÆCOCES.
1, Psittaci.	
1. Americani; 2, Orbis antiqui.	
2, Accipitres.	
3, Passeres.	
1, Oscines; 2, Volucres.	
1, Zygodactyli; 2, Anisodactyli.	
4, Columbæ.	
1, Inepti.	7, Struthiones.
2, Gyrantes.	8, Gallinæ.
	1, Passeripedes; 2, Grallipedes.
5, Herodiones.	9, Grallæ.
	1, Cursores; 2, Alectorides.
6, Gaviæ.	10, Anseres.
1, Totipalmi; 2, Longipennes.	1, Lamellirostres; 2, Urinatores; 3, Ptilopteri.

The bearing of the pterylosis, or arrangement of the feathers, on classification, was recognized by Christian Ludwig Nitzsch in 1833, although the results of his labors were not published until 1840, or three years after his death. Nitzsch showed that very few birds are evenly clad with feathers, and that in most birds the feathers are grouped in certain well-defined tracts, interspersed with bare spaces, or apteria, these tracts and apteria being arranged differently in different groups of birds. Nitzsch, too, was the predecessor of Garrod in the study of the carotid artery and its relation to classification, for he published a paper on the subject as early as 1829, and he was one of the first to see the value of the character of the vocal apparatus, or syrinx, among passerine birds.

As early as 1838 Macgillivray recognized that there were essential differences between the vocal organs of those birds to which the terms clamatores and oscines were given later on, but it was Johannes Müller who, in 1845–47, described at length the structure of the syrinx and arrangement of the tracheal muscles, and founded the groups *Oscines* and *Tracheophones*. Prof. Newton says of Müller that his work "forms the groundwork of all the later or recent researches in the comparative anatomy and consequent arrangement of the *Passeres*."

In 1867* Prof. Thomas Henry Huxley, in a course of lectures afterward printed in the *Proceedings* of the Zoölogical Society, made known a new system of classification of birds, which excited great interest, and has had a very decided influence on the recent progress of ornithology, as much by the spirit infused into the mode of investigation as by the innovations that were proposed. The author, like Merrem and Blanchard, recognized as the primary divisions of the class the *Carinatæ* and *Ratitæ*, and these, like Blanchard, he dignified as the only existing orders, degrading the subordinate groups, equivalent in rank at least to many of those which had been called orders by others, to inferior rank. Four secondary groups were distinguished among the *Carinatæ*, more especially by the condition of the vomer and its relation to the neighboring bones. Tertiary groups were combinations of families or peculiar isolated families, characterized by osteological and other characters of moment. This classification had the merit of being the first expression, in a rigorous systematic form, of combinations of anatomical facts, and first gave due weight to aggregates of osteological and other anatomical features characteristic of the several groups of birds. The following synopsis, modified from Prof. Huxley's *Manual of the Anatomy of Vertebrated Animals*, is an exhibit of the chief features of this classification:

I. ORDER SAURURÆ. The metacarpals not ankylosed together. The tail longer than the body.

1, Archæopterygidæ (extinct).

II. ORDER RATITÆ. The metacarpals ankylosed together. The tail considerably shorter than the body. The sternum devoid of a keel.

a. The wing with a rudimentary, or very short, humerus, and with not more than one ungual phalanx.

2, Apterygidæ (the kiwis).
3, Dinornithidæ (the moas).
4, Casuaridæ (the cassowaries).

* *Ornithologiskt System af C. J. Sundevall* (in *K. Vetenskaft Academiens Handlingar för ar 1835, 1836*).

† *Comptes Rendus.*

* *On the Classification of Birds; and on the Taxonomic Value of the Modifications of certain of the Cranial Bones observable in that Class* (in *Proc. Zoöl. Soc. London* for 1867, pp. 415–472).

b. The wing with a long humerus and with two ungual phalanges.

5, Rheidæ (the nandus).
6, Struthionidæ (the ostriches).

III. Order Carinatæ. The metacarpals ankylosed together. The tail considerably shorter than the body. The sternum provided with a keel.

a. The vomer broad behind, and interposing between the pterygoids, the palatines, and the basisphenoidal rostrum.

[I. Sub-order] Dromæognathæ.

7, Tinamomorphæ (the tinamous).

b. The vomer narrow behind; the pterygoids and palatines articulating largely with the basisphenoidal rostrum.

a. The maxillo-palatines free.

i. The vomer pointed in front.

[II. Sub-order] Schizognathæ.

8, Charadriomorphæ (plovers, etc.).
9, Cecomorphæ (gulls, petrels, divers, and auks).
10, Spheniscomorphæ (penguins).
11, Geranomorphæ (cranes).
12, Turnicimorphæ (hemipods).
13, Alectoromorphæ (fowls).
14, Pteroclomorphæ (sand-grouse).
15, Peristeromorphæ (pigeons).
16, Heteromorphæ (hoazin).

ii. The vomer truncated in front.

[III. Sub-order] Ægithognathæ.

17, Coracomorphæ (passerines).
18, Cypselomorphæ (humming-birds, swifts, and goatsuckers).
19, Celeomorphæ (woodpeckers).

β. The maxillo-palatines united.

[IV. Sub-order] Desmognathæ.

20, Ætomorphæ (birds of prey).
21, Psittacomorphæ (parrots).
22, Coccygomorphæ (colies, plantain-eaters, cuckoos, barbets, toucans, capitonidæ, galbulidæ, kingfishers, hornbills, hoopoes, bee-eaters, motmots, coraciidæ, and trogons).
23, Chenomorphæ (anatidæ, palamedeidæ).
24, Amphimorphæ (flamingoes).
25, Pelargomorphæ (storks, ardeidæ, plataleidæ, etc.).
26, Dysporomorphæ (cormorants, pelicans, tropic-birds, darters).

In 1873 and 1874 A. H. Garrod * based a classification of birds upon the consideration of the muscles of the thigh. He also made known those differences in the characters of the narial openings and nasal bones to which he applied the terms holorhinal and schizorhinal, and showed the importance of certain peculiarities in the arrangement of the deep plantar tendons. He also extended the researches on the trachea and tracheal muscles on the lines laid down by Müller. In his classification as based on the muscles of the thigh, the more important characters from a taxonomic point of view were considered to be the femoro-caudal muscle, the accessory femoro-caudal, the semitendinosus, and the accessory semitendinosus; but most important of all is the ambiens muscle; this arises from the tip of the short anteriorly directed spine, which is situated just above the anterior border of the acetabulum, and runs along the inner side of the thigh to the inner side of the knee, where it is covered by the sartorius, which is above it in the former part of its course. Its thin tendon then crosses the knee, running in the substance of the fascial extensor tendon, just in front of the patella, to the outer side, where it joins the fibers of the origin of the flexor perforatus digitorum. The presence or absence of this muscle determined Garrod to differentiate the class into two sub-classes. Those forms in which it is present were designated *Homologonatæ*, or typical kneed; while those in which it is absent were combined as *Anomalogonatæ*, or abnormally kneed. "There are," said Garrod, "peculiarities in the arrangement of the cæca of the intestine and of the tuft of feathers on the oil-gland which are correlatable with this presence or absence of the ambiens muscle." The secondary and tertiary groups of these sub-classes were distinguished by the combinations of the muscles already alluded to, and the presence or absence of cæca to the intestine, the development of a tufted or nude oil-gland, and the combinations in which those characters occur; and further, in the homologonatous birds, by the development of either a left or right carotid, or of both.

* *On Certain Muscles of Birds and their Value in Classification*, part ii. (in *Proc. Zoöl. Soc. London*, 1874, pp. 111–123).

The chief and apparently only merit of this arrangement is the generalized information respecting the muscles in question therein conveyed. The exceptions suggest the inadequacy of the combinations in question to serve as the expressions of the natural affinities of the various forms. Combined with other information, it will be of use in the construction of a more perfect system.

Other important characters used in classification are the number of the primaries, the arrangement of the wing coverts, the convolutions of the intestine and general character of the alimentary canal, the arrangement of the muscles of the upper arm, and resemblances or differences between the plumage of the young and adult. The importance of this last point seems to have been first recognized by Seebohm.

Numerous classifications of birds have been brought forward since 1880, but these have of necessity been based on the better use of known facts rather than founded on new discoveries. Among the most important are the systems of Dr. Leonhard Stejneger, Dr. Max Fürbringer, Dr. R. Bowdler Sharpe, Henry Seebohm, and Dr. H. Gadow. The first two are noteworthy for the fact that the primary divisions *Ratitæ* and *Carinatæ* are discarded, a step which seems a decided advance in classification, as the characters ascribed to the *Ratitæ* are very largely those due to a loss of the power of flight, and are not based on morphological facts. Dr. Stejneger employs Dr. Gill's convenient terms super-order and super-family to express degrees of group division. His system is based mainly on anatomical characters, although external characters are used as well. Omitting the families, Dr. Stejneger's scheme is as follows:

Sub-class I. Saururæ.
  Order I. Ornithopappi. (*Archæopteryx.*)
Sub-class II. Odontotormæ.
  Order I. Pteropappi. (*Ichthyornis*, etc.)
Sub-class III. Odontolcæ.
  Order I. Dromæopappi. (*Hesperornis.*)
Sub-class IV. Eurhipiduræ.
  Super-order I. Dromæognathæ.
    Order I. Struthiones.
      Super-family I. Struthioideæ.
      " II. Rheoideæ.
      " III. Casuaroideæ.
      " IV. Dinornithoideæ.
    Order II. Æpyornithes.
    Order III. Apteryges.
    Order IV. Crypturi.
  Super-order II. Impennes.
    Order V. Ptilopteri.
  Super-order III. Euornithes.
    Order VI. Cecomorphæ.
      Super-family I. Colymboideæ.
      " II. Heliornithoideæ.
      " III. Alcoideæ.
      " IV. Laroideæ.
      " V. Procellaroideæ.
    Order VII. Grallæ.
      Super-family VI. Chionoideæ.
      " VII. Scolopacoideæ.
      " VIII. Eurypygoideæ.
      " IX. Cariamoideæ.
      " X. Gruioideæ.
    Order VIII. Chenomorphæ.
      Super-family XI. Anhimoideæ.*
      " XII. Anatoideæ.
      " XIII. Phœnicopteroideæ.
    Order IX. Herodii.
      Super-family XIV. Ibidoideæ.
      " XV. Ardeoideæ.
    Order X. Steganopodes.
      Super-family XVI. Pelecanoideæ.
      " XVII. Fregatoideæ.
      " XVIII. Phaetontoideæ.
    Order XI. Opisthocomi.
    Order XII. Gallinæ.
      Sub-order I. Gallinæ Alectoropodes.
      " II. Gallinæ Peristeropodes.
    Order XIII. Pterocletes.
    Order XIV. Columbæ.
    Order XV. Accipitres.
    Order XVI. Psittaci.
    Order XVII. Picariæ.
      Super-family, Cuculoideæ.

* Equivalent to Palamedeæ of other authors.

Super-family, Coracoideæ.
" Colioideæ.
" Alcedinoideæ.
" Upupoideæ.
" Picoideæ
" Trogonoideæ.
" Micropodoideæ.
Order XVIII. Passeres.
Super-family, Menuroideæ.
" Eurylaimoideæ.
" Tyrannoideæ.
" Formicaroideæ.
" Passeroideæ.

Dr. Fürbringer's system is founded on anatomical characters, and he employs the term GENS in much the sense that Dr. Stejneger uses super-family, while his sub-orders have about the same value as Dr. Stejneger's orders. The arrangement is as follows:

Sub-classis I. SAURURÆ.
Order Archornithes.
Sub-order Archæopterygiformes.
Gens Archæopteryges.
Sub-classis II. ORNITHURÆ.
Order Struthiornithes.
Sub-order Struthioniformes.
Gens Struthiones.
Order Rheornithes.
Sub-order Rheiformes.
Gens Rheæ.
Order Hippalectryornithes.
Sub-order Casuariiformes.
Gens Casuarii.
Intermediate sub-order Æpyornithiformes.
Gens Æpyornithes.
Intermediate sub-order Palamedeiformes.
Gens Palamedeæ.
Order Pelargonithes.
Sub-order Anseriformes.
Gens Gastornithes.
" Anseres.
Sub-order Podicipitiformes.
Gens Enaliornithes.
" Hesperornithes.
" Colymbo-Podicipites.
Sub-order Ciconiiformes.
Gens Phœnicopteri.
" Pelargo-Herodii.
" Accipitres.
" Stegnanopodes.
Intermediate sub-order Procellariformes.
Gens Procellariæ.
Intermediate sub-order Aptenodytiformes.
Gens Aptenodytes.
Intermediate sub-order Ichthyornithiformes.
Gens Ichthyornithes.
Order Charadriornithes.
Sub-order Charadriiformes.
Gens Laro-Limicolæ.
" Parræ.
" Otidides.
Intermediate sub-order Gruiformes.
Gens Eurypygæ.
" Grues.
Intermediate sub-order Ralliformes.
Gens Fulicariæ.
" Hemipodii.
Order Alectorornithes.
Sub-order Apterygiformes.
Gens Apteryges.
Sub-order Crypturiformes.
Gens Crypturi.
Sub-order Galliformes.
Gens Galli.
" Opisthoco.
Intermediate sub-order Columbiformes.
Gens Pterocletes.
" Columbæ.
Intermediate sub-order Psittaciformes.
Gens Psittaci.
Order Coracornithes.
Sub-order Coccygiformes.
Gens Coccyges.
Intermediate gens Galbulæ.
Sub-order Pico-Passeriformes.
Gens Pico-Passeres.
" Makrochires.
" Colii.
Intermediate gens Trogones.
Sub-order Halcyoniformes.
Gens Halcyones.
" Bucerotes.
" Meropes.
Intermediate gens Todi.
Sub-order Coraciiformes.
Gens Coraciæ.
" Caprimulgi.
" Striges.

Realizing the fact that no correct idea of the relationships of animals can be given by arranging them in a continuous line, Dr. Fürbringer has carefully elaborated the idea of a genealogical tree. He gives views of this ideal tree from two sides, and also gives cross-sections which illustrate very clearly his ideas regarding the line of descent and affinities of various groups. While the *Passeres* do not stand first in Dr. Fürbringer's tables, they form the topmost twig of his genealogical tree.

In reviewing the various classifications of birds, the two facts which stand out most prominently are the gradual abandonment of external for anatomical characters, and the advancement of the perching birds from a subordinate to the leading position. The earlier systems are based wholly on external, the more recent almost as entirely on internal characters, and while the idea held by Linnæus, that the *Accipitres*, or birds of prey, stood at the head of the class Aves, prevailed for a long time, it is now generally agreed that the *Oscines*, or singing birds, stand first, and among these the place of honor is variously assigned to the thrushes, crows, or sparrows. Incidentally it may be said that while the old plan in tabulating groups was to begin at the top and work downward, the modern method is to begin at the bottom and go upward, and that Lillejeborg, in the year 1866, was almost the first to publish a system arranged in this manner.

From what has been said in this article, it will be observed that the classification of birds is an extremely difficult problem, and, furthermore, that it is one whose satisfactory solution is still far from reached. It is, however, very evident that it is the resultant of many characters, rather than the use of any one or two, no matter how salient these may be, which must be relied upon for determining relationships and differences, and it will require the patient accumulation of detailed information on many points to set matters straight.

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* Titles preceded by an asterisk contain many bibliographical references.

rica.—*The Birds of South Africa*, by E. L. Layard (edited by R. B. Sharpe, London, 1875–84); *Die Vögel Ost Afrikas*, by Finsch and Hartlaub (Leipzig and Heidelberg, 1870); *Ornithologie d'Angola*, by du Bocage (Lisbon, 1877); Shelley's *Handbook to the Birds of Egypt* (London, 1872). 4. Australasia.—Gould's *Handbook to the Birds of Australia* (London, 1865); Buller's *History of the Birds of New Zealand* (London, 1887–88), and *Manual of the Birds of New Zealand* (Wellington, New Zealand, 1882); *Ornithologia della Papuasia e delle Molluche*, by Salvadori (Turin, 1880–81). 5. South America.—*Systematische Uebersicht der Thiere Brasiliens*, by C. H. Burmeister (Berlin, 1855–56); *Ornithologie du Perou*, by Ladislaus Tacanowski (Rennes, 1884–86); *Argentine Ornithology*, by Hudson (London, 1888–89). 6. North America.—*The Birds of America*, by Audubon (New York, 1828–30); *The Birds of North America*, by Baird, Cassin, and Lawrence (Philadelphia, 1860; reprint with additions from Pacific R. R. Report, Salem, 1870); *A History of North American Birds*, by Baird, Brewer, and Ridgeway (Boston, 1874–84); *Biologia Centrali Americana*, by Salvin and Godman (London, 1879–87); Ridgeway's *Manual of North American Birds* (Philadelphia, 1887); Coues's *Key to North American Birds* (4th ed. Boston, 1892).

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THEODORE GILL.
Revised by F. A. LUCAS.

Ornithorhyn'chidæ [Mod Lat., named from *Ornithorhyn'chus*, the typical genus; ὄρνις, ὄρνιθος, bird + ῥύγχος, snout, beak]: one of the two families representing the order *Monotremata* and sub-class *Ornithodelphia*, and including the DUCKBILL (*q. v.*) or "water-mole" of Australia. The general form of the body is somewhat beaver-like; the covering is a dense and soft fur; the jaws are produced into a depressed bill-like snout resembling somewhat (but only superficially) the bill of a duck; the nostrils are above and near the end of the bill; no external ears are developed; there are eight horny teeth—i. e. each jaw is provided on each side behind with a broad and nearly oval tooth with a flattened crown adapted for grinding, and toward the front it has a long and narrow one; the tongue is short, and covered, to some extent, with horny papillæ; the legs are short; the feet well adapted for swimming, and each provided with five toes; the anterior ones have a web extending considerably beyond the toes, and the claws are depressed; the posterior feet have webs only between the toes, and the claws are curved; in the male a spur is developed on the hinder surface of each hind leg, which has no representative in the female; the tail is rather short, depressed, and quite broad. These are the characters which at once superficially distinguish the *Ornithorhynchidæ* from the *Tachyglossidæ*, but in addition to these are numerous anatomical characters. The family is peculiar to Australia, and is represented by but a single genus containing but one certainly known species, which, however, exhibits differences which have caused a distinction, by some authors, of two species. The species was first made known in 1799 by Shaw, under the name of *Platypus anatinus*, and in the following year by Blumenbach under that of *Ornithorhynchus paradoxus*; the name *Platypus* having been previously used in ornithology, that of *Ornithorhynchus* has been almost universally retained. The specimen which first served for description was supposed by some to be a made-up specimen composed of the bill of some unknown duck-like bird and the body of a mammal. The fact that the animal is oviparous was not established until 1884.

Ornithorhynchus: See ORNITHORHYNCHIDÆ and DUCKBILL.

O'ro: a southwestern province of Ecuador; on the Gulf of Guayaquil, adjoining Peru; area, 2,340 sq. miles. It lies entirely in the lowlands adjoining the coast, and the climate is hot and in parts unhealthful. Cacao-raising is the principal industry. The capital and largest town is Machala, on the river Santa Rosa, near its mouth. Pop. of Oro (1885) estimated, 32,600.

H. H. S.

Or'odus [Mod. Lat.; Gr. ὄρος, mountain + ὀδούς, tooth]: a genus of cestraciont sharks of which the remains are found in the Carboniferous rocks. The teeth have their crowns set with a series of blunt but frequently highly ornamented cones. The spines called *Ctenacanthus* probably belonged to the same fish. Some of the species of *Orodus* must have been of immense size, as the teeth, of which the number was large, are occasionally found 4 to 5 inches broad and very massive.

Orono: town (settled in 1774, incorporated in 1806); Penobscot co., Me. (for location, see map of Maine, ref. 6–E); on the Penobscot river, and the Maine Cent. Railroad; 8 miles N. of Bangor. It is the seat of the MAINE STATE COLLEGE (*q. v.*), and has paper, pulp, and lumber mills, iron-foundries, machine-shops, a savings-bank, and a monthly college paper. Pop. (1890) 2,790; (1900) 3,257.

EDITOR OF "CADET."

Oron'tes (in Gr. Ὀρόντης and Ὀρόντας): 1. A Persian general, put to death by Cyrus for treason (Xen., *Anabasis*, i., 6). 2. A Persian general, satrap of Armenia and son-in-law of Artaxerxes II. Mnemon. His immediate family reigned as satraps of Armenia and kings of Commagène from the times of Darius Hystaspis to those of Trajan, or for about seven centuries. See Humann and Puchstein, *Reisen in Klein-Asien und Nord-Syrien* (Berlin, 1890, pp. 283–286), and *American Journal of Archæology* (1890, p. 534). J. R. S. S.

Orontes [= Lat. = Gr. Ὀρόντης], or **Nahr-el-Asi** (the rebellious river): the principal river of Syria. 240 miles long, but not navigable. It rises in the Anti-Lebanon, proceeds northerly 200 miles, then turning abruptly S. W. flows close to Antioch (Antakia) through a picturesque country, and enters the Mediterranean 29 miles S. of Iscanderoon. It was originally called Typhon from a mythical dragon who was said to have traced its course with his tail, but received its later name from Orontes, who built a bridge over it. The neighboring country was often called by the same name. Not far from its source is a peculiar square monument terminating in a pyramid about 65 feet high. Grotesque hunting scenes are carved in relief on the four sides. This monument is connected with the garden or hunting-park mentioned by Strabo as being near the source.

E. A. GROSVENOR.

Oroomiah: See URUMIA.

Oro'sius, PAULUS: historian; b. in Spain, probably at Tarragona, toward the end of the fourth century A. D.: took orders, and engaged with zeal in the controversies of his time. Having by direction of his bishop visited Africa to confer with St. Augustine, he was sent by the latter to Palestine, where Pelagius was spreading his heresies. In Bethlehem he made the friendship of Jerome. At a synod held at Jerusalem he opposed Pelagius, and in so doing provoked the hostility of John, the Bishop of Jerusalem. Orosius wrote in justification of himself in 415 a work entitled *Liber Apologeticus* (*contra Pelagium*) *de Arbitrii Libertate*. He returned to Africa, and probably to Spain, and after his return composed, at the request of his friend Augustine, or completed, his *Historiæ* (*adversus Paganos*), a history of the world, in seven books, from the beginning of the world to A. D. 417, designed to meet the assertions of pagan writers that the calamities of Rome, especially the capture of the city (A. D., 410), were chargeable to Christianity for having abolished the worship of the old heathen gods. The date of Orosius's death is not known. The best edition is by C. Zangemeister (Vienna, 1882; ed. minor, Leipzig, 1889). King Alfred translated the history of Orosius into Anglo-Saxon, which has been edited with an English translation by Dr. Bosworth (London, 1856), and by H. Sweet (1883) with the Latin text. Another work of Orosius, entitled *Commonitorium ad Augustinum de Priscillianistis et de Origenis errore*, is printed in Schepss's edition of Priscillian (Vienna, 1889). See Teuffel's *Hist. Rom. Lit.*, § 455; Mörner, *De Orosii Vita eiusque Historiarum Libris Septem* (Berlin, 1844).

Revised by M. WARREN.

Oroz'co y Ber'ra, MANUEL: author and publicist; b. at Mexico city, June 8, 1816. He studied topographical engineering and subsequently law, and was admitted to the bar in 1847. In 1852 he was appointed director of the national archives; he was twice secretary of public works under the liberal governments; and in 1863 he became associate judge of the Supreme Court. Having accepted office under Maximilian, he was imprisoned on the return of Juarez in 1867, but was soon pardoned. His works on Mexican history and ethnology are widely and favorably known; they include *Geografía de las lenguas y carta etnográfica de*

México (1864); *Historia de México* (1880–81), etc. He edited the Mexican supplement of the *Diccionario universal de historia y geografía*. D. at Mexico, Jan. 27, 1881.

HERBERT H. SMITH.

Or'pheus, ōr'fyus, or ōr'fĕĕ-ŭs (in Gr. 'Ορφεύς): a mythical singer of Thrace, son of Oeagrus by the muse Calliope, and husband of the nymph EURYDICE (*q. v.*). The charm of his song and lyre-playing was so great that even wild animals, trees, and rocks followed him. When Eurydice died of a snake's bite he descended to Hades to bring her back, and moved even Persephone to grant his request, conditionally. He was a member of the Argonautic expedition, and wrought various wonders in behalf of his comrades. He was torn to pieces by Thracian bacchantes, either because he was opposed to their orgies or because, after the death of Eurydice, he hated all women. His dismembered body was buried by the Muses of Pieria on Mt. Olympus, but his head and lyre floated across the sea to Methymna in Lesbos, the island of song. Aristotle (Cicero, *De natura deorum*, i., 38) denied the very existence of Orpheus, but ancient critics had early disputed the genuineness of the *poems* ascribed to Orpheus. The poems that have been preserved to us under his name are Αργοναυτικά (1,394 hexameters), being a glorification of the deeds of Orpheus on the Argo; Λιθικά (768 verses), in which the magical powers of certain precious stones are described; eighty-eight *Hymns* in honor of various gods. These poems were written by members of the ORPHIC BROTHERHOOD (*q. v.*), which was powerful even in the time of Pisistratus and continued to exist for some time after the Christian era. A number of other poems belonging to different periods, such as the Θεογονία, Ἱεροὶ λόγοι, Κατάβασις ἐς Ἄιδου, etc. (for a list of them, see Christ, *Griechische Litteraturgeschichte*, pp. 658–659), were ascribed to Orpheus, but some of them, for varying reasons, must be assigned even to the second century after Christ. See Hermann, *Orphica* (Leipzig, 1805); Tyrwhitt, *Lithica* (London, 1781); Abel, *Orphica* (1885); Abel, *Orphei Lithica* (Berlin, 1881); Buresch, *Klaros* (Leipzig, 1890); Lobeck, *Aglaophamus* (1829); Schuster, *De veteris Orphicæ theogoniæ indole* (Leipzig, 1869); Kern, *De Orphei Epimenidis Pherecydis theogoniis* (Berlin, 1888). For a discussion of Orpheus in works of art, see the article *Orpheus* in Baumeister's *Denkmäler*, and for a discussion of the Orphic cult, see Gruppe, *Die Griechischen Culte und Mythen* (Leipzig, 1887, i., 612–674. J. R. S. STERRETT.

Orphic Brotherhood (in Gr. *οἱ 'Ορφικοί*): in ancient Greece, a society of ascetic persons who devoted themselves to a mystical worship of the Thracian Bacchus (Dionysus-Zagreus) and the elaboration of a system of theology, under the professed guidance of the spirit of ORPHEUS (*q. v.*). They dressed in white, ate no animal food, avoided all excesses, and professed to aim at purity of life, an exalted religious experience, and an immortal existence after death. See Gruppe, *Die Griechischen Culte und Mythen* (Leipzig, 1887, i., 612–674), where the literature on the subject will be found cited. J. R. S. STERRETT.

Orpiment, or **King's Yellow** [*or'piment* is viâ O. Fr. from Lat. *auripigmen'tum*, liter., pigment of gold; *au'ri*, genit. of *au'rum*, gold + *pigmentum*, coloring, pigment, deriv. of *pin'gere*, draw, paint, color]: a sulphide of arsenic of the composition As_2S_3. It may be prepared artificially by precipitating a solution of arsenic with sulphuretted hydrogen gas, and by fusing together equal parts of white arsenious acid and sulphur. It is stated on good authority that, when entirely *free from arsenious acid*, orpiment is not poisonous when swallowed, owing to its insolubility even in acids. As, however, it is easily soluble in alkalies, it is a dangerous material, and should be banished from common use as a pigment by those unfamiliar with its nature. It was formerly employed, in admixture with lime, as a depilatory, and in another dangerous way is used as an ingredient in fireworks. Revised by IRA REMSEN.

Orr, JAMES, D. D.: clergyman and professor; b. at Glasgow, Scotland, Apr. 11, 1844; was educated at the University of Glasgow; minister at East Bank United Presbyterian church of Hawick 1873–91; first lecturer on the Kerr foundation, United Presbyterian Hall, Edinburgh, 1891; delegate to the Pan-Presbyterian Council at Toronto 1892; since 1891 has been Professor of Church History in the United Presbyterian College of Edinburgh. He has written numerous articles for periodicals, such as *Assyrian and Hebrew Chronology* in *The Presbyterian Review* (1888), and the homiletical sections in the volumes of the *Pulpit Commentary* on Exodus, Deuteronomy, 2 Kings, and Hosea. He has published the Kerr Lectures for 1891; *The Christian View of God and the World as Centering in the Incarnation* (Edinburgh, 1893); and with Principal Rainy and Prof. Dods, *The Supernatural in Christianity* (Edinburgh, 1894).

C. K. HOYT.

Orr, JAMES LAWRENCE: jurist and Congressman; b. at Craytonville, S. C., May, 12, 1822; graduated at the University of Virginia 1842; was admitted to the bar and practiced in Anderson, S. C.; member of the Legislature 1844–45; member of Congress 1848–59, and Speaker of the Thirty-fifth Congress; in 1860 was one of the convention that inaugurated secession, and was a State commissioner to Washington to treat with the U. S. Government for partition of property in South Carolina; Confederate State Senator 1862–65. He was provisional Governor of South Carolina 1865–69; was appointed judge of the circuit court of South Carolina 1870, and in 1873 U. S. minister to Russia. D. in St. Petersburg, May 5, 1873.

Or'rery [named in honor of the Earl of Orrery]: a machine constructed to exhibit the motions of the planets round the sun, or of satellites round their primary. Planetary machines (that is, machines exhibiting the motions of the planets) constructed in accordance with the idea that the earth was the center of motion were very early in use. Such were the Chinese spheres, said to have been made some 2,000 years before the Christian era, and later the spheres of Archimedes and Posidonius. It is thought that the earliest machine representing the Ptolemaic system was that of Chromatus. This system continued to be represented in all planetary machines until about fifty years after the death of Copernicus, when the last of the kind of any note was erected in the library of the Pantheon at Paris by Orone Finnée. Machines intended to represent the Copernican system were invented in the latter part of the seventeenth century by Huyghens and Römer, Huyghens introducing a method of calculating the wheelwork with precision. Then Römer invented a planetarium, and also a satellite-machine. The orrery made by Rowley in 1715 at the expense of Charles Boyle, Earl of Orrery, was a combination of the planetarium of the sixteenth century with other machines which showed the motions of the earth, moon, and planetary satellites.

Perhaps the most perfect of orreries were two invented and constructed by David Rittenhouse, LL. D., one of which is in possession of the College of New Jersey. The date on the face of the instrument is 1768. It is fitted for exhibiting continually the motions of the moon, as well as those of the earth and other principal planets to Saturn inclusive, then the outermost known. It is furnished with dial-plate arrangements for the current month and the day of the month, as well as the passing year, and the successive positions, at the dates thus recorded, of the bodies already specified, and the years of cycles; the whole kept in motion by a clockwork attachment. The orbits of the moon and of the planets are all elliptical, and the surrounding graduated circular ring, representing the arrangement of the twelve signs, has a rackwork and a screw of slow motion attached, by which even the precession of the equinoxes is allowed for.

Though it is impossible to construct a machine which will represent the motions of planets and satellites accurately, an orrery is useful in giving a general notion of the way in which they take place. Revised by R. A. ROBERTS.

Orris Root: See IRIS.

Orrville: village; Wayne co., O. (for location, see map of Ohio, ref. 3–G); on the Cleve., Akron and Col., the Penn., the Pitts. and W., and the Wheeling and Lake Erie railways; 14 miles W. N. W. of Massillon, 54 miles S. of Cleveland. It is in an agricultural and stock-raising region, is an important shipping-point, and has a private bank and a weekly newspaper. Pop. (1880) 1,441; (1890) 1,765; (1900) 1,901.

Or'say, ALFRED GUILLAUME GABRIEL, Count d': society leader; b. in Paris, France, Sept. 4, 1801; served in the French army; married in 1827 a daughter of the Earl of Blessington by his first wife; was separated from her 1829; lived thenceforth chiefly in London, where he was regarded as a model of elegance and courtliness; was the most conspicuous member of the social circle at Gore House; was for many years a constant companion of Lady Blessington; was distinguished for his handsome person, fascinating powers of conversation, and artistic skill; became director of fine arts at Paris under Louis Napoleon. D. in Paris, Aug. 4, 1852.

Orsi'ni; a wealthy Roman family of princely rank; belonged to the party of the Guelphs, and became very conspicuous in the history of Rome during the Middle Ages by its perpetual feuds with the family of the Colonnas, which belonged to the Ghibelline party. It spread very widely, acquired immense possessions, and its power culminated in the latter part of the thirteenth century, when one of its members became pope under the name of Nicholas III. (1277–81). Another member of the family became pope under the name of Benedict XIII. (1724–30). The family-seat is still at Rome, where the Orsini palace stands on the spot where formerly stood the theater of Marcellus.

Orsini, Felice: conspirator; b. in 1819 at Meldola, in the province of Forlì, Italy, at that time a part of the papal states; joined Mazzini's Young Italy Society in 1838; was imprisoned and condemned to the galleys for life, but restored to liberty in 1846 by the amnesty of Pius IX.; acted as a deputy for Bologna in the constituent assembly at Rome in 1849, and after the fall of the Roman republic was an agitator in Genoa and Modena; fled in 1853 to England, but reappeared in 1854 in Italy, agitating in Parma, Milan, Trieste; was captured at Vienna and put in the fortress of Mantua, but escaped to England in 1856. He repaired in 1857 to Paris, having formed a conspiracy with three others, Pieri, Rudio, and Gomez, for the assassination of Napoleon III., on whom vengeance was to be taken for his desertion of the principles of the Carbonari, into whose organization Napoleon had been admitted in 1831. On Jan. 14, 1858, Orsini, with his accomplices, threw three explosive bombs under the carriage of the emperor in the Rue Lepelletier, killing eight persons and wounding over a hundred. He was tried and sentenced to the guillotine. While in prison he wrote two letters to the emperor calling upon him to free Italy from her oppressors. These, which were published in the French papers, served to direct popular attention to Italian affairs, and Napoleon's policy in 1859 was along the lines advised by Orsini. The latter was guillotined Mar. 13, 1858. His autobiography was translated into English by G. Carbonel (Edinburgh, 1857).

Orsova, ōr'shō-vaă: Hungarian frontier town on the Danube; consisting of Alt (Old) Orsova and Neu (New) Orsova; the latter, a strongly fortified island which commands the Roumanian and Servian frontier, was ceded by Turkey in 1878 (see map of Austria-Hungary, ref. 9–J). Equidistant between the Iron Gates, it is the center of the grandest Danubian scenery. Pop. (1891) 3,381. E. A. G.

Orte'lius, Abraham: geographer; b. at Antwerp, Apr. 4, 1527. He was wealthy, traveled in England, France, Germany, and Italy, and had a wide acquaintance with the geographers of his time. In 1570 he published his *Theatrum orbis terrarum*, a collection of maps with short descriptions of the various countries in Latin. This was long a standard geographical authority in Europe, and there are various editions in Latin, French, and German. Several of the maps are of great interest for the early cartography of America. Ortelius published other geographical works, and he amassed a museum of coins, antiquities, etc. He was appointed royal geographer by Philip II. in 1575. D. at Antwerp, Jan., 1598. Herbert H. Smith.

Orth, Johannes, M. D.: pathologist; b. at Wallmerod, Nassau, Germany, Jan. 14, 1847; studied medicine at the Universities of Bonn, under Rindfleisch, and Berlin, under Virchow, graduating M. D. from the former in 1870; in 1878 was elected Professor of Pathology and Pathological Anatomy in the University of Göttingen. His most important works are *Compendium der pathologisch-anatomischen Diagnostik* (Berlin, 1876; 5th ed. 1893); *Cursus der normalen Histologie* (1878; 5th ed. 1888); *Lehrbuch der speciellen pathologischen Anatomie* (1887). S. T. Armstrong.

Orthacan'thus [Mod. Lat.; Gr. *ὀρθός*, straight, erect + *ἄκανθα*, spine]: a name given to certain defensive spines of sharks found in the coal-measures. They are slender and acute, but not always straight, though the name indicates this, and are ornamented with two rows of sharp, depressed hooks on the posterior face. They probably belong to the shark of which the teeth have been named *Diplodus*.

Orthagoris'cidæ [Mod. Lat., named from *Orthagoris'cus*, the typical genus, from Gr. *ὀρθαγορίσκος*, sucking pig]: a family of plectognath fishes, distinguished from all other fishes by the peculiar truncation of the posterior region of the body. The form varies, being either oblong or higher than long, but in all ends abruptly behind, and is entirely destitute of anything like a tail or caudal peduncle; the abdomen is never distensible by air, as in the swell-fishes; the skin is rough or covered with hexagonal plates; the head externally inseparable from the body, and with all the bones covered by the integument; mouth terminal, small; the jaws, both upper and lower, developed into cutting ridges, and each destitute of a median suture; branchial apertures very small, slits in front of the pectoral fins; dorsal and anal fins far back, opposite each other, and developed alike, higher than long, and united with the caudal fin when present; pectorals well developed; ventrals entirely wanting. The skeleton is peculiar for the small number of caudal vertebræ, there being less than twenty, and in the adult of *Mola* there are ten abdominal and about eight caudal; no pelvic bones are developed; the air-bladder is absent; many other peculiarities are observable in the anatomy. The family is represented by two genera: *Mola* and *Orthagoriscus*. The species attain a large size, *Mola* sometimes weighing as much as 800 lb. Revised by D. S. Jordan.

Or'thidæ [Mod. Lat., named from *Or'this*, the typical genus, from Gr. *ὀρθός*, straight]: a family of extinct brachiopods abundantly represented in Palæozoic rocks. An elaborate analysis and description of the various genera of this group of fossils is contained in the eighth volume of the *Palæontology of New York State*.

Orthocerat'idæ [Mod. Lat., named from *Ortho'ceras*, the typical genus; Gr. *ὀρθός*, straight + *κέρας*, *κέρατος*, horn]: a family name under which are combined a varying number of genera belonging to the class of Cephalopods, order of Tetrabranchiates, and sub-order *Nautiloidea*. All have a shell furnished with numerous chambers, which extend across the axis of the shell; the septal margins are simple and the funnel-like throat more or less sub-central and directed backward; they differ, however, in other respects. In the typical forms (*Orthoceras*, etc.) the shell is straight and the aperture simple: to this, by some authors, the family is restricted; others (*Cyrtoceras*) have the shell curved, but the aperture simple; others, again (*Gomphoceras*), have the shell straight, but a heterogeneous aperture; others still (*Phragmoceras*) have the shell curved, and the aperture is heterogeneous. The species are numerous, and lived from the Lower Silurian up to the Liassic epoch. They sometimes attained a large size. A species of Endoceras, 15 feet long, has been described from the Trenton limestone. Revised by H. S. Williams.

Orthoëpy: See Pronunciation.

Orthognathous: See Face.

Orthog'raphy [viâ O. Fr. from Lat. *orthogra'phia* = Gr. *ὀρθογραφία*, correct writing, deriv. of *ὀρθόγραφος*, writing correctly; *ὀρθός*, straight, correct + *γράφειν*, write]: the art of conventionally correct spelling, or of writing words according to a conventional standard of usage. The necessity for such an art commonly arises only in languages which have developed a standard literary type, compromising or repressing dialectal diversities of the same period, and to some extent also absorbing historical varieties of successive periods. When a language is first reduced to writing its spelling is approximately phonetic, at least so far as the available alphabet will permit. In the early Greek inscriptions, for example, each of a score or more of local communities speaking diverse dialects has recorded its language in a rude phonetic spelling. They simply used the alphabetic symbols in their received value, making with them as well as they might a record of words as they sounded when spoken. In the fourth century B. C. the Bœotians adopted from Athens the Ionic alphabet, but not an orthography, for they simply proceeded to apply the symbols in the value they had at Athens to the respelling of their *spoken* language. Only four or five of the Greek dialects became the receptacles of literary records. These began therewith to show some tendency toward the establishment of a standard form of spelling, but not until the Attic dialect in the form of the *koinè* began to assert its pre-eminence as a universal Greek literary medium did a sense for a standard Greek orthography manifest itself. This standard, which, following the manuscripts, we now use for all the monuments of Attic Greek literature, and which has even extended itself in large measure to the Modern Greek, represents essentially the pronunciation of the fourth century B. C.

The experience of Greece illustrates the general principle. The necessity for an orthography is dictated (1) by the existence of dialects within the domain covered by a litera-

ture, and (2) by the accumulation of books which give an historical continuity to a literature even over periods in which the spoken language has suffered change.

The English orthography presents the most extreme illustration of divorcement of the written from the spoken form of language. The spelling forms no certain guide to the sound of a word. The word and not the letter is the unit. The appeal is to the eye, not the ear. In acquiring the written language, one must practically learn each word by itself. How inconsistently the alphabetic symbols are used may be judged from a few illustrations. The voiceless lingual sibilant *š* is variously denoted by *sh* in *shine*, *si* in *pension*, *s* in *sugar*, *sensual*, *ss* in *issue*, *sci* in *conscious*, *ti* in *nation*, *ci* in *social*, *ce* in *ocean*, *ch* in *charade*, *chivalry*, *machine*. The combination *si* denotes the voiced sibilant *ž* in *vision*, *occasion*, etc., as does also *s* in *usual*, *pleasure*, etc. The voiced dental sibilant *z* is denoted by *z* in *zeal*, *zz* in *buzz*, *s* in *easy*, *lands*, *ss* in *scissors*, *sc* in *discern*, *c* in *sacrifice* (verb), *x* in *Xerxes*. The voiceless guttural explosive *k* is variously denoted by *k* in *book*, *ck* in *duck*, *c* in *music*, *cc* in *accuse*, *ch* in *chord*, *q* in *queen*, *qu* in *liquor*. The high-front vowel *ī* (*ii*) is represented by *e* in *me*, *ee* in *see*, *ea* in *sea*, *ie* in *piece*, *ei* in *conceit*, *ey* in *key*, *eo* in *people*, *ay* in *quay*, *i* in *marine*, *æ* in *Cæsar*. The combination *ough* denotes *ŏf* in *cough*, *trough*, *ou* in *though*, *dough*, *ŭf* in *enough*, *au* in *plough*. Words of like sound are often widely apart in spelling; as *cite*, *site*, *sight*; *draft*, *draught*; *bored*, *board*; *air*, *heir*; *base*, *bass*. Words of different sound are sometimes spelled alike; as *read* (pres.), *read* (pret.); *abuse* (noun), *abuse* (verb.); *close* (adjec.), *close* (verb); *record* (noun), *record* (verb), etc.

Prior to the sixteenth century the spelling of English, though not self-consistent, owing in general to the diversity in the sources of the language, and especially to the perverting influence of French methods of spelling, was still quasi-phonetic; i. e. though it did not always represent the same sound by the same symbol, it undertook to represent the spoken word. The appearance, however, in this (sixteenth) century of an abundant literature, coincident with the development of printing, tended to fix the spelling and remove it from subservience to sound. Since this time English spelling has remained in its essential features unchanged, though the pronunciation has meantime, especially in the vowel system, suffered radical change. Our present orthography may therefore be roughly said to represent nineteenth century words by means of symbols which, though by no means used with the simplicity or self-consistency of phonetic spelling, really stand for sixteenth century sounds. At that time the vowel-symbols were used essentially in their "continental" values. We now write the phonetic word *naym* (*name*) with *a*, because it was pronounced *naam* in the sixteenth century, and write *mile* with *i*, because it was then pronounced *meel*. We write the word *see*, on the one hand, as *sea*, commemorating its former pronunciation with the open *ay*-sound (indicated phonetically as *æ*), and on the other as *see*, as a record of the older close *ay*-sound (indicated phonetically as *ē*). The two words were distinct in Shakspeare's time.

In the latter part of the sixteenth century appeared the first treatises on orthography: Sir Thomas Smith, *De recta et emendata linguæ anglicæ scriptione dialogus* (Paris, 1568); John Hart, *An Orthographie, conteyning the due order and reason howe to write or printe thimage of mannes voice, most like to the life or nature* (London, 1569); William Bullokars, *Booke at large for the Amendment of Orthographie* (1580); Richard Mulcaster, *The First Part of the Elementarie which entreateth chefelie of the right writing of the English tung* (London, 1582).

The influence of printing tended to the gradual development of an orthographical uniformity which was practically established in its present existing form by the beginning of the eighteenth century. The appearance of dictionaries (Bailey's, 1721; Johnson's, 1755) and the use of spelling-books in the schools further developed this sense for uniformity into the present extraordinary orthographical prudery, which often treats false spelling as a mark of vulgarity, if not of mental inferiority. The following examples of diverse spellings current between 1600 and 1800 may serve to illustrate how late an achievement our present orthodoxy is: *arithmetic*, *arithmetike*, *arithmetique*, *arithmatick*, *arithmaticke*, *arithmetick*; *beauty*, *beawtye*, *bewtie*, *bewtye*, *beautie*, *beuty*; *engineer*, *engenier*, *ingenier*, *ingenicr*, *engenir*, *ingeneer*, *inginier*, *ingineer*; *bailiff*, *bailliff*, *bailiffe*, *baliffe*, *balyfe*, *balyve*, *baylyff*, *bailiefe*, *baylife*, *bayliffe*, *bailive*, *bayllive*, *bayliff*; *curb*, *courbe*, *kurbc*, *kerbe*, *kirb*, *kerb*. There still remains a slight residue of words for which an authoritative spelling has not been established; thus notably in the case of loan-words from languages not using the Roman alphabet, as *Brahmin*, *Brahman*; *attar*, *ottar*; *baksheesh*, *bakhshish*; also in the case of dialectal words which have but recently appeared in literature, as *bletherskate*, *blatherskite*; and in certain derivatives, as *abridg(e)ment*, *judg(e)ment*, *blam(e)able*, *civilize* (*-ise*), *inflection* (*-xion*), *worship(p)er*, *travel(l)er*, *mileage* (*milage*), *mov(e)able*, *sal(e)able*, *wool(l)en*, etc.; also individual cases like *ambassador* (*em-*), *briar* (*brier*), *brazier* (*brasier*), *offence* (*offense*), *dispatch* (*des-*), *inquire* (*en-*), *centre* (*-er*), *theatre* (*-er*), etc. See list in Webster's *International Dictionary*, pp. xciii. ff., and the rules for spelling, pp. xc. ff.

English spelling is neither phonetic nor etymological, but merely conventional. Attempts to reform it in the interest of etymology, and especially in conformity to Greek and Latin etyma, have been frequent since the revival of learning, but they have helped little and hindered much. Thus the addition of a *b* in *debt* and *doubt* (M. Eng. *dette*, *doute*) serves to suggest Lat. *debita* and *dubitare*, but is perfectly gratuitous and unhistorical, for both words came into English without either the sound or the letter. In a case like *fault* for *faute* or *arctic* for *artic* (O. Fr. *artique*), the introduction of the letter in spelling has resulted in perverting the pronunciation. Often the etymology suggested by the revised spelling is entirely false. Thus the *g* in *sovereign* (older *soverayne*, M. Eng. *soverain*, representing a Latin *supera'nus*) falsely suggests *reign*; as the *sc* of scissors (M. Eng. *sisoures*) does Lat. *scissus*, cut. The *s* of *island* (M. Eng. *iland*) is a deception, as *island* and *isle* are not related etymologically; so the *u* of *guest*, which is a Teutonic, not a French word, the *w* of *whole* (earlier *hole*), *whoop* (M. Eng. *houpen*), which is not etymological, and the *gh* of *delight* (M. Eng. *delit*), which imitates cases like *night*, *right*, where *gh* has etymological value. The *ue* of *tongue* (older *tung*; cf. Germ. *zunge*) sadly disfigures a genuine English word in a possible deference to *langue*, and the plain Eng. *rime* (O. Eng. *rīm*) is even ludicrous masquerading in Greek toggery as *rhyme*. Much of this pseudo-etymological spelling is merely a decorative rococo.

Various attempts have also been made to reform the spelling upon a purely phonetic basis. See F. A. March, *The Spelling Reform*, Circular of Information of U. S. Bureau of Education (1880), No. 7; Skeat, *Principles of English Etymology*, i., ch. xvii. While radical changes in our present system are scarcely to be expected, especially such changes as involve a restoration of the "continental" values of the vowel-signs, or in other ways involve a violent break with the older recorded form of the language, it is not unlikely that a consideration for the spoken form of words will gradually tend to the simplification of our spelling and the elimination of some of its grosser inconsistencies.

BENJ. IDE WHEELER.

Orthometric Systems: See CRYSTALLOGRAPHY.

Orthopædic Surgery [*orthopædic* is from Gr. *ὀρθός*, straight + *παίς*, *παιδός*, child]: that branch of general surgery which relates to the prevention and treatment, both by surgical and mechanical measures, of the various deformities and malformations of the human body, particularly such deformities as pertain to the osseous and muscular structures. In some countries deformities and malformations of the soft parts, as harelip, cleft palate, hypospadias, etc., are classified under this heading; but in the U. S. these are ordinarily grouped under plastic surgery.

There is no sharply drawn line between general and orthopædic surgery; nor is the division between orthopædic and nervous diseases with paralysis a distinct one, since there is an overlapping in both directions. The term orthopraxy (from Gr. *ὀρθός*, straight + *πράσσειν*, to do, act), is also occasionally employed. By the term deformity is meant any marked deviation from the normal symmetrical proportions of the human frame. The following classifications are generally recognized:

- DEFORMITIES.
  - Congenital.
    - Malformations.
    - Distortions.
  - Acquired.
    - From traumatism.
    - " paralysis.
    - " inflammatory conditions.
    - " rickets.
    - " joint diseases.
    - " other diseases.

Hippocrates in his book on *Articulations* discusses both the nature and the character of the treatment of clubfoot,

spinal curvature, and other diseases now included under orthopædic surgery. His practical ideas were not equaled by other surgeons for centuries afterward. He describes accurately a very effective apparatus for straightening club-foot, which was not improved upon from that time (B. C. 500) until the sixteenth century, when Ambrose Paré published a work in which he reëapitulated Hippocrates's teachings and ideas, and added many suggestions of his own. Paré's method of treating hunchback, or disease of the spine, was to have the patient lie on a bed while two strong persons pulled in opposite directions, the surgeon meanwhile moulding and forcing the bones into position by a wooden bar. About the middle of the eighteenth century Andry published a book with the specific title *Orthopædic Surgery*, in which he described a large number of mechanical appliances which, though rude, were efficient and ingenious. Scarpa, at the close of the eighteenth century, devised a shoe for clubfoot which has since been designated by his name. About this time the treatment of lateral curvature by suspension and splints received further impetus. To Delpech, of Montpellier, was largely due the great advance in this branch, yet none of Delpech's countrymen was wise enough to see the advantages to be gained from his work. It remained for Stromeyer, of Hanover, in 1834, to introduce the practice of subcutaneous tenotomy, although this operation had been foreshadowed by Mincius in the fifteenth century. Tenotomy proved to be almost revolutionary, and the subcutaneous division of tendons soon became a recognized procedure. Orthopædic surgery has since then steadily advanced. The tenth international congress at Berlin in 1890 was the first to give a special section to this subject, and the U. S. of America contains the only distinct national association of orthopædic surgeons.

Rickets, a disease essentially due to filth, close confinement, and poor air, and hence commonly found in crowded cities, is one of the most common causes of deformities. Knock-knee, bow-legs, curve of the arms, and sometimes lateral curvature of the spine, etc., are notable instances. The treatment consists in supplying good air, good food, and proper hygienic surroundings, with the internal administration of tonics, lime-salts, cod-liver oil, etc. The weight of the body should not be put upon the bones during their soft stage unless the limbs are properly supported by apparatus. After hardening occurs straightening is more difficult, but it may be accomplished, first, by the use of mechanical appliances; secondly, by division of the bone, or osteotomy; and, thirdly, by fracture of the bone, or osteoclasis.

Lateral curvature of the spine is a very common cause of deformity. It occurs with the greatest frequency in young girls about the age of puberty, especially if in poor health. Among the numerous causes are faulty positions in sitting or standing, difference in the length of the limbs, unequal weight bearing upon the shoulders, feeble muscular development, etc. As the deformity advances not only are the spinous processes twisted laterally, but rotation of the vertebral bodies also takes place, with consequent projection of the ribs and shoulder-blade on one side, and flattening of the chest on the opposite side. The condition is due to feeble muscular development, and indicates disproportionate power of the two sides of the body; hence gymnastics and general attention to the health are of primary importance, and if these are properly employed the use of apparatus is seldom necessary. When used it should be of the lightest kind. Strong supports are only necessary when the deformity is rapidly increasing. Spinal curvature should be distinctly separated from caries of the spine; the latter is an entirely different process—an osteitis—that involves the vertebral bodies; while lateral curvature of the spine is dependent not upon disease of the vertebræ, but upon unequal muscular development.

Clubfoot, or talipes, is a deformity of the foot usually occurring congenitally; but it may be found as an acquired condition, following the various paralyses of infancy. When one set of muscles becomes stronger than its opposing group, deviation occurs. When the anterior part of the foot turns inward, the variety known as talipes *varus* is produced. When the anterior part of the foot drops, with elevation of the heel, the condition known as *equinus* results, so called from its resemblance to the position of the bones of the foot in the horse. When the toes turn outwardly, the deformity is known as *valgus*; when upward, with elongation of the heel, it is *calcaneus*; other varieties are known as *cavus*, *plantaris*, etc., when the instep is highly elevated. In congenital cases the bones are sometimes distorted at birth, and the distortion rapidly increases as soon as the weight of the body is placed upon them. In congenital cases the treatment should begin at birth with systematic measures designed to straighten the foot and mould it into proper position by manipulation and forcible stretching of the contracted tissues.

Some form of mechanical appliance should also be employed at once in order to bring the bones of the foot into the proper shape, particularly during the rapid growth of the first weeks of life. Various forms of apparatus are useful, and operative measures are required whenever the child begins to walk, provided the foot has not been already straightened by the previous use of apparatus. In older cases removal of the bones, or tarsectomy, is sometimes necessary, when other operative measures, such as tenotomy, fasciotomy, etc., have failed.

Hammer-toe is a condition of flexion in which the ligaments of one or more toes are contracted. It can be relieved by apparatus or by division of the fascial bands and tendons.

Dupuytren's contraction of the fingers is due to shortening of the fascia, and is usually found in rheumatic patients. It can be relieved by multiple and subcutaneous divisions of the shortened tissues. The tendons are rarely involved.

Joint diseases are among the most common causes of deformity. They are usually inflammatory in character, and in the majority of cases are tubercular in their origin. The inflammation is usually awakened by some slight injury, but is largely dependent upon a tubercular predisposition in the individual. The course of the osteitis is ordinarily slow and tends to destruction first of the bones in the neighborhood of the joint, the process then extending to the articulation. Absolute rest in the recumbent posture is the first indication, to be followed by thorough mechanical fixation of the joint involved. Ambulatory apparatus, with axillary or perineal crutches, is permissible after the acute or painful stage has passed. Extension, both in bed and after the upright position has been assumed, is beneficial. Operative measures are usually necessary after suppuration has occurred. Hip, knee, and ankle joint disease are the most common varieties, the articulations of the upper extremities being but seldom affected.

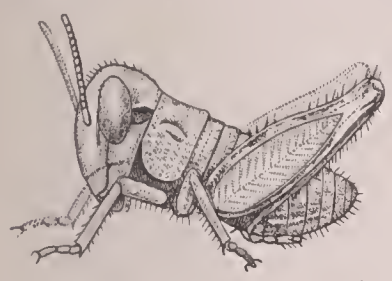
DE FOREST WILLARD.

Orthopnœa: See DYSPNŒA.

Orthoptera [from Gr. *ὀρθός*, straight + *πτερόν*, wing]: an order of insects (see ENTOMOLOGY), characterized by having the jaws fitted for biting, an incomplete metamorphosis, and four wings, the anterior or outer pair narrow and coriaceous and serving as wing covers, the posterior pair membranous, broad, and folded like a fan when at rest. Examples are familiar to all in the grasshoppers, locusts, walking-sticks, cockroaches, and the like. A few (the mantis insects) are beneficial to man, but with these exceptions all are injurious from the fact that they feed on vegetation, and some forms, coming in vast swarms, are the most terrible scourges of the agriculturist. In all the jaws are strong. The head bears, besides the large compound eyes, three pairs of ocelli. The three joints of the thorax are distinct, and the abdomen in the female is frequently provided with an enormous ovipositor. The eggs are laid either in plants or in the ground, and the young when hatched resemble the parent, except in the absence of wings. With successive casting of the skin the adult condition is gradually attained. There are many forms in which wings are lacking even in the adult. Among the interesting features are the presence of sound-producing structures. These occur only in the males of certain forms, and consist of rasping organs upon the wings, or wings and legs. Corresponding to these, organs usually interpreted as ears occur, in the grasshoppers on the basal joint of the abdomen, in the crickets upon the tibial joint of the first pair of legs.

Six families are recognized. The *Blattidæ*, or cockroaches, are among the oldest of insects, numerous fossils occurring in the Carboniferous. In these the legs are all fitted for walking, the body is flattened, and no sound-producing apparatus occurs. The eggs are laid in a pod-like case, which the female carries about with her. The best-known example is the imported "Croton bug" (*Blatta germanica*), which forms a pest in most parts of the U. S. Persian insect-powder is the best means of ridding a house of them. The mantis insects (*Mantidæ*) are tropical and subtropical. From the strange attitudes they take they are known as rear-horses, praying-mantes, camel-crickets, and the like. They feed upon other insects, for which they lie in wait. In

the walking-sticks and leaf insects (*Phasmidæ*) are some of the strangest examples of mimicry. In the U. S. the forms are long and wingless, and resemble closely a dried twig, but in the tropics occur winged forms in which the whole body is strikingly leaf-like, sometimes bright green, sometimes of the color of a dried leaf. The two families *Acrididæ* and *Locustariæ* exhibit a strange confusion of scientific and popular names, for the Acridians are locusts and the Locustarians are grasshoppers. In both the hind legs are large and stout, serving as organs for leaping; sound-producing organs are present. The *Acrididæ* have short antennæ and short ovipositors. Among the most prominent forms is the Rocky Mountain locust (*Melanoplus spretus*) which in 1872–75 created much destruction in the region W. of the Missouri river. In the *Locustariæ* the antennæ are long and thread-like, while the ovipositor is enormous. The katydids, named from their note, are the best-known forms. The last family is that of the crickets (*Gryllidæ*). The males make a chirping sound by rubbing together the anterior wings. With these are to be grouped the large mole-crickets which live subterranean lives, feeding upon the roots of the grass, etc. In these the anterior legs are fashioned into digging organs.



Locust just hatched, enlarged.

See Reports of U. S. Entomological Commission (1878–83); Thomas, *Synopsis of Acrididæ*, U. S. Geological Survey (vol. v., 1872); Ayers, *Embryology of Œcanthus*; *Memoirs* Boston Society Natural History (iii., 1884); and numerous papers by Scudder, Brnner, and Walker. J. S. Kingsley.

Or'tolan [= Fr. from Ital. *ortolano*, ortolan, liter., gardener < Lat. *hortula'nus*, gardener, deriv. of *hor'tulus*, dimin. of *hor'tus*, garden]: any one of several species of song-birds. In Enrope the name was primarily employed for the garden-bunting, *Emberiza hortulana*, common on the continent of Europe and in the Levant. It is a handsome little bird without song, and is chiefly noteworthy for its extensive nse as food. Immense numbers are captured in nets and are placed in dark rooms, where they are gorged with millet and other grain mixed with spices, until they undergo a kind of fatty degeneration. In fact when killed the ortolan is a mere lump of fat, of a flavor highly prized by gourmands. It is some 6 inches in total length, and attains a weight of nearly 3 oz. In some parts of the U. S. the name is applied to the Bobolink (*q. v.*), and to the Sora rail (*Porzana carolina*). Revised by F. A. Lucas.

Or'ton, Edward, Ph. D., LL. D.: geologist; b. at Deposit, N. Y., Mar. 9, 1829; graduated at Hamilton College in 1848; studied science at Lawrence School; was Professor of Natural Sciences, New York State Normal School, 1856–59, and at Antioch College 1866–73; was president of Antioch College 1872–73; president State University of Ohio 1873–81; Professor of Geology, State University of Ohio, from 1873; Assistant Geologist, Geological Survey of Ohio, 1869–83; State geologist of Ohio from 1883; vice-president (geological section) American Association for the Advancement of Science 1885. In geology Prof. Orton has given chief attention to economic problems, especially problems conneeted with the distribution of petroleum, natural gas, and coal. His principal writings are contained in the official reports of the Ohio Geologieal Survey from 1869 to 1890. He has also contributed papers on the geology of petroleum, gas, and asphalt to the Kentucky Geological Reports, 1891, to the *Annual Report* of the U. S. Geological Survey for 1887, to the *Bulletin of the Geological Society of America*, and to various journals. G. K. Gilbert.

Orton, James: naturalist and traveler; b. at Seneca Falls, N. Y., Apr. 21, 1830. He graduated at Williams College 1855, and at Andover Theological Seminary 1858; traveled in Europe and Asia Minor; became a Congregational minister 1860; was appointed instructor in Natural Science in Rochester University 1866; was at the head of the Williams College expedition which crossed the Andes of Ecuador and descended the Napo and Amazon 1867–68; became Professor of Natural History in Vassar College 1869; and in 1873 made another journey to South America, ascending the Amazon and visiting Peru. He published *The Andes and the Amazon* (1870; enlarged edition 1876); *Underground Treasures: how and where to find them* (1872); *The Liberal Education of Women* (1873); *Comparative Zoölogy* (1875). In 1877 he attempted to explore the river Beni, from Bolivia, but was forced to return after being deserted by his Indian canoemen, and died on Lake Titicaca, Sept. 25, 1877. Revised by Herbert H. Smith.

Ortygia: See Delos.

Oru'ro: a western department of Bolivia, S. of La Paz and bordering on Chili; area, 21,333 sq. miles; population (1888) 111,372. It lies in the southern part of the great inclosed plateau called the Titicaca basin, and includes Lake Aullagas and part of the Desaguadero river; hardly any portion of the surface is below 12,000 feet, and the Andes on the W. and the Cordillera Real on the E. rise far above the limits of perpetual snow. Much of the land is arid, with extensive marshes and salty plains, and it is so cold that few crops will grow. The department is rich in silver, copper, and tin, and mining is the only important industry. A large proportion of the rural population is of Indian blood. Oruro, the capital, is near the left bank of the Desaguadero river, 118 miles S. S. E. of La Paz (see map of South America, ref. 6–C). It was founded in 1590, was an important mining town, and during the latter part of the seventeenth century is said to have had over 75,000 inhabitants: but later the mines were abandoned, and the place was nearly depopulated. It has lately become important again, owing to the railway which connects it with the port of Antofagasta in Chili. Valuable tin mines are worked in the vicinity, and tin, copper, and silver are largely exported. In 1891 Oruro was temporarily the capital of Bolivia. Pop. (1894) about 9,000. Herbert H. Smith.

Orvie'to (anc. *Orbitum*, *Urbs Vetus*): city; in the province of Perugia, Italy; 78 miles N. N. W. of Rome (see map of Italy, ref. 5–D). It crowns an abrupt volcanic hill near the confluence of the Chiana and the Paglia, about 8 miles from Lake Bolsena. The Pozzo di San Patrizio (a circular well with 250 steps, exeavated by Clement VII. in 1527 after the famous sack of Rome) is worthy of notice; but the great boast of Orvieto is its beautiful cathedral, founded in 1290 in honor of the famous miracle of Bolsena. (See Charles E. Norton's *Notes of Travel and Study in Italy*.) Orvieto is of Etruscan origin, was not conspicuous nnder the Romans, but on the breaking up of the empire declared itself independent, and being Guelph in its policy was long a safe refuge for fugitive popes. It manufactures white wine, and has considerable trade in silk, grain, and cattle. Pop. 7,304.

Orzeszkowa, or'zesh-kov'a, Eliza: novelist; b. at Milkowszczyzna, Poland, the hereditary estate of an uncle, in 1842; was edueated at Warsaw; married when hardly sixteen. Her first published work, a prose idyl, *Obrazek z lat glodowych* (A Sketch of the Lean Years), appeared in 1866 in the *Tygodnik Ilustrowany*. Her novels, the first of which, *W Klatce* (In Prison), was published in 1867, include *Na dnie sumienia* (At the Bottom of Conscience, 1871); *Rodzina Brochwiczów* (1876); and *Bene Nati* (1890). She has also written a number of essays on literary and social matters. In her stories woman is generally represented as a victim of social injustice and a slave to her lord, the man, and the author appears as a champion of woman's rights. Her collected works appeared in 1885. J. J. Král.

Osage: city; capital of Mitchell co., Ia. (for location, see map of Iowa, ref. 2–H); on the Red Cedar river, and the Ill. Cent. and the Winona and S. W. Railways; 17 miles N. N. W. of Charles City. It is the seat of Cedar Valley Seminary (Baptist, opened in 1863), is the trade center of a large agrieultural region, has a number of manufactories, and contains 2 national banks with combined capital of $100,000, a private bank, and 2 weekly newspapers. Pop. (1880) 2,012; (1890) 1,913; (1900) 2,734.

Osage City: city (founded in 1869); Osage co., Kan. (for location, see map of Kansas, ref. 6–I); on the Atch., Top. and S. Fé and the Mo. Pac. railways; 35 miles S. W. of Topeka. It is in the great Kansas coal basin and is principally engaged in coal-mining and flag-stone quarrying. The city and vicinity have extensive beds of pure yellow ocher, from which an excellent quality of brick is manufactured. There are 12 churches, a national bank, a State bank, and 2 weekly newspapers. Pop. (1880) 2,098; (1890) 3,469; (1900) 2,792. Editor of "Free Press."

Osage Indians: See Siouan Indians.

Osage Orange, or **Bois d'Arc**: a North American tree, *Maclura aurantiaca*, of the family *Urticaceæ*, native to the Arkansas region. It has a handsome, tough, and durable

yellow wood, which has been proposed as a substitute for fustic. The fruit is large, yellow, and somewhat like an orange, whence the name. It is not edible. The principal use of the tree is as a hedge-plant.

Osage River: a stream which rises in Kansas, where it is often called MARAIS DES CYGNES (*q. v.*). It traverses Missouri, and falls into the Missouri river 10 miles below Jefferson City. Its lower course is navigable.

Osaka (liter., hill of the large estuary): an important seaport, the second city of Japan in population and general importance, and in early times its capital; situated on the bay of the same name at the mouth of the river Yodogawa, which carries off the overflow of Lake Biwa (see map of Japan, ref. 6-C). For purposes of foreign trade Osaka is united with Hiogo, one hour distant by rail. Until the fifteenth century it bore the name of Naniwa; it dates its modern greatness from the time of HIDEYOSHI (*q. v.*), who resolved to make it the seat of his government, and founded the magnificent castle, still used as barracks. The interior palace, possibly in its time the handsomest building in the empire, was destroyed by fire in 1868; the gateways of the castle, with the huge stones of which they are constructed, attest the grand scale on which the whole structure was planned. The city, the streets of which are narrow, is the commercial center of the empire, and the great rice emporium. The most important Government building is the mint, opened in 1871 for the coining of bullion. Originally officered by Englishmen from the Hongkong mint, it has turned out a coinage of the finest quality. Close to Osaka is Sakai, where are made the cotton rugs which are largely exported. The trade in straw-matting has also its center in this neighborhood. On an island in the Yodogawa is situated the small foreign settlement, now deserted by traders and left entirely to missionaries. Osaka and its environs form one of the three city prefectures or *fu*, the other two being Tokio and Kioto. Population of the city, 483,600; of the *fu*, 1,216,670.

J. M. DIXON.

Osar: See DRIFT.

Osawatomie: city; Miami co., Kan. (for location, see map of Kansas, ref. 6-K); on the Mo. Pacific Railway; 8 miles S. W. of Paola, the county seat. It is in an agricultural region, and contains the Kansas State Insane Asylum, 2 State banks with combined capital of $37,740, and 2 weekly newspapers. Pop. (1880) 681; (1890) 2,662; (1900) 4,191.

Osborn, SHERARD: admiral; b. in Madras, India, Apr. 25, 1822; entered the British navy 1837; served in one of the expeditions in search of Sir John Franklin, in the Crimean war, and in the seas of China and Japan; accepted from the Chinese Government the command of a squadron for the suppression of piracy 1862; returned to England 1864 to take command of the turreted monitor Royal Sovereign; was for several years manager at Bombay of the Great Indian Peninsular Railway; became rear admiral 1873, and was a member of the commission for fitting out the Aretic expedition of 1875. Author of *Stray Leaves from an Arctic Journal* (1852); *A Cruise in Japanese Waters* (1859); *The Past and Future of British Relations in China* (1860); and other works. D. in England, May 6, 1875.

Oscan: See ITALIC LANGUAGES.

Oscar I.: King of Norway and Sweden; b. in Paris, France, July 4, 1799; the only child of Bernadotte, who, on Aug. 21, 1810, was elected heir to the throne of Sweden. On June 19, 1823, Oscar married Josephine, a daughter of Eugène Beauharnais, formerly Viceroy of Italy. He ascended the throne Mar. 8, 1844, and died July 8, 1859. He was a successful composer of music; in 1840 he published a work on prisons and the punishment of crime. His eldest son, Charles XV., succeeded him on the throne. R. B. A.

Oscar II., FREDRIK, of the house of Bernadotte: King of Norway and Sweden; poet and writer; b. Jan. 21, 1829, succeeded to the throne at the death of his brother, Charles XV., Sept. 18, 1872. His literary and artistic talents are of a very high order. In 1858 he gained the second prize of the Swedish Academy for a collection of poems, *Ur Svenska Flottans Minnen* (2d ed. 1862); since that time he has published miscellaneous writings under the title *Nytt och Gammalt af O***** (5 small volumes, 1859–72); *Några bidrag till Sveriges krigshistoria åren 1711, 1712, och 1713* (1859–65); translations of Herder's *Cid*, Goethe's *Torquato Tasso*, and others. His complete writings (*Samlade Skrifter*) have appeared in four volumes (1875–91). King Oscar is a very felicitous speaker, and most of his addresses and speeches on different occasions in the Swedish, Norwegian, and other languages have been published in the periodical press. His speeches in the Musical Academy (*Tal i Musikaliska Akademien*) were published in 1885, with notes by Fr. Cronhamn. A fifth volume of his complete writings, containing all his speeches made since his accession to the throne, appeared in 1894. P. GROTH.

Osceola: city (founded in 1850); capital of Clarke co., Ia. (for location, see map of Iowa, ref. 7-G); on the Chi., Burl. and Quincy and the Des M. and Kan. City railways; 50 miles S. by W. of Des Moines. It is in an agricultural and stock-raising region; contains 7 churches, 3 public-school buildings, new court-house, a sanitarium, 2 State banks, a private bank, electric-light plant, and 2 weekly newspapers; and has marble-works, agricultural-implement works, and railway machine-shops. Pop. (1880) 1,769; (1890) 2,120; (1900) 2,505. EDITOR OF "SENTINEL."

Osceola: a Seminole chief, son of William Powell, an Englishman, by an Indian mother, born about 1804, near the river Chattahoochee. Osceola was early distinguished for ability, courage, and hatred of the whites; attained great influence among the Seminoles, and strongly opposed the cession of the tribal lands in Florida. In 1835 his wife, the daughter of a fugitive slave, was stolen as a slave, and Osceola, demanding her release of Col. Thompson, U. S. agent at Fort King, used language which the latter resented, and the chief was put in irons. Six months later Thompson was murdered; the battle on the Withlacoochie, the massacre of Dade, the assaults on Forts Micanopy and Drane, and other spirited actions followed, in which the Indians more than held their own against very great odds; but during a conference with Gen. Jessup, under a flag of truce, Osceola was treacherously seized (Oct. 22, 1837), and imprisoned at Fort Moultrie, S. C., where he died Jan. 20, 1838.

Os'cines: a term applied by Johannes Müller to a group of *Passeres* containing those with a highly developed singing apparatus, having five or six pairs of tracheal muscles attached to the ends of the upper bronchial half rings—an arrangement termed acromyodian. The name was used by Merrem, but not in the same manner as it was by Müller, and not with his exactness of definition. The group, or sub-order, contains over nine-tenths of the passerine birds, and is contrasted with the CLAMATORES (*q. v.*) or Mesomyodian birds. F. A. LUCAS.

Osco'da: village; Iosco co., Mich. (for location, see map of Michigan, ref. 5-J); on Lake Huron, at the mouth of Au Sable river, and the Au Sable and N. W. and the Detroit, Bay City and Alpena railways; 100 miles N. E. of Bay City, 200 miles N. of Detroit. It is in an agricultural, lumber, and salt-manufacturing region; has a large trade in lumber; and contains three churches, public and Roman Catholic schools, a savings-bank, and a weekly newspaper. Pop. (1880) 1,951; (1890) 3,593; (1900) 1,109.

EDITOR OF "SATURDAY NIGHT."

Oscula'trix and **Osculatory Circle** [*osculatrix* is Mod. Lat., liter., femin. of **oscula'tor*, a kisser, deriv. of *osculum*, a kiss, liter., dimin. of *os*, mouth]: an osculatrix is a curve of a given kind which, at an assigned point of another curve, has the closest possible contact with the latter. If two plane curves have two consecutive points in common, the straight line passing through these points is tangent to both curves at the first point, and the two curves are said to have a contact of the first order. In general, if two plane curves have $n + 1$ consecutive points in common, they will have n consecutive rectilinear tangents in common, and the two curves are then said to have a contact of the nth order. If two curves have a contact of the nth order, they must have $n + 1$ consecutive ordinates in common, counting from the first point, and consequently they must have n successive differential coefficients of their ordinates at that point equal to each other. Conversely, if two curves have a common point, and if n successive differential coefficients of their ordinates at that point are equal, they will have a contact of the nth order.

It is a property of osculatrices that no osculatrix whose contact is of an odd order can cut the curve to which it is osculatory at the point of osculation, and that every osculatrix whose contact is of an even order must cut the curve to which it is osculatory at the point of osculation.

The *osculatory circle* is a circle that, at a given point of a curve, has the closest possible contact with the curve. Thus it passes through three consecutive points of the curve, as a

circle is determined by the three conditions; consequently the first and second differential coefficients of the ordinates of the curve and circle are equal at the point of contact. The radius of the circle is called the radius of curvature, and its reciprocal may be considered as a measure of the curvature of the curve. The center of the circle is called the center of curvature; and the locus of this point is the evolute of the curve. (See EVOLUTE.) It is to be remarked that we can not assign to a circle a higher order of contact than the second, but it may happen that it has a higher order of contact at particular points. This is the case at those points where three consecutive normals (see NORMAL) pass through a point, as, for instance, at the vertices of the conic sections. Revised by R. A. ROBERTS.

Osgood, SAMUEL: soldier and official; b. at Andover, Mass., Feb. 14, 1748; graduated at Harvard 1770; studied divinity, but became a merchant; was much in public life; attained the rank of colonel and assistant commissary in the Revolutionary army; served in the Massachusetts Legislature; was in Congress 1780–84; was first commissioner of the U. S. Treasury 1785–89; Postmaster-General 1789–91; became Speaker of the New York House of Assembly; supervisor in New York 1801–03; naval officer of the port of New York 1803–13. He wrote various works, chiefly on religious questions. D. in New York, Aug. 12, 1813.

Osgood, SAMUEL, D. D., LL. D.: clergyman and man of letters; b. in Charlestown, Mass., Aug. 30, 1812; graduated at Harvard College 1832, and at Cambridge Theological School 1835; was pastor in Nashua, N. H., 1837, in Providence 1841, and in New York 1849; in 1870 left Unitarianism for the Episcopal Church, but assumed no pastoral charge. His numerous writings include *Studies in Christian Biography* (1851); *The Hearth-stone* (1854); *God with Men* (1854); *Mile-stones in our Life Journey* (1855); *Student Life* (1860); he translated from the German de Wette's *Human Life* (1842) and Olshausen's *History of the Passion* (1839). He edited *The Western Messenger* two years and *The Christian Inquirer* four; was for many years home corresponding secretary of the New York Historical Society. D. in New York, Apr. 14, 1880.

O'Shaughnessy, ō-shaw'ne-sē̆, ARTHUR WILLIAM EDGAR: poet; b. 1846; d. 1881. In 1864 he entered the British Museum. In 1873 he married Eleanor, sister of Philip Bourke Marston. He belonged to the neo-romantic group of poets, followers of Morris and Swinburne and of the French romantic school; published *An Epic of Women* (1870); *Lays of France* (1871), a free paraphrase of the *lais* of Marie de France; *Music and Moonlight* (1874); and *Songs of a Worker* (1881). H. A. B.

Osh'awa: town and warehousing port of Whitby township, Ontario County, Ontario, Canada; on the Grand Trunk railway, 33 miles N. E. of Toronto and near Lake Ontario (see map of Ontario, ref. 4–E). It has manufactures of flour, furniture, farm implements, machinery, etc., and two weekly newspapers. Pop. (1891) 4,066.

O'Shea, M. VINCENT: See the Appendix.

Osheba: See FANS.

Osh'kosh: city; capital of Winnebago co., Wis. (for location, see map of Wisconsin, ref. 5–E); on Lake Winnebago at the mouth of Fox river, and on the Chi. and N. W., the Chi., Mil. and St. P., Mil., L. S. and W., and the Wis. Cent. railways; 35 miles N. W. of Milwaukee, 49 miles S. S. W. of Green Bay. It is in a lumber region; has an excellent location for communication with distant points by water; and is the third city in the State in population, wealth, and commercial importance. The census returns of 1890 showed that 423 manufacturing establishments (representing 71 industries) reported. These combined had a capital of $6,531,213, employed 5,397 persons, paid $2,017,267 for wages and $4,663,510 for materials, and had products valued at $8,619,219. The principal manufactures were connected with the lumber and sash and door industry, and comprised 15 establishments, which had a combined capital of $3,354,598, used materials valued at $2,700,816, and had products valued at $4,208,400. Other important industries, in the order of capital investment, were the manufacture of furniture, $556,464; carriages and wagons, $378,702; foundry and machine-shop products, $313,960; malt liquors, $151,838; flour and grist mill products, $116,655; tobacco, $107,771; printing and publishing, $97,951; and slaughtering and meat-packing, $38,300. The city is the seat of a State normal school and of the Northern Wisconsin Insane Asylum; contains a U. S. Government building, 2 libraries (State Normal School and Public) with over 7,000 volumes, large city-hall building, 10 public-school buildings, public-school property valued at over $233,000, gas and electric-light works, and Holly water-works; and has 4 national banks with combined capital of $600,000, 3 State banks with capital of $350,000, and 2 daily, 7 weekly, and 2 monthly periodicals. The assessed valuation in 1894 was $8,580,497, and the bonded debt on Feb. 15, 1894, was $236,800. Pop. (1880) 15,748; (1890) 22,836; (1900) 28,284.
EDITOR OF "NORTHWESTERN."

Osian'der (or **Hosemann**, his true name), ANDREAS [*Osiander* is a Grecized form of *Hosemann*: cf. Gr. ἀνήρ, ἀνδρός, man, and Germ. *mann*, man]: theologian; b. at Gunzenhausen, near Nuremberg, Dec. 19, 1498; studied theology at Ingoldstadt and Wittenberg; became preacher at Nuremberg in 1520, and being an ardent adherent of Luther he labored with great energy for the Reformation. In 1548, however, he was deprived of his office, as he would not subscribe to the Augsburg Interim, but he was shortly after (1549) made preacher and Professor in Theology at Königsberg. Here he entered into a hot controversy concerning justification. He held very peculiar views on that point. Fundamentally he agreed with Luther and was as antagonistic to Calvinism as to Romanism, but he was a mystic, and maintained the righteousness of Christ is not imputed to us but infused into us. His views may be best learned from his two pamphlets *An filius dei fuerit incarnandus*, etc. (1550), and *Von dem einigen Mittler, Jesu Christo*, etc. (1551). He died suddenly in Königsberg, Oct. 17, 1552. His principal works were *Harmonia Evangetica* (1537); *De Lege et Evangelio* (1549); and *De Justificatione* (1550). See his *Life*, by W. Möller (Elberfeld, 1870). See also the article GERMAN THEOLOGY. Revised by S. M. JACKSON.

Osi'ris [= Lat. = Gr. Ὄσιρις, Egypt. Ausâr Âsiri, Hesiri]: the Egyptian god of the dead and ruler of the nether regions. He is conceived as the son of Nut, brother and husband of Isis; brother also of Nephthys and Set-Typhon. The story of Osiris is told at length by Plutarch (*Isis and Osiris*), and is the only Egyptian myth of which we have the outlines in any degree of completeness. The native texts are full of allusions to this as to a multitude of other myths, but they are fragmentary in character and extent. *Osiris* appears first as a divine ruler of Egypt, elevating the mode of life, improving the condition of the land, dividing it and organizing its administration. After a happy and prosperous reign he was murdered by his brother Set. He afterward rose again in the region of the departed and became the ruler of the dead, in which character he henceforth appears. His death was avenged by Horus, son of Isis, who succeeded in overcoming Set. According to the myth, Set had divided the body of Osiris into fourteen parts. Thirteen of these were found by Isis, who erected a temple to Osiris over each. The place which was specially sacred to him was Abydos, where his heart was believed to be buried. Before him, as god of the dead, the judgment scene occurs, with its weighing of the soul of the individual over against the symbol of truth. (See RITUAL OF THE DEAD.) Like Osiris, every man must die, be judged, and rise again in order to partake in the future happiness that awaited the pious Egyptian. The dead themselves were called by his name. He was the special hero of the *Book of the Dead*, and the prayers of funeral steles were addressed to him. The belief in him and in the immortality which he symbolized was the deepest in Egyptian religious thought.
CHARLES R. GILLETT.

Oskaloosa: city; capital of Mahaska co., Ia. (for location, see map of Iowa, ref. 6–I); on the divide between the Des Moines and the South Skunk rivers, and the Burlington Route, the Ia. Cent., and the Chi., Rock Is. and Pac. railways; 24 miles N. N. W. of Ottumwa, 62 miles E. S. E. of Des Moines. It is in a coal, agricultural, and stock-raising region, which also has valuable deposits of iron ore and fire-clay. It is the seat of Oskaloosa College (Christian, chartered in 1855), and of Penn College (Friends, chartered in 1873); has gas and electric light plants, water-works, street-railways, 4 libraries (public, high school, and Oskaloosa and Penn Colleges) containing over 11,000 volumes; a national bank, 2 State banks, a private bank, and a daily, 5 weekly, and 3 monthly periodicals; and manufactures flour, woolen goods, iron and brass goods, paving-brick, and furnaces, and packs pork. Pop. (1880) 4,598; (1890) 6,558; (1900) 9,212.
EDITOR OF "HERALD."

Osler, William, M. D., F. R. C. P.: clinician; b. at Tecumseth, Ontario, Canada, July 12, 1849; graduated at Trinity College, Toronto: studied medicine at McGill University, Montreal, and in London, Berlin, and Vienna; was Professor of the Institutes of Medicine, McGill University, 1874–84: Professor of Clinical Medicine, University of Pennsylvania, 1884–89; became professor in Johns Hopkins University, and physician-in-chief Johns Hopkins Hospital, Baltimore, in 1889; was Galstonian lecturer at the Royal College of Physicians, London, in 1885, and Cartwright lecturer at the College of Physicians and Surgeons, New York, in 1886. He is the author of *Clinical Notes on Smallpox* (Montreal, 1877); *Histology Notes for Students* (1881); *The Cerebral Palsies of Children* (London and Philadelphia, 1889); *The Principles and Practice of Medicine* (New York, 1892); and edited *Montreal General Hospital Reports* (1878).

S. T. Armstrong.

Osman: See Othman.

Osman Pasha: soldier; b. at Tokat, Asia Minor, 1832; was educated at the military schools of Constantinople; fought in the Crimean war, the Cretan campaign, and the Serbo-Turkish war; at the outbreak of the Russo-Turkish war was commander of the Fifth Army-corps. Defeated at Scalevitze, he intrenched himself at Plevna, which he held from Aug. 31 to Dec. 10, 1877, when he surrendered with 43,000 men. Since the conclusion of peace he has been several times Minister of War, and is now (1894) grand marshal of the palace. In personal appearance, character, and mode of warfare, he is a typical Ottoman soldier, fanatical, frugal, brave, and when behind earthworks almost invincible.

E. A. Grosvenor.

Os'mazome [from Gr. *ὀσμή*, smell + *ζωμός*, broth]: a name given by Thénard to that portion of meat extract which is soluble in alcohol and contains those constituents of the flesh which determine its taste and smell.

Os'mium [from Gr. *ὀσμή*, smell, odor, deriv. of *ὄζειν*, smell]: an element of matter, one of the "platinum metals"; that is, found in association in nature with platinum. Its only ore is a native compound with another metal of the same natural group, Iridium (*q. v.*), forming the mineral metallic alloy called iridosmine or osmiridium, which is exceedingly hard, and therefore used for tipping gold pens. This native alloy contains also Ruthenium (*q. v.*). The methods of procuring metallic osmium and its compounds from the ore are complex and difficult. At the most intense heats it volatilizes without fusion. In fine division it is very combustible, burning to osmic acid. Osmium is believed to be, in some of its combinations, the most poisonous also of known substances. Revised by Ira Remsen.

Osmundaceæ: See Fernworts.

Os'nabrück: town; in the province of Hanover, Prussia; on the Hase; 70 miles W. S. W. of Hanover (see map of German Empire, ref. 3–D). It contains a large cathedral, built in the thirteenth century, a town-hall, in which the Treaty of Westphalia was signed in 1648, and numerous manufactories of steel and iron, tobacco, chicory, soap, paper-hangings, leather, and linen and woolen fabrics. It dates from 772; suffered much during the Thirty Years' war, but recovered in the eighteenth century, owing to the development of its linen industry. Pop. (1890) 39,929.

Oso'rio, Manoel Luiz: soldier; b. near Pelotas, Rio Grande do Sul, Brazil, May 10, 1808. He early entered the army; first attained distinction in the civil war in Rio Grande do Sul 1839–45; was prominent in the campaign in Uruguay and against Rosas 1851–52: and on the breaking out of the Paraguayan war was made commander-in-chief of the Brazilian forces in operation Mar. 1, 1865. He was superseded by Caxias July 15, 1866, but continued to serve until Dec., 1869, when he was severely wounded. As a cavalry leader he was unsurpassed: the soldiers called him *O legendario*, or The Fabulous, on account of his bravery. He became lieutenant-general in June, 1867, and was created successively baron, viscount, and Marquis of Herval. After the war he took an active part in politics; was senator from Jan. 11, 1877, and Minister of War from Jan. 5, 1878. D. at Rio de Janeiro, Oct. 4, 1879. Herbert H. Smith.

Osorkon: the name of three Egyptian kings; the second and fourth of the twenty-second (Bubastite) dynasty, and the second of the twenty-third (Tanite) dynasty. Of Osorkon I. and II. little of importance is known, except that the former apparently founded a city at the entrance to the Fayum near the site of the modern Illahun. It has also been conjectured, on the ground of chronology, that he was the Zaræus of Josephus (*Antiq. Jud.*, viii., 12, 1–2) and the Zerah of 2 Chron. xiv. 9–13; but this is very doubtful. The third Osorkon is named among the twenty kings of Egypt at the time of Pianchi the Ethiopian conqueror, as King of Bubastis in the Delta. The divided condition of the land made it an easy prey to the power of the growing Ethiopian kingdom whose capital was at Napata (*q. v.*).

Charles R. Gillett.

Osorno, Marquis of: See O'Higgins, Ambrosio.

Ospi'na Rodriguez, Mariano: politician; b. at Guasca, New Granada, 1803. He was a lawyer, early took part in politics, and joined the party which opposed Bolivar in 1830. Subsequently he was a leader of the conservative party; was a member of congress, Secretary of the Interior 1841, and governor of Bogotá. From 1857 to 1861 he was president of the Grenadine Confederation. A revolt which broke out in 1859 was partially suppressed, but was successful soon after Ospina's term came to an end, and resulted in a change of constitution. Ospina was imprisoned for a short time, and subsequently exiled until 1872. D. at Medellin, 1885. Herbert H. Smith.

Osprey: See Fish-hawk.

Os'sein [from Lat. *os*, *ossis*, bone]: the modification of Gelatin (*q. v.*) that occurs in bones, forming substantially the whole of the organic part of the bone, apart from the tricalcic phosphate, which makes up the mass of the earthy part. Ossein may be isolated in its natural state by dissolving out the earthy part of the bone with muriatic acid and long and repeated washing with cold water. It then forms, before drying, a soft elastic mass, which is insoluble in cold water, but quickly dissolves in boiling water to a solution of ordinary gelatin. Revised by Ira Remsen.

Osse'tish: an Iranian language; the speech of the Caucasus folk Ossetians. The Ossetians are the most northwestern people of the Iranians, and they are somewhat separated by other tribes from the main body of the race, but their speech is none the less Iranic. Three dialects of the language may be recognized: First, the northeastern or eastern, called Tagaurian; second, the northwestern or western, termed Digorian (but styled Ironian by the Ossetians themselves); third, the southern or Tualian. In its inflectional system the Ossetish shows ten cases, including a so-called sociative and elative, in the declension; the verb conjugation and the syntax show a comparative fullness in accordance. A striking phonetic feature of the speech is the absence of *h*, a letter otherwise common in Iranian tongues. Ossetish can make but slight literary claims.

The names of the principal authorities on this language are Sjögren, G. von Rosen, W. Miller, Fr. Müller, Lerch, Tsorajew, Salemann, B. Joseph, Stackelberg, and Hübschmann. A. V. Williams Jackson.

Ossian (Oisin or Ossin): bard and hero of Irish legend, son of Fingal (Finn or Find), father of Oscar. The legend puts these heroes in the latter half of the third century, and in the earliest poems and tales they have the air of historical characters. References to them in the oldest sources are scanty. Between the twelfth and fifteenth centuries they were the center of a vigorous growth of stories that developed in the east of Ireland, and are known as the cycle of Leinster, or the Ossianic cycle. This cycle long kept its vitality, developing new branches as late as the eighteenth century. It was carried across to the Scotch Highlands, and first came to general notice through the Gaelic forms of the tradition. James MacPherson, a young Highland schoolmaster, had collected from oral tradition a few fragments of Gaelic poetry, and brought them to the notice of the Rev. John Home, who showed them to Dr. Hugh Blair, then a power in the world of Scotch letters. Blair urged MacPherson to publish his English versions of them, and these accordingly appeared in 1760, in a small volume, entitled, *Fragments of Ancient Poetry, collected in the Highlands of Scotland, and translated from the Gaelic or Erse*, with a preface by Dr. Blair. The volume provoked considerable enthusiasm among Scotch literary men and antiquarians, who subscribed money in aid of further search for similar remains. MacPherson undertook the task, and traveled extensively through the remoter Highlands, and upon his return published in London two additional volumes: *Fingal, an Ancient Epic Poem, in six books, with other lesser poems* (1762); *Temora, an Epic Poem, in eight books, with other poems* (1763). All were then collected in

a single volume as *The Poems of Ossian* (1765). Immediately upon their appearance a fierce controversy arose. Dr. Johnson declared that no ancient poetry could be discovered among the Highlanders; that MacPherson had had no originals and was tricking the public; and that his poems were worthless bombast. W. Shaw's *Inquiry into the Authenticity of the Poems of Ossian* (London, 1781) and Malcolm Laing's *Notes and Illustrations to Ossian* (Edinburgh, 1805) were important works in support of that contention. On the other hand, Dr. Blair and others collected evidence of the existence of poetry in the Highlands and its collection by MacPherson, and pointed out beauties in the poems equal to those of Homer. In 1805 the Highland Society of Edinburgh published a report of its elaborate inquiry into the question of the existence of ancient Gaelic originals. The report found that a great legend of Finn and Ossian and popular poetry concerning them had existed; that fragments were collected having in the main the same substance as the poems published by MacPherson, but none which were exact originals; and that MacPherson had edited his materials freely, and added of his own invention. Those who attacked the authenticity of the poems had challenged MacPherson to publish the Gaelic manuscripts, and £1,000 had been subscribed among his Scotch supporters for that purpose. MacPherson died (1796) without publishing them, but left among his papers materials which were published in 1807. This Gaelic text seems to be a curious mosaic of old and new materials, made by one unproficient in the Gaelic language; it was contended that MacPherson had made his Gaelic text by translating his poems from the English, and the dispute continued. It has not yet been entirely abandoned, though the advances in Celtic scholarship and the publication of authentic remains of old Gaelic tradition (cf. notably J. F. Campbell, *Popular Tales of the West Highlands, orally collected, with a Translation*, 4 vols., Edinburgh, 1860–62; *The Dean of Lismore's Book*, edited by T. MacLauchlan, London, 1862) have confirmed the general conclusions of the Highland Society's report of 1805, and made it clear that MacPherson had originals to work upon, found in the living oral tradition; that these originals were very old, or made up of very old materials, developed and elaborated in the popular imagination, and were not indeed poems of Ossian, but Ossianic poems; that MacPherson used his materials with great freedom, and mixed with the heroes of the Ossianic cycle those of the cycle of Ulster; and that the style, tone and manner of MacPherson's versions are very different from the older forms of the traditions, and are the work of the translator himself.

Wholly aside from the question of authenticity, MacPherson's publications produced an impression upon literary Europe that was phenomenal in its breadth and intensity for nearly two generations. Numerous translations of MacPherson's volumes, or parts of them, appeared in Germany, France, Italy, Spain, and other countries. In Italy Cesarotti wrote a considerable essay, ranking Ossian with Homer. Goethe, Schiller, Herder, Schubert, Chateaubriand, Byron, and Coleridge all passed under the spell. Napoleon carried Ossian about with him incased in a costly box. Lamartine owns him as among the most powerful formative influences of his youth. Traces of the general enthusiasm are universal in the works of the years about 1800. At that time a Parisian publisher, planning to issue the masterpieces of the world's literature, made Ossian the first and Homer the second of the series. Now the poems of Ossian have passed almost completely out of notice. The ecstatic, declamatory style, the indistinct actors and nebulous landscape, saturated with a vague and monotonous melancholy, have ceased to be pleasing. They have been reprinted in almost innumerable editions. For the Ossianic cycle in Celtic literature, cf. d'Arbois de Jubainville, *Cours de littérature celtique*, vols. i., ii., and v. (Paris, 1884–93). A. E. Canfield.

Os'soli, Sarah Margaret Fuller, Marchioness: author; b. in Cambridgeport, Mass., May 23, 1810: daughter of Hon. Timothy Fuller, a representative in Congress 1817–25; was in early childhood a proficient in the classical languages and modern literature, but noted for eccentricities and the violence of her passions; taught languages in Boston to private classes, and in Bronson Alcott's school after the death of her father in 1835; was a conspicuous figure in the literary set comprising also Emerson, Hawthorne, and Channing, and became widely known for brilliant powers of conversation; became principal of a school at Providence, R. I., in 1837; was in 1840 editor of *The Dial*, a quarterly magazine: published in 1839 a translation of Eckermann's *Conversations with Goethe*, and in 1841 the *Letters of Günderode and Bettina*; made in 1843 a journey to Lake Superior, and wrote *A Summer on the Lakes*; removed to New York in Dec., 1844; became a writer for the *Tribune*, to which she contributed most of the *Papers on Art and Literature* issued in a volume in 1846; expanded an early essay in *The Dial* into a volume entitled *Woman in the Nineteenth Century* (1845; new ed. 1855); went to Europe early in 1846; married in Rome in Dec., 1847, a nobleman, Giovanni Angelo Ossoli; was a witness of the Roman revolution of 1848, and of the siege of Rome by the French in 1849, at which time she was appointed by Mazzini directress of one of the hospitals; embarked at Leghorn for the U. S. in the ship Elizabeth May 17, 1850, accompanied by her husband and infant son, and with them perished by shipwreck at Fire island, near New York, July 19, 1850. An unpublished history of the Roman revolution was lost with her. A monument to her memory is in Mt. Auburn cemetery. Her collected newspaper correspondence, edited by her brother, Rev. Arthur B. Fuller, was published in 1856, under the title *At Home and Abroad*. See the memoirs by Emerson, Channing, and James Freeman Clarke (2 vols., 1852), by Julia Ward Howe (Boston, 1883), and by Thomas W. Higginson (Boston, 1884). A new edition of her complete works appeared at Boston in 1874. Revised by H. A. Beers.

Ostade, ōs'tăă-de, Adrian, van: painter and etcher; b. at Lubeck in 1610. He studied under Franz Hals, and soon became famous as a genre-painter. His pictures were in great demand in his own time, and are to be seen in Flanders, Germany, France, and England. He worked in Haarlem, in Lubeck, and in Amsterdam, where he died in 1685. A series of fifty-four of his etched plates have been published. His brother Isaac, who was his pupil, acquired the manner of his brother so thoroughly that his pictures are often mistaken for those of Adrian. W. J. Stillman.

Ostend': town; in the province of West Flanders, Belgium; on the German Ocean, 77 miles by rail W. N. W. of Brussels (see map of Holland and Belgium, ref. 9–A). It has a good harbor, is fortified and neatly built, and communicates daily by steamers with London and Dover. Besides manufactures of linen, sail-cloth, and ropes, it has important fisheries of oysters, cod, and herrings and an active traffic in the transport of butter, rabbits, etc. In the summer season it is the resort of 20,000 visitors. There is a handsome kursaal, and a sea-wall 3 miles long and 35 yards broad forms a favorite promenade. Pop. (1896) 30,730.

Ostend Manifesto: See the Appendix.

Osteoblasts and **Osteoclasts**: See Histology (*Bone*).

Osteoglos'sidæ [Mod. Lat., named from *Osteoglos'sum*, the typical genus; Gr. ὀστέον, bone + γλῶσσα, tongue]: a family of fresh-water fishes of the sub-order *Isospondyli*, characterized by the peculiar form and bony head. The body is more or less elongated, compressed, and covered with large hard scales composed of mosaic-like pieces; the lateral line high, little incurved from the back, and with widened mucous ducts; the head oblong, with the integument very thin, and cheeks protected, with large suborbital and postorbital plates; mouth with a lateral cleft; its upper margin formed by the intermaxillaries at the middle and the supramaxillaries at the sides; teeth acute, on the jaws as well as palate; gill apertures large; branchiostegal rays numerous (8–16); dorsal and anal posterior elongated, the anal originating farther forward than the dorsal; caudal separately developed; pectorals inserted low down on each side of the throat; ventrals perfect, not very far from the head. The skeleton has numerous vertebræ (60–80). The family is noted for the peculiar distribution of its species. It is divisible into two sub-families (1) *Osteoglossinæ*, in which the abdomen is trenchant, having two genera, *Osteoglossum*, represented in South America, and *Scleropages*, with one species in several of the Philippine islands, and another in Queensland, Australia; and (2) *Heterotinæ*, also with two genera: *Hetrotis*, peculiar to West Africa and the Nile, and *Arapaima*, confined to South America. One species (*Arapaima gigas*) reaches a gigantic size, sometimes exceeding 15 feet in length and weighing upward of 400 lb. It is taken sometimes with a hook baited with small fishes, and sometimes with a harpoon. In Brazil it sells for a high price. Revised by F. A. Lucas.

Osteol'ogy [Gr. ὀστέον, bone + λόγος, discourse, reason]: the science of the skeleton of vertebrated animals. This

skeleton is composed of bone, or its cartilaginous or membranous basis, the intimate structures of which are pointed out in the article Histology (*q. v.*). The skeleton consists either of a cartilaginous or membranous continuum, or of cartilaginous or osseous segments arranged in continuous succession, so as to form two tubes, one superior and one inferior, attached by a solid axis between them, the whole furnished with various appendages. Each axial segment is in turn composed of sub-segments, each of which arises from a separate (sometimes more than one) center of ossification in the primal cartilage or membrane. Each primary segment of the skeleton is called a vertebra, and each vertebra is composed of the same elementary segments, some of which may be omitted, subdivided, etc., and also greatly modified in their form for the accommodation of the viscera they inclose. The superior arches or tubes protect the nervous axis of the animal, while the inferior surround the nutritive organs, or the digestive, circulatory, respiratory, and reproductive systems. The elementary segments and their modifications are exhibited in the accompanying sections from the cranial, thoracic, and caudal regions respectively, in order to display the excessive developments of the *neural* or upper arch (Fig. 1), the *hæmal* or lower arch (Fig. 2), and of the centrum (Fig. 3), by reduction of the arches. The

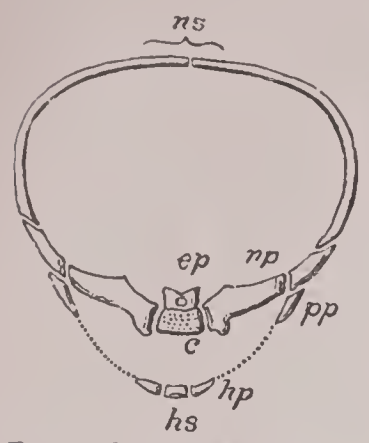


Fig. 1.—Cranial segment : *c*, centrum ; *np*, neurapophysis ; *ns*, neural spine ; *ep*, epapophysis ; *pp*, pleurapophysis ; *hp*, hæmapophysis ; *hs*, hæmal spine.

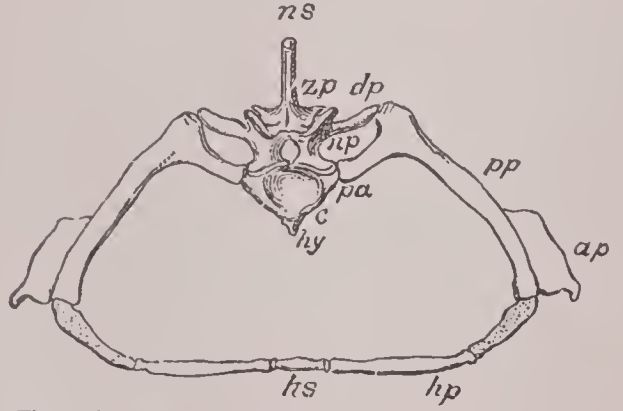


Fig. 2.—Thoracic segment from a crocodile. Letters as in Fig. 1: *zp*, zygapophysis ; *dp*, diapophysis ; *pa*, parapophysis ; *hy*, hypapophysis ; *ap*, appendage.

elements are named as follows : *ns*, neural spine : *zp*, zygapophysis ; *dp*, diapophysis ; *pp*, pleurapophysis : *hp*, hæmapophysis ; *hs*, hæmal spine. In addition to these, there are other processes less universally present—namely, on the middle line of the centrum above, *ep*, epapophysis (Fig. 1), on the middle line below, *hy*, hypapophysis (Fig. 2), and on the side of the centrum below the diapophysis, *pa*, parapophysis (Fig. 2, represented by capitular articulation for rib). In the thoracic vertebra the segments correspond to the following special names of the bones : neural spine, *spinous process* ; zygapophysis, *articular process* : diapophysis, *transverse process* ; neurapophysis, *superior arch* ; pleurapophysis, *rib* ; hæmapophysis, *thoracic rib* or *cartilage* ; hæmal spine, *sternal segment* ; centrum, *body*.

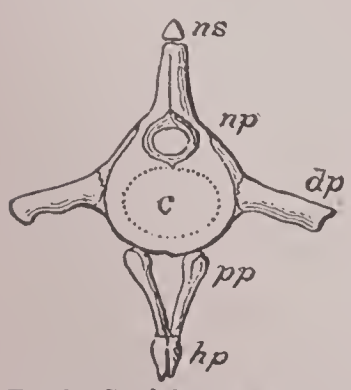


Fig. 3.—Caudal segment from dugong. Letters as before.

There are many peculiarities in the segments which compose the skull of the Vertebrata, on which account the name of vertebræ has been denied them. Since they also present some likenesses to the vertebræ of the body in their growth-history as well as composition, they may be regarded as representing a special class of vertebræ. The limbs of Vertebrata also have received a variety of interpretations. These, when fully represented by a front pair and a hinder pair, are attached to corresponding arches, which depend from the vertebral axis, and are therefore hæmal. The pelvic arch, which bears the hinder limbs, is attached to the sacral vertebræ, and includes one superior (*ilium*) and two inferior elements (viz., *ischium* and *pubis*). That which supports the fore limbs, or the scapular arch, is not attached to an axial body in any class excepting that of the fishes, and then it is to the occipital or posterior segment of the skull and by dermal bones only. It also includes one superior element (*scapula*) and two inferior (*epicoracoid* and *coracoid*). The limbs are lateral appendages of these arches, like the uncinate processes of the ribs (Fig. 2, *ap*), opercula of the suspensor of the lower jaw in fishes, etc.

Development of the Skeleton.—The spinal column will first claim attention. The germinal layer of the yolk of the egg, or blastoderm, is early marked by a linear impression, the "primitive groove." The blastoderm is divided into three layers, of which the lower ultimately forms the interior lining of the alimentary canal, and the upper forms the cerebro-spinal nervous axis and the epidermis of the body. It is the upward longitudinal folding of the upper and middle layers (ectoderm and mesoderm) on each side

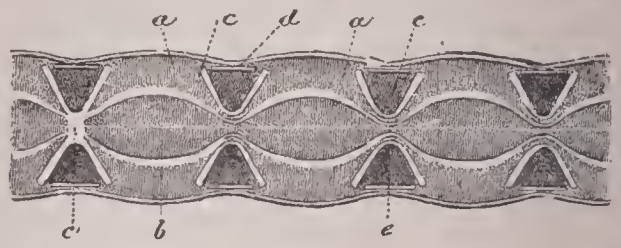


Fig. 4.—Longitudinal section of the posterior part of the vertebral column of *Heptanchus* (from Kölliker) : *a*, fibro-cartilaginous part of sheath of chorda dorsalis ; *b*, gelatinous chorda ; *c*, osseous double cone perforated for the contracted chorda ; *c'*, section of a vertebra to one side of the perforation ; *d*, the external lateral osseous plates of the vertebræ ; *e*, the cartilage filling the interspace of a double cone.

into the "dorsal laminæ" that forms the "primitive groove." The laminæ grow toward each other and unite along the median line, forming the neural canal. The two layers are at the same time folded downward as parallel folds, or ventral laminæ. The middle layer divides, the inner laminæ, with the entoderm, forming the alimentary canal, while the outer, with the mesoderm, form the outer walls of the abdominal cavity, or the somatopleure. In the meantime there appears in the layers below the primitive groove a cylindrical body of large cells filled with transparent protoplasm or sarcode, around which are differentiated from two to four layers, forming a sheath. This cylinder is the *chorda dorsalis*, which extends forward to within a short distance of the end of the primitive groove. The portion of the

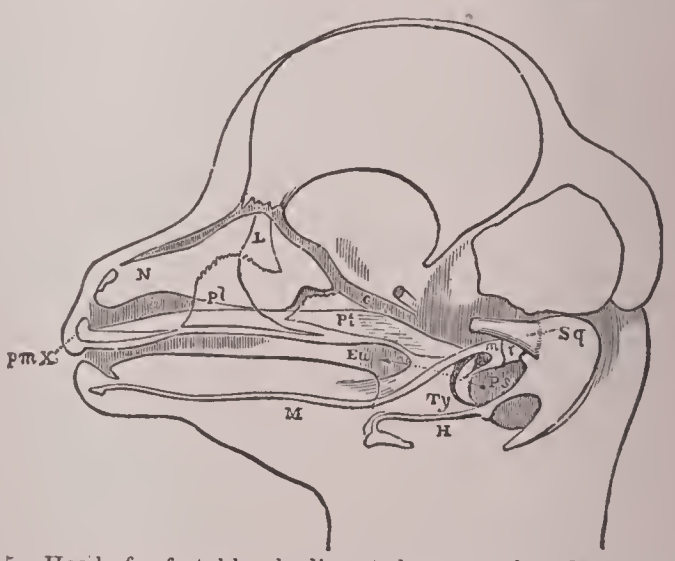


Fig. 5.—Head of a fœtal lamb, dissected so as to show Meckel's cartilage, M (from Huxley) : *m*, the malleus ; *i*, the incus ; *Ty*, the tympanic ; *H*, the hyoid ; *Sq*, the squamosal ; *Pt*, the pterygoid ; *pl*, the palatine ; *L*, the lachrymal ; *pmx*, premaxillary ; *N*, nasal sac ; *Eu*, Eustachian tube.

groove above it is enlarged, and then bent downward in front of the chorda. There is a constriction in the last-named portion of the now inclosed groove, or neural canal, so that three vesicles are formed, which are the concavities of the three axial segments of the future brain. The walls of this neural canal are continuous from the one end of the animal to the other. In the bodily portion of the axis, that part of the blastoderm which surrounds the chorda dorsalis

early presents the appearance of sub-quadrate segments or bodies, which, extending, gradually inclose the chorda as rings. At the same time corresponding segments appear in the dorsal laminæ. These are the bases of the future vertebræ, representing centrum and neurapophysis. The diapophysis and ribs appear in the form of cartilage in the somatopleure. The elements are completed by the deposit of phosphate of lime round the nutritive vessels, or the process of ossification; and they may remain distinct from each other or become co-ossified, according to the type of vertebrate. The manner of ossification of the body of the vertebra varies as follows:

I. Spinal column represented by the membranous sheath of the chorda dorsalis: class *Leptocardii* (lancelet).

II. Spinal column represented by the membranous sheath of the chorda, and cartilaginous neurapophyses and pleurapophyses; class *Marsipobranchii* (lamprey) and the *Chondrostei* (sturgeon, etc.).

III. Column represented by imperfect ossifications of the sheath of the chorda alone, with similar neurapophyses and pleurapophyses: certain sharks; e. g. *Hexanchus* and the merospondylous *Teleostomi*.

IV. Bodies of column ossifications of the chorda, together with the investing sheath: class *Selachii*, most sharks and rays.

V. Centra of vertebræ composed of ossifications of the external or blastodermic investment of the chorda: classes *Teleostomi*, bony fishes, *Batrachia*, *Reptilia*, *Aves*, and *Mammalia*.

The ossification of the bodies, beginning in the circumference of the sheath, first completes a ring, which then grows inward, constricting the chorda. The latter may be nearly or quite divided by the osseous body, and portions of it and the sheath remain between the biconcave centra as doubly conical or globular bodies, as in the osseous fishes and many salamanders.

When cartilage appears round the chorda dorsalis, in what becomes the base of the skull, it is unsegmented. It is plate-like, and sends a bar on each side round that part of the brain cavity (hypophysis) which is decurved in front of the end of the chorda. The bars (trabeculæ) reunite in front of it, forming another smaller plate. The borders of the plates then curve upward, forming the sides of the primordial cartilaginous skull, and, meeting above, close it in, leaving a vacuity in the middle line, or a fontanelle. In the cranial as in the spinal parts of the axis, cartilaginous rods appear in the inferior folds of the blastoderm or somatopleure, forming the visceral arches, the upper pieces of which become the ribs. Two of these appear beneath the posterior part of the skull, which become the *hyoid arch*, and the mandibular arch or lower jaw; a third (the palatopterygoid arch) appears as nearly horizontal, extending from the base of the second to near the end of the cartilaginous skull in front. When ossification sets in, the segmentation of the skull appears. This, however, takes place under two forms: the ossific deposit may be made in the cartilage or in the membrane investing that cartilage, forming the membrane bones of anatomists. It appears that the membrane bone represents a primary condition, and one that prevailed among the early Vertebrata, while the penetration of ossification to the cartilage was the mode of origin of the first cartilage bones. Hence, though corresponding ones of the cranial bones may have different origins to-day, their correspondence is not thereby destroyed. The base of the brain-case ossifies into three bones, the posterior the *basioccipital*, the next the *basisphenoid*, the anterior the *presphenoid*. The sides of the case ossify three plate-like bones, which correspond to and rest on these; namely, the *exoccipital*, the *alisphenoid*, and the *orbitosphenoid*. Closing the cranial cavity above are the three corresponding bones, the *supraoccipital*, *parietal*, and *frontal*. Thus three distinct cranial segments are presented, the occipital, the parietal, and the frontal. A section of the parietal arch is seen at Fig. 1 (*ns*, parietal; *np*, alisphenoid; *c*, basisphenoid). Of these elements the parietal and frontal bones are membrane bones, the remainder cartilage bones. An extended membrane

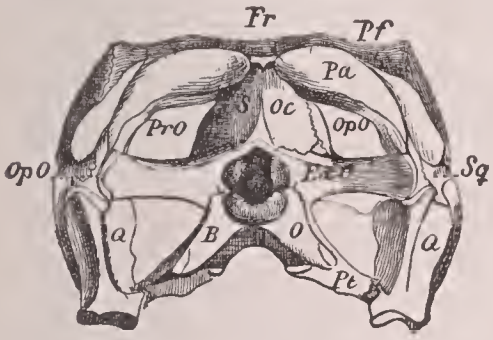


FIG. 6.—Cranium of *Iguana tuberculata*, from behind.

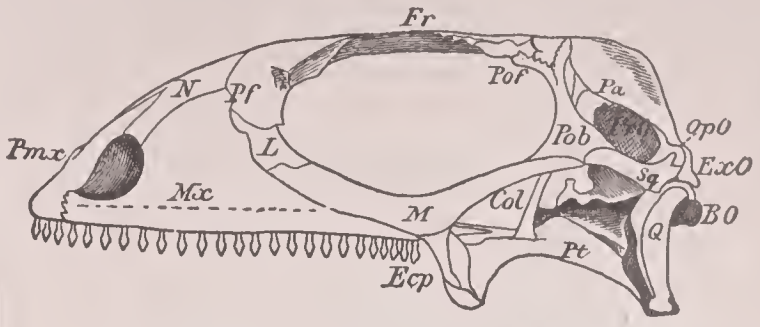


FIG. 7.—Cranium of *Iguana tuberculata*, profile.

bone, the *parasphenoid*, takes the place more or less completely of the cartilage bones, forming the axis or base of the brain-case in the fishes and batrachians. In front of it is another membrane bone, which is always present, the *vomer*, which forms the axis of that part of the skull which lies in front of the brain-case. This consists, first, of the ethmoid bone, which is a flattened cylinder formed by the union of the upturned borders of the primitive cartilaginous basal plate of that part of the skull. After uniting at the top, they turn downward in the middle line, forming a vertical septum. Laminæ project into the cavities so formed, from the outer wall, on which the branches of the olfactory nerve are spread; these are the *turbinal* bones. Above or on the ethmoid two membrane bones are developed, the *nasals*; at their sides behind and in front of the orbit, two other membrane bones may be present—viz., the *prefontal* (the upper) and the *lachrymal* (the lower). We have then a fourth or *ethmoid* segment. It remains to consider another series of bones situated between the parietal and occipital segments. These do not extend to the middle line of the superior or neural arch, but are developed in the cartilage in which the semicircular canals of the labyrinth of the auditory organs are imbedded. The upper lateral bone, which is usually only present in fishes, is the *pterotic*. Below this is the *petrous* bone, which is separated posteriorly from the exoccipital in some fishes by the *intercalary*. This bone is wanting in higher Vertebrata. In the Rhipidopterygian and Crossopterygian fishes, in Stegocephalous Batrachia, and in Cotylosaurian Reptilia the temporal fossa in which the temporal muscle is inclosed is covered by a roof which consists of some or all of the following bones: Immediately posterior to the orbit, above, the postfrontal; below, the postorbital. Posterior to these, above, the supramastoid; below, the supratemporal. Below these, in front, the jugal; behind, and joining the quadrate, the zygomatic. Between the supramastoid, supraoccipital, and exoccipital, the tabulars. In higher Vertebrata this roof is perforated by large foramina, so that bars or arches only remain. These may be either of three, or any two of them together. These are, according to their posterior attachments, the supramastoid, the supratemporal, or the zygomatic arches.

If we turn to the inferior or hæmal arches, we find three almost constantly and several others occasionally present. The former are, beginning at the front of the skull, the maxillary, the pterygopalatine, the mandibular, and the hyoid arches; the latter are the branchial arches, most of which are present only in fishes and some batrachians. The maxillary rods of opposite sides do not meet on the middle line, but the apex of the ethmoid arch is produced and its membrane ossifies on each side, forming the premaxillary bones, which in all vertebrates occupy the space between the maxillaries. The latter result from the ossification of the membrane covering the cartilage of the first visceral rods. Their inner margins sometimes grow together, forming the roof of the mouth and removing the posterior opening or the nostrils to the back part of it. The mandibular arch in its cartilaginous state is known as *Meckel's cartilage*. The part next the skull becomes separated from the rest, and is the support of the palatopterygoid cartilage. The remaining portion may be wanting, as in the lampreys (*Marsipobranchi*), or may remain as a movable articulated lower jaw. If these portions remain mostly cartilaginous, we have the permanent condition seen in the sharks and rays. In bony fishes three ossifications appear in it, namely (beginning next the skull), the *metapterygoid*, the *inferior quadrate*, and the *articular*. In the membrane

surrounding the cartilage the *angular* and *coronoid* bones appear in some; round the remainder of it the *dentary* is developed in all Vertebrata above Marsipobranchii. In reptiles and birds the metapterygoid and the inferior quadrate are represented by a single bone, the *quadrate*, which is the true support of the under jaw. In mammals the articular disappears, while the quadrate is drawn into the ear-chamber

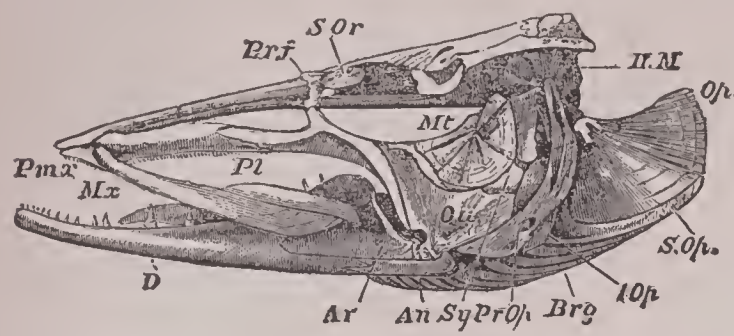


FIG. 8.—Skull of pike (*Esox*), from Huxley: *Pmx*, premaxillary; *Mx*, maxillary; *Pl*, palatine; *Prf*, prefrontal; *SOr*, supraorbital; *HM*, hyomandibular; *Mt*, metapterygoid; *Op*, operculum; *SOp*, suboperculum; *IOp*, interoperculum; *PrOp*, preoperculum; *Brg*, branchiostegal rays; *Sy*, symplectic; *Qu*, quadrate; *An*, angular; *Ar*, articular; *D*, dentary.

as the *malleus* or hammer, leaving the dentary to articulate directly with the skull. The hyoid arch also develops several osseous segments. In fishes these are called (beginning at the cranium) the *hyomandibular*, the *stylohyal*, *ceratohyal*, and as the middle piece below, the *basihyal*. The first named is a large bone, and supports in part the articulation of the lower jaw through the intervention of the inferior quadrate. The *stylohyal* segment is united by suture with the ceratohyal in fishes; in reptiles and mammals it is cartilaginous or ligamentous, and the portion next the skull in the latter when ossified is called the *styloid process*.

It remains to notice some membrane bones which protect the sides of the cranium, and the muscles attached to them. The maxillary carries on its posterior end a more or less flat rod, the *malar* bone, which protects the orbit below in mammals and many reptiles. On its posterior end it is joined to another piece, the *zygomatic*. In mammals this piece is fused to a plate on the side of the temple (the *squamosal*), and unites with the petrosal bone to form the *temporal*. In reptiles, where the quadrate carries the articulation of the lower jaw away from the skull, the zygomatic accompanies them and stands above the end of the quadrate, supported on the projecting rod formed of the paroccipital, exoccipital, etc., which is now known as the *suspensorium*. In *Batrachia salientia* the supratemporal lies over the length of the quadrate, and in fishes occupies a similar position on the outer face of the inferior quadrate and hyomandibular, and is known as the *preoperculum*. In fishes other membrane bones are added; namely, the operculum and suboperculum behind it, and the interoperculum below it. Another bone is formed in some reptiles which develops in the cartilage between the position of the interealary in fishes and the exoccipital, viz., the paroccipital. In tortoises and pythonomorphs it forms part of the suspensorium, and is very much elongated in serpents. In lizards it sends a process upward with the supramastoid, which forms, with a descending projection of the posterior angle of the parietal, the parieto-quadrate arch. The zygomatic arch is the only one found among the mammals. The ethmoid segment surrounds the olfactory lobes of the brain; the frontal is in front of the optic foramen; the parietal passes before the foramen of exit of the trigeminus (fifth) nerve. The otic bones extend posteriorly to the vagal (tenth) foramen, and the occipital to the foramen magnum.

In the fishes no bones are expressly related to the function of hearing. In the Batrachia and forms above them a portion of the otic capsule is separated as a lid, and is known as the *stapes*. In the tailless Batrachia (Salientia) a short bone originates at its anterior border (the interstapedial) and extends forward. To its distal end is appended a cartilaginous rod (the mesostapedial), and this is followed by a cartilaginous disk, the epistapedial, over which is stretched the integument forming the tympanum or ear-drum. In reptiles the interstapedial and mesostapedial are represented by a single bony rod, which is confluent with the stapes, the whole being termed the columella auris. In Mammalia the stapes is distinct, the interstapedial is represented by a small bone, the orbiculare, and the mesostapedial by the incus or anvil. The epistapedial has disappeared, and in its place the proximal end of the Meckel's cartilage is ossified as the malleus, which impinges on the tympanic membrane.

Special Osteology.—There are very numerous peculiarities characteristic of natural divisions of the Vertebrata to which only brief allusion can be made here. The vertebral bodies consist originally of three elements, two superior, each supporting a neurapophysis, and one below, or an intercentrum. All unite to form the body in fishes generally, but both form complete bodies in the tail of the Amia, etc. In Batrachia the body consists chiefly of intercentrum, while in the remaining Vertebrata the intercentrum is gradually extinguished, remaining principally in the caudal region as the basis of the chevron-bones. The centrum may be concave at both ends (*amphicœlous*), as in selachians, fishes, and Ichthyosauri, and many tailed batrachians; with ball-and-socket joint, the concavity being in the front of the body (*procœlous*), as in most tailless Batrachia and a majority of reptiles; with the cup behind (*opisthocœlous*), in the bony garfishes, some salamanders and frogs, a few Reptilia, and in the neck of many ungulate mammals. Finally, the centra are plane at both ends in Mammalia in general, and numerous reptiles, especially the extinct types Rhynchocephalia, Sauropterygia, Dinosauria, and some Crocodilia, where the ends are sometimes somewhat excavated. In Mammalia, and to a lesser degree in other Vertebrata, the vertebræ are distinguished into cervical, dorsal, lumbar, sacral, and caudal. The first are generally seven in number, and are readily distinguished by the perforation of their transverse processes (= diapophysis + parapophysis) for the conduct of the vertebral artery. The dorsals are distinguished as furnishing the points of attachment for the ribs. These vary in structure as follows: I. A single rib-basis; *a*, exclusively on the vertebral centrum: fishes, batrachians, and some reptiles, viz., tortoises, lizards, Pythonomorpha, and serpents; *aa*, partially standing on the neural arch: Sauropterygia. II. Two separate points of rib attachment; *a*, on the centrum only: Reptilia, Ichthyopterygia; *aa*, the lower (capitular) articulation on the centrum, the upper (tubercular) on the diapophysis, which springs from the neural arch: reptiles (Crocodilia, Dinosauria, most Theromora, Pterosauria), birds and mammals. The lumbar vertebræ succeed the dorsals, and are distinguished by the absence of rib articulations; but the ribs extend to the sacrum in some Crocodilia (Belodon), Dinosauria, Theromora, and birds. The sacral vertebræ are usually co-ossified into a single mass, the sacrum, with very massive diapophyses for sutural attachment to the iliac bones or pelvis. They are numerous in the birds, less so in the Dinosauria (Agathaumas has eight), four to six among mammals with well-developed hind limbs. There are three or two in reptiles with hind limbs, while in any of the orders where these members are small or rudimental a single vertebra serves the same purpose. The caudal vertebræ are distinguished among Vertebrata below the mammals by the presence of the chevron-bones (see Fig. 3, *pp*, *hp*) on the inferior surface. They are present in Cetacea (whales), Edentata, some Insectivora, etc., among Mammalia.

The ribs present a general similarity except in their proximal attachments, as already pointed out. They articulate in the thorax with the median bones of the breast or sternum in all above the fishes, and usually remain separate for the remainder of their length. An exception, however, occurs in the tortoises, where they are so widened as to unite by their borders into a more or less complete shield, which protects the entire visceral cavity, and into which, in many species, the head, tail, and limbs may be withdrawn. In birds and some crocodiles and Rhynchocephalia there are recurved processes on the ribs pointing backward, the "uncinate processes." The thoracic ribs are united by segments on the middle line below, which, taken together, constitute the sternum. The hæmal element of the ribs is wanting in fishes, serpents, Ichthyopterygia, Sauropterygia, and tortoises; the sternum is absent in the same groups, so far as known. The first appearance of the sternum is in the Batrachia, where a cartilaginous plate behind the shoulder-girdle represents it in the tailed and many of the tailless forms. In many of the latter it becomes an osseous segment, and in some extinct Stegocephali is a bony, shield-like body. In Lacertilia and Pterosauria it is a broad plate behind the coracoid bones. In Dinosauria it is small and often divided. In birds it is of similar form in the most reptile-like forms, as the apteryx, ostriches, etc., but is peculiar in the possession of a produced process on each side in front (costal process). This is frequently ossified from a separate cen-

ter (protosteon), while the main shield originates from a center on each side, the pleurosteon, and sometimes from two others behind these, the metostea. In most existing birds besides the ostriches there is a middle center of ossification, the lophosteon, which when ossified is a prominent keel extending along the length of the sternum. The metostea are frequently produced as separate lateral rods, and in nearly all birds the hinder margin of the sternum is variously incised. In Crocodilia the sternum exists as a small shield in front, and a prolongation from it backward on the median line. This brings us to the form seen in the Mammalia, where it defends the middle line of the thorax as a series of segments which may number from two (Echidna) to thirteen (two-toed sloth). In the whales it is represented by an oval or cruciform bone, and its posterior segment in other mammals is a spatulate cartilage or bone known as the xiphisternum.

There are various *dermal* ossifications found posterior to the sternum and hæmapophyses in different Vertebrata. These consist, in many Stegocephali, of osseous rods arranged *en chevron*, with the angle anteriorly directed. Similar pieces, with the addition of lateral ones, exist in ichthyopterygian, sauropterygian, crocodilian, and rhynchocephalian reptiles. In tortoises these extend below the shoulder-girdle in front and the pelvic arch behind, and unite together into the solid inferior plate or plastron. This is connected with the ribs by a series of membrane bones, the marginals, which also extend all round the free margin of the upper shell or carapace. The dermal pieces of the plastron are the two clavicles, the interclavicle between them, the two hyosternals, the two hyposternals, and the two postabdominals.

The scapular arch in vertebrates is composed of both cartilage and membrane bones. Like the pelvic arch, it appears as a cartilaginous rod in the somatopleure of the fœtus, often extending in its fold to near the point of contact above the vertebræ on the median line. If development proceeds, the upper part of this cartilage becomes segmented off, forming the scapula, while the lower portion becomes bifurcated into the coracoid and epicoracoid bones. In mammals, fishes, and some others, a membrane bone is developed in front of the epicoracoid, the clavicle. From the junction of the three, the cartilaginous basis of the fore limb appears. Above the scapula another segment is usually present, the suprascapula.

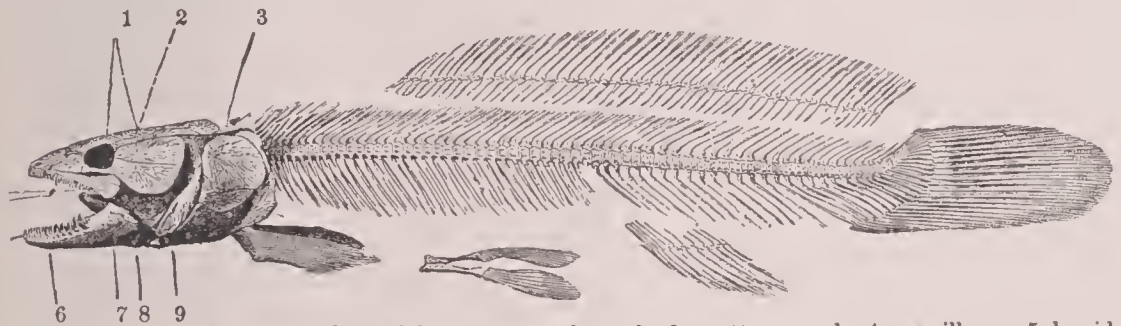


FIG. 9.—*Amia calva*, L.: 1, frontal bone; 2, postfrontal; 3, posttemporal; 4, maxillary; 5, hyoid; 6, dentary: 7, angular; 8, interoperculum; 9, branchiostegal rays.

The fishes differ from other vertebrates in having another membrane bone, the posttemporal, connecting the epiclavicle with the cranium at the tabular bone. This is wanting in sharks, where the arch is cartilaginous and without laminiform membrane bones. In many fishes there are membrane bones which extend in a bar backward and downward from the clavicle; namely, the first, second, and third postclavicles. There may also be a cartilage bone behind the coracoid, the postcoracoid. The following scheme will express the leading characters of the classes and orders in the structure of the scapular arch:

A. Arch suspended to cranium by posttemporal.

1. Scapula, coracoid; epiclavicle and clavicle, and sometimes interclavicle, present: *Pisces.*

AA. Arch not suspended to the cranium; no laminiform dermal bones.

1. Arch cartilaginous: *Selachii.*

2. Coracoid and scapula osseous; suprascapula and epicoracoid cartilaginous: *Batrachia urodela.*

3. Coracoid and scapula, suprascapula and clavicle osseous; epicoracoid cartilaginous: *Batrachia anura.*

AAA. Arch not suspended; laminiform dermal bones present (except Chamæleo).

1. Scapula and coracoid only ossified; no clavicle or interclavicle: *Lacertilia rhiptoglossa.*

2. Interclavicle only ossified membrane bone: *Crocodilia.*

3. Clavicle and single interclavicle of membrane, and scapula, procoracoid and coracoid of cartilage, all osseous.

a. Clavicle and interclavicle united with plastron: *Testudinata.*

aa. Clavicle and interclavicle free; epicoracoid cartilaginous: *Ichthyopterygia, Lacertilia.*

aaa. Clavicle and interclavicle united with a short procoracoid, forming furcula; epicoracoid not osseous; suprascapula co-ossified with scapula: *Aves.*

aaaa. Clavicle and interclavicle distinct; epicoracoid large, osseous; procoracoid wanting: *Mammalia prototheria.*

AAAA. Arch not suspended; both membrane and cartilage bones; coracoid rudimental or wanting.

a. Clavicle united with mesoscapula and procoracoid into one bar; epicoracoid and suprascapula rudimental or wanting: *Mammalia eutheria.*

The Limbs.—The cartilage forming the limb-bones appears early in a fold of the outer skin, and in the Vertebrata above the fishes is soon divided by transverse interruptions into three segments. In the Lepidosirenidæ this cartilage may be broken up into many successive joints. In Ceratodus a branch segment is given off at the end of each of these primary joints, but in sharks and fishes most of the segments diverge from one side only. The basal and the first and second of the one side are especially enlarged in the sharks, forming the *metapterygium*, *mesopterygium*, and *propterygium*, from which numerous cartilaginous radii arise, forming a triangular fin. The extremital parts of the fins are dermal, and embrace the ends of the cartilaginous rods. In true fishes the propterygium and mesopterygium are wanting, and the radii of the first cross-row, either cartilaginous or osseous, reach the scapular arch. The upper radial unites with the metapterygium to form the first ray of the fin, often a strong spine; the remainder usually number four, but may be more numerous in the lower groups. They are subquadrate in the higher fishes, but much elongate in the Pediculati, where the number is reduced to three and two.

In Vertebrata, from the Batrachia up, the limbs, both fore and hind, are early divided into three principal segments. In the anterior, the first presents a single bone, the humerus; the second, two parallel bones, the ulna and radius; and third the foot. This consists of two transverse rows of small bones, the carpals, and from three to five rows of longer bones, the phalanges, arranged in typically five ray-like lines or digits, the basal segments of which are called the metacarpals. Typically, there are three bones in the first transverse row of carpals and five in the second, with a median bone inclosed between the rows, a condition seen in various batrachians and reptiles. In higher classes these bones are variously combined or omitted. The bone next the radius is the scaphoid, the next the lunar, the next the cuneiform; in the second row the first is the trapezium, the second trapezoides, third magnum, while in many forms the fourth and fifth are combined and called the unciform, and the centrale is united with the scaphoid. In Ichthyopterygia the bones of the fore and hind limb beyond the humerus and femur are of similar shape, but, though undistinguishable as to form, are proximally of the usual position and number. In birds there are never more than three digits of the fore foot, in the Apteryx and Casuarius only one. These answer to the second, third, and fourth of the ordinary foot. The metacarpals are co-ossified in all birds excepting the extinct Archæopteryx. In Mammalia of the order *Cetacea* the ulna and radius are immovably fixed in a single plane with the carpus and manus, and not flexibly articulated with the humerus, thus resembling the aquatic reptiles (Sauropterygia). In higher orders the radius possesses greater or less power of rotation on the ulna, which is especially developed in apes and man. In proboscidians the proximal end of the radius is moved outward above the ulna, so as to cross it obliquely. In Perissodactyla (odd-toed) and Artiodactyla the ulnar attachment to the carpus is more and more reduced, until the radius, appropriating the larger part, extends almost entirely in front of the ulna. The latter becomes in the horse and

ruminants very slender and co-ossified with the radius. In the carpus a bone develops below the tendon of one of the flexors of the foot, which articulates with the cuneiform, called the *pisiform*. In five-toed orders the carpals are usually distinct, excepting in the Carnivora, where the scaphoid and lunar are generally co-ossified. In the Artiodactyla the number of toes is regularly reduced from four to

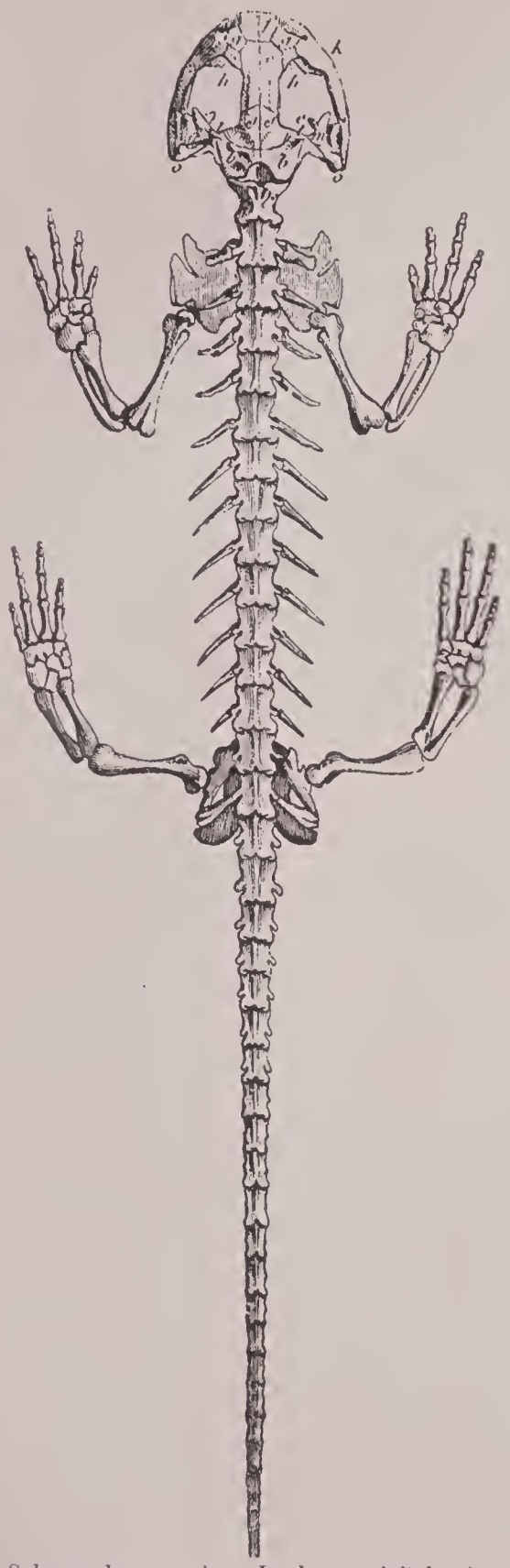


FIG. 10.—*Salamandra maculosa*, L.: *b*, exoccipital; *c'*, parietal; *c*, frontal; *e*, pterygoid; *f*, premaxillary; *g*, nasal; *h*, prefrontal; *k*, maxillary; *l*, proötic; *m*, squamosal; *o*, quadrate.

two, and the number of carpals is reduced correspondingly in the second row, those of the first being narrowed. In the most specialized Ruminantia the trapezium is wanting, and the trapezoides and magnum are confluent. The outer digits become smaller and disappear, while the two middle metacarpals, representing the third and fourth, co-ossify into the single "cannon-bone." In the living types the third metacarpal supports the whole width of the trapezoides and magnum, while in the extinct family of the *Anoplotheriidæ* it articulated with the magnum only. The last phalange in Carnivora, Insectivora, bats, rodents, etc., is compressed, and with its complete horny sheath forms a claw; in ungulates it is broad, the posterior faces becoming inferior when in use; the horny covering partly incloses it behind, and forms a hoof. In apes and men the last phalange is flat, and supports a flat horny nail.

The *pelvic* arch is composed of the single superior element, the *ilium*, and the two inferior ones arranged as limbs of a fork, the anterior, the *pubis*, the posterior, the *ischium*. The ilium corresponds with the scapula, the pubis with the epicoracoid, and the ischium with the coracoid. The ilium generally presents a crest forward, from which a strong ligament descends to the end of the pubis, which represents the clavicle. It is the Poupart's ligament of human anatomy. Fishes, however, do not possess a pelvis, with two exceptions, those of the Lepidosirenidæ and of the Holocephali. In the

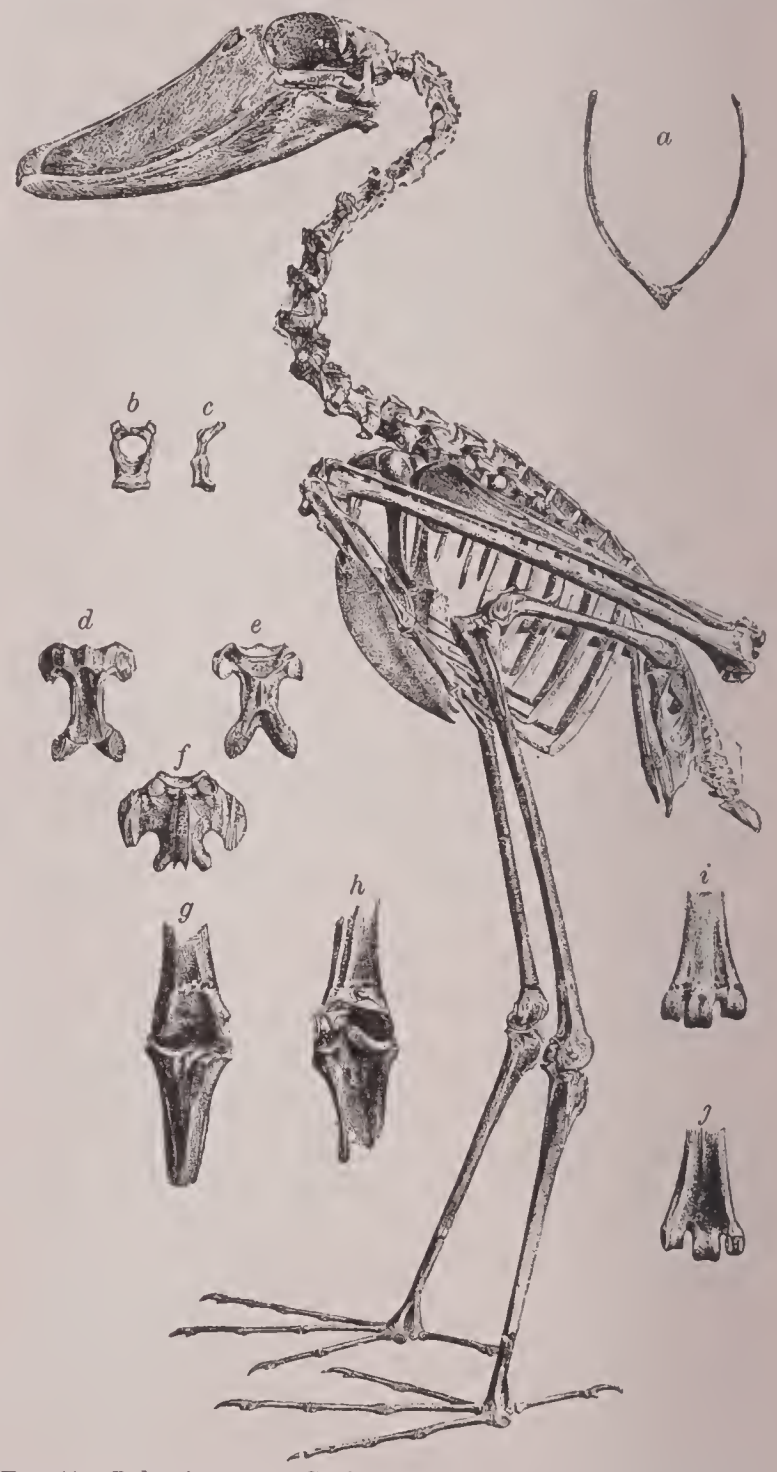


FIG. 11.—*Balæniceps rex*, Gould: *a*, hyoid arch; *b*, atlas from behind; *c*, atlas, profile; *d*, ninth cervical vertebra from below; *e*, same from above; *f*, middle dorsal vertebra from above; *g*, posterior view of tibio-tarsal joint; *h*, anterior view of the same; *i*, distal end of tarso-metatarsus, front view; *j*, same from behind.

former there is a single median diamond-shaped cartilage, to which the limbs are attached, whose homology is unknown. In the latter there is a flat curved cartilage extending forward from the basis of each fin on each side, which occupies the position of the pubis. Another and serrate cartilage is attached to its anterior margin in the male, which projects into an open pouch, from which it can be protruded. A cartilaginous rod succeeds the pubic bone as the basal element of the posterior limb. In the Dipnoi this is followed by others, forming the segmented ray representing the ventral fin. In Ceratodus each segment is furnished with a short divergent sub-segment on each side; but in the sharks and rays the sub-segments or radii are all on one side. In

these animals the axis is much shortened, so that the radii are packed closely together on the basal piece or metapterygium; the first radius also is enlarged, forming an opposite border of the fin. In the rays the latter is much enlarged, and supports radii indistinguishable from the others. In Polypterus the basal element is deprived of rays, except at its extremity, and they, as in the sharks, support the dermal fin-rays proper. In sturgeons the radial bones are present in the ventral fins only, but in Lepidosteus and Amia one or two very small rudiments remain, and the dermal fin-rays are attached immediately to the femur, as is the case with all the true fishes. In sharks the axis is developed into some peculiar and complex organs, the elaspers, which function as intromittent reproductive organs.

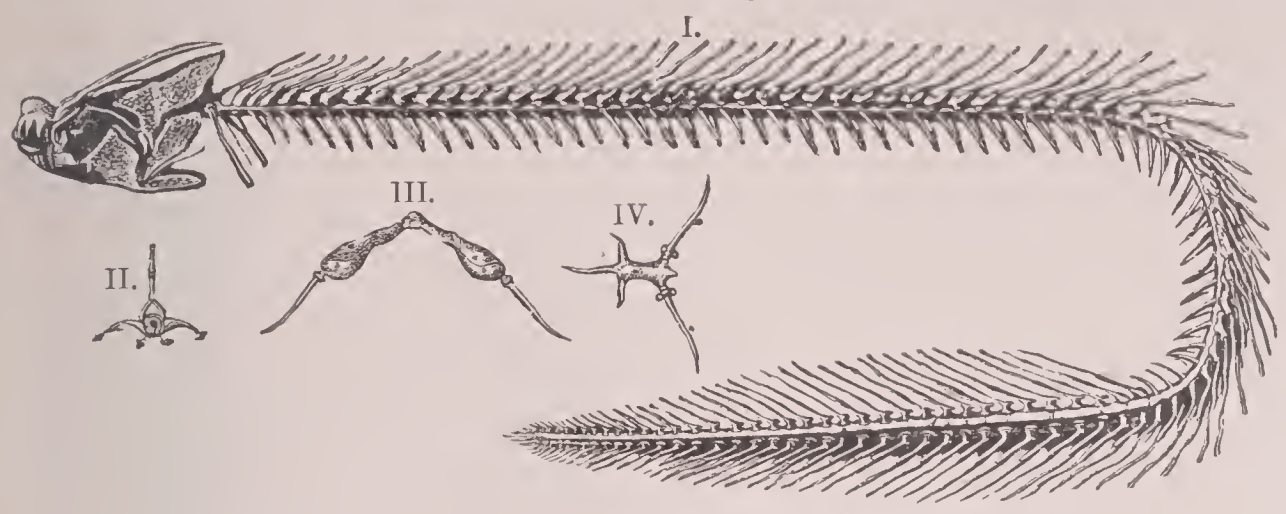


FIG. 12.—*Lepidosiren paradoxa* (I.); II., a vertebra: III., pelvis; IV., pectoral arch.

The three pelvic elements are remarkably constant in all the land vertebrates, the most marked variations being seen in the *Batrachia anura* and the Dinosauria and Aves. In the former the ilia are much elongate and extended backward to the acetabula, round which the ischia and pubes are compacted in a solid mass. In Dinosauria Goniopoda the ischia are slender and unite into a dense osseous rod, which served as a support when in a sitting position (e. g. Megadactylus). In the Dinosauria Orthopoda the pubes are turned backward beneath the ischia, are slender, and not united distally. They are similar in position in the birds, but are united distally in the ostriches. The ischia in birds are slender and not distally united, but often co-ossified with the ilia. The ilium is directed backward and upward in reptiles, both backward and forward in birds and Dinosauria, and forward in Mammalia. In the earliest Batrachia and Reptilia (of the Palæozoic realm) it is directed upward. The acetabulum is perforated and not completed at the fundus in Dinosauria and the birds. In Crocodilia the pubes are not united on the middle line below, but are directed forward. In the marsupial mammals the pubes support a pair of bones directed outward and forward, the marsupial bones, which are ossifications of the produced symphysial cartilage. In Mammalia the pubes and ischia are in contact on the middle line below, and are sometimes extended posteriorly, joining the peduncles of the ilia (American Edentata, Notoryctes).

FIG. 13. — Posterior foot of *Rhinoceros*: *a*, calcaneum; *b*, astragalus; *c*, cuboid; *d*, navicular; *e*, mesocuneiform; *f*, ectocuneiform; *g*, fourth; *h*, third; *i*, second toe.

The *hinder limbs* are wanting in Leptocardii, Dermopteri, and several orders of true osseous fishes collectively called Apodes or eels. In most other fishes they occupy the usual position on the abdomen, but in the Physoclysti they are placed beneath the pectoral limbs, or nearly so, the pubic bones being more or less united and suspended from the symphysis of the coracoids. In Plectognathi they form a simple rod, which is generally deprived of fins. In Batrachia the hind limbs are constituted like the fore limbs, and therefore embrace one bone in the first segment, *femur*; two in the second, *tibia* and *fibula*; three in the third, *tibiale*, *mediale*, and *fibulare*; five in the fourth, from which are continued the five metatarsals and series of phalanges. These correspond with the elements of the fore leg as follows: femur to humerus; tibia to radius in front, and fibula to ulna behind. These relations are maintained so long as the limbs extend horizontally without twist, either in paddles, as in Ichthyopterygia, or terrestrial animals, as salamanders. In most vertebrates the first bones are twisted in opposite directions, that is, toward each other, the knee pointing forward, the elbow backward, which causes an apparent reversal of the homologies of the two bones of the second segment. In the hind foot of the higher Vertebrata, especially the mammals, the tibiale and intermedium form the single astragalus, while the fibulare is produced backward, forming the heel-bone or calcaneum. The centrale becomes the navicular, while the fourth and fifth of the second row unite to form the cuboid. In the reptiles these bones are less distinctly constituted, and various modes of combination present themselves. In the Dinosauria the astragalus and calcaneum are often co-ossified, and may be united, by suture or co-ossification, with the tibia. In the birds the latter case always prevails, and the fibula, being much reduced, does not generally extend to the articulation. In reptiles and birds, then, the ankle-joint is between the two rows of tarsals, while in Mammalia it is between the tibia and astragalus. The number of toes is usually four and five in the Batrachia and reptiles; among birds it is usually four, the inner being turned backward and reduced in size, and sometimes wanting. The metatarsals of the three remaining toes are co-ossified with each other and with the second row of tarsal bones. In Mammalia the normal number of digits is five, but is often reduced to four. Among ungulates the hippopotamus displays four; the lateral ones are reduced in the hog and the *Tragulus*, till in the *Poëbrotherium* they are reduced to rudiments, two only remaining. These are united into a solid "cannon-bone" in the *Boöidea*, which supports two distinct toes. In the rhinoceros there are but three toes, of which the central is the largest; the laterals are successively reduced in the horse series, composed of such genera as *Anchitherium* and *Prothippus*. In ruminants the navicular and cuboid bones are united, and often the second and third of the second row or cuneiforms with each other and the naviculo-cuboid.

FIG. 14.—*Diplopus*, hind foot (from Kowalevsky): *Cal*, calcaneum; *As*, astragalus; *nav C*, navicular; *Cb*, cuboid; C^3, ectocuneiform.

It remains to notice the peripheral ossifications of fishes and a few appendages of other Vertebrata. In the archetypal fin each neural spine and each hæmal behind the abdominal cavity supports an additional bone called an interneural, and the latter another bone, the basilar. This is the case in a large portion of the unpaired fins of the sharks and the Dipnoi. These basilar bones support the fin-rays, which are developed in the dermal fold that represents the fins in the early stages. The vertebræ in the Dipnoi and a number of other fishes gradually diminish in size to the end of the tail, forming a type called the protocereal. In other fishes the hæmal spines of the last vertebræ are largely developed, forming the principal part of the basis of the caudal fin. In these the vertebral axis turns upward to the end, forming the type called heterocercal, which is seen in sharks, sturgeons, and some bony fishes. In the majority of osseous fishes the terminal vertebræ are wanting, and the greatly expanded hæmal spines extend round its end, forming a fan. This is the homo-

cercal tail. In the dorsal and anal fins of the Teleostomi the basilar bones are usually wanting, but in some cases rudimentary; they are long in the anal fin of Amia. In Polypterus certain median fin rays are very elongate, and each supports a number of cartilaginous rays, the posterior from the end, but the more anterior from the posterior side, forming the horizontal dorsal pinnules of that genus. In higher fishes the interneurals, which support the dorsal, and the interhæmals, that support the anal fin, are more numerous than the vertebræ they are opposite to. In many fishes there are interneurals between the cranium and dorsal fin which support no fin.

Horn cores are developed on the crania of various species of Mammalia, especially the *Eobasiliidæ* among Amblypoda, *Menodus* among Perissodactyla, and the *Boöidea* among Artiodactyla. They are permanent except in the *Cervidæ* among ruminants, where they grow and are shed annually, leaving a basal portion, the burr, attached to the frontal bones. They are often of large size, and grow with incredible rapidity.

See Cope, *On Osteology of Fishes, Batrachia, and Reptilia, especially Lacertitia*; Cuvier, *Ossemens Fossiles*; Flower, *Osteology of Mammalia*; Gegenbaur, *On Limbs and the Shoulder and Pelvic Girdles*; Huxley, *Elements of Comparative Anatomy*, and *Anatomy of Vertebrated Animals*; Kölliker, *The Development of the Vertebral Column*; Owen, *Anatomy of Vertebrate Animals*; *Homologies of the Vertebrate Skeleton*; Parker, *Anatomy of the Shoulder Girdle*; *Development of the Skull in the Ostrich Tribe, the Pig, Frog, Eel, and Salmon*; Vrolik, *On the Ossification and Bones of the Skull of the Teleostei.* E. D. Cope.

Osteopathy [from ὀστέον, bone, and πάθος, suffering]: a method of treating diseases of the human body without the use of drugs, by means of manipulations applied to various nerve centers, chiefly those along the spine, with a view to inducing free circulation of the blood and lymph, and an equal distribution of the nerve forces. Special attention is given to the readjustment of any bones, muscles, or ligaments not in the normal position.

The system was formulated in 1874 by Dr. A. T. Still, a physician of Baldwin, Kan., who, having become dissatisfied with the results attained through the practice of medicine, determined, if possible, to discover a more natural and efficacious method of healing. He reasoned that a body so perfectly constructed mechanically should be able to protect itself against the inroads of disease without the artificial aid of external substances, except those employed as food. His next conclusion was that "a natural flow of blood is health, and disease is the effect of local or general disturbance of blood." With this as a working hypothesis, he made a series of experiments, the results of which convinced him that the various organs of the body were controlled by nerve centers located chiefly along the spine, and that these could be operated upon and controlled by pressure or stimulation of the fingers. He holds also that if the bones, muscles, arteries, veins, lymphatics, glands, organs, and tissues of the body are in their correct anatomical positions, disease can not exist. Displacement may arise from a variety of causes, such as a fall, a blow, a strain, or atmospheric changes. Pressure upon the blood vessels or nerves in the immediate vicinity of the part so affected will follow, and a consequent shutting off of the nerve or blood supply to some organ, which will then become diseased. With a readjustment of the displaced part will come "perfect freedom of motion of all the fluids, forces, and substances pertaining to life, thus re-establishing a condition known as health."

Osteopathy does not confine itself to a treatment of maladies of the bones, nor does it find in diseased bones the origin of all pathological conditions. The name was considered by Dr. Still as applicable to his system because of the relative importance which his theory gives to anatomy, and because of his belief that "the bones could be used as levers to relieve pressure on nerves, arteries, and veins." Treatments, which do not as a rule occupy more than twenty minutes, are given through thin garments, and not, as in massage, upon the bare flesh. No machines or appliances are used. Among the complaints said to have been treated successfully are heart and lung diseases, nervous prostration, sciatica, lumbago, all forms of neuralgia and paralysis, asthma, catarrh, incipient consumption, spinal curvature, eye and ear affections, and all dislocations, liver, kidney, stomach, and intestinal affections.

The first institution for the training of practitioners in osteopathy was opened about 1894 in Kirksville, Mo., under the name of the American School of Osteopathy. Since then others have been established in different parts of the U. S.

Osthoff, Hermann: comparative philologist; b. at Billmerich, Westphalia, Apr. 18, 1847; educated at the gymnasium in Unna and at the Universities of Bonn, Tübingen, and Berlin; teacher at the gymnasium in Cassel 1871–74, privat docent in Leipzig 1875–77; Professor of Comparative Philology in the University of Heidelberg since 1877. His chief works are *Forschungen im Gebiete der indogerm. nominalen Stammbildung* (2 vols., 1875–76); *Das Verbum in der Nominalcomposition* (1878); *Morphotogische Untersuchungen* (in collaboration with Karl Brugmann, 5 vols., 1878–90); *Zur Geschichte des Perfects im Indogermanischen* (1884); also many important articles in various scientific journals.

Benj. Ide Wheeler.

Os'tia: an old Roman town; on the left side of the mouth of the Tiber; about 14 miles S. W. of Rome. Ancient writers agree in stating that it was founded by Ancus Martius as a maritime station for his capital, but it was not until the wars with Carthage that it became important as a port for the introduction of foreign grain. From that time it grew rapidly, and was soon the principal commercial and naval station of the Romans. The harbor, however, was never a really good one, and in the reign of Claudius it was already so shoaled up by deposits from the Tiber as to necessitate the construction of an artificial basin about 2 miles to the N. This was called *Portus Augusti*, afterward *Portus Trajani*; but the new town which grew up around it (*Portus* or *Portus Urbis*) never equaled the old one in size and opulence. Ostia began to decline with the declining empire, and early in the ninth century was a heap of ruins. Gregory IV. then tried to rebuild it, but without success; and later popes have made similar fruitless attempts. Fine statues and other works of art are often disinterred here, and excavations, which have been systematically carried on since 1855, have disclosed extensive warehouses and other commercial and public structures, whose foundations and lower stories remain to witness to the former greatness of this ancient city. Ostia was an episcopal see at the beginning of the fifth century, and the title bishop of Ostia and Velletri is now given only to the dean of the Sacred College, resident in Rome.

Os'tracism [from Gr. ὀστρακισμός, ostracism, deriv. of ὀστρακίζειν, banish by vote, ostracize, deriv. of ὄστρακον, shell, tile (used in voting)]: a form of temporary banishment that prevailed in ancient Athens and some other Greek cities (Argos, Megara, Miletus). The Athenian senate and ecclesia having decided that ostracism was necessary in the case of any citizen, the ten tribes voted upon the question in the agora. Each voter in favor of the ostracism presented a tablet or shard of burnt clay, on which was written the name of the person to be banished. If there were 6,000 votes for it, the person ostracized was obliged to leave the state within ten days and not return for ten years unless recalled. Ostracism was not a penalty for crime, but was employed against persons supposed to possess dangerous power. The exile retained his property and social position. In Syracuse the olive-leaf was used instead of the clay tablet, and the act of exile was called *petalism*.

Ostrac'oda [from Gr. ὄστρακον, shell + εἶδος, form]: an order of Crustacea, sub-class Entomostraca (*q. v.*), embracing a few small aquatic forms, some living in the sea, others in fresh water. The most striking features in their structure are the presence of seven pairs of appendages, a short unjointed abdomen, the whole inclosed in a horny or even calcareous bivalve shell. These forms feed upon decaying animal matter and are abundant in stagnant water. Fossil forms occur in all formations since the Palæozoic. For an illustration, see article Cypris. The two principal genera are *Cypris* and *Cypridina*, the former of which has the power of reproducing parthenogenetically. See Brady, *Transactions of Linnean Society* of London (xxvi.), and papers by Claus and Sars. J. S. Kingsley.

Ostre'idæ [Mod. Lat. from *Ostre'a*, the typical genus, from Lat. *os'trea*, from Gr. ὄστρεον, oyster]: the family of Lamellibranch molluscs which includes the Oysters (*q. v.*). Among the characters separating it from the Lamellibranchiata (*q. v.*) are the following: The mantle lobes are not united to each other, no siphon is formed, there is but a single adductor muscle for closing the shell, while the foot has disappeared. The shell is irregular, the two valves being more or less unequal, and the hinge is without projections or teeth. Only one living genus, *Ostrea*, is recog-

nized, while this and two others (*Gryphæa* and *Exogyra*) exist as fossils. The pearl oysters belong to a different family.

J. S. Kingsley.

Ostrich [from O. Fr. *ostruche* > Fr. *autruche*: Span. *avestruz*: < Lat. *a'vis stru'thio*; *a'vis*, bird + *stru'thio* = Gr. στρουθίων, ostrich, deriv. of στρουθός, sparrow, bird]: the largest of living birds, belonging to the family *Struthionidæ* and order *Struthiones*, distinguished by its great size and by having only two toes on each foot. Its scientific name is *Struthio camelus*. The adult male ostrich stands nearly 8 feet high and weighs upward of 200 lb. The head is flattened, eyes large, neck and thighs praetically bare, the wings small and useless. The plumage, including the wing and tail feathers, which furnish the large plumes of commerce, is loose and wavy. The males are glossy black with white wings and tail, the females and young are dirty gray; the chicks are striped. The ostrich inhabits the sandy plains of Africa from the Barbary States to Cape Colony, but in many places has been exterminated, or nearly so, for its feathers. In former days it was found over a considerable portion of Southwestern Asia, but is now practically restricted to Central Arabia. The ostrich is sometimes found in small troops, but more often, especially during the breeding season, a male and from three to five females will be found together. The females lay their eggs to the number of about thirty in one nest, a shallow pit scooped in the sand, and during the day they are mostly left to the heat of the sun. At night the male sits on the eggs and they are rarely left unguarded in the daytime. A number of loose eggs are always found in the vicinity of the nest, it is said for the nourishment of the newly hatched young. The food of the ostrich consists of grass, roots, and seeds, but lizards, insects, and other animal food are also eaten. The ostrich trusts to flight for protection, but can inflict a dangerous blow with its foot. Two or three species of ostriches have been described, but it is not yet clear whether these are good species or only geographical races. The egg of the northern bird is rough; that of the southern smooth.

Ostrich-farming is extensively carried on in South Africa, and to a far less extent in Northern Africa, South America, and Southern California. London is the chief market for ostrich feathers, and the annual sales amount to from 120,000 to 175,000 lb. The prices vary greatly; from $200 per lb. for the best white plumes to $7 for the young feathers. The name ostrich is frequently applied to the South American rhea. See Rheidæ. F. A. Lucas.

Ostrog': town; in the government of Volhynia, European Russia; 176 miles W. of Kieff (see map of Russia, ref. 8–C). Here the first Slavonic Bible was printed. Ostrog has a military school, a school for teachers, five churches, and a trade in wool, wood, leather, wheat, and flour. Pop. about 16,900, mostly Jews.

Ostrogoths: See Goths.

Ostrolen'ka (in Polish, *Ostroleka*): town; in the government of Lomza, Russian Poland; on the Narew. An encounter took place here Feb. 16, 1807, between the French under Savary and the Russians under Essen, in which the former were victorious. The place became still more famous by the battle which was fought here May 26, 1831, between the Poles under Skrzynecki and the Russians under Diebitsch. After a long and bloody contest the Poles were forced to retreat, but the Russians were unable to follow them on account of their own losses. Pop. 5,120.

Ostrov'skiĭ. Aleksandr Nikolaevich: dramatist; b. in Moscow, Russia, Mar. 30, 1824; d. June 2, 1886. Having begun to write while still a schoolboy, he first became known to the public by a couple of scenes which appeared in Moscow newspapers in 1847. Two years later he established his reputation with *Svoĭ Liudi sochtemsia* (We Get on with Our Own Kind), one of his best comedies. His pieces followed each other in rapid succession. After 1862, while still continuing with his comedies, he also composed dramatic chronicles in verse, which, however, do not rise to the height of real historical tragedy, and achieved only moderate success. Perhaps the best known of them are *Dmitriĭ Samozvanets i Vasiliĭ Shuiskiĭ* (1867) and *Vasilisa Melentĭevna* (1868). Ostrovskiĭ is very popular in Russia. He chose as the field of his descriptions the life and ways of the middle classes in Moscow, a part of society hardly above the peasants in intelligence, with customs and ideas still those of the Middle Ages, almost unaffected by Western European thought and culture. Among the best of his plays are *Bednaĭa Nevesta* (The Poor Bride, 1852); *Bednost ne Porok* (Poverty is not a Fault, 1853); *Dokhodnoe Mesto* (A Profitable Place, 1857); *Groza* (The Storm, 1859); and *Goriachee Serdtso* (A Warm Heart, 1869). He also was the author of many excellent single scenes and of several translations, especially a remarkable one of *The Taming of the Shrew*. His complete works were published at St. Petersburg (1887, 10 vols.). Three of his plays have been translated into French by Durand Greville. A. C. Coolidge.

Ostrow'ski: the name of a celebrated family of Polish nobility, originally descending from the palatinate of Lublin. Among its most remarkable members was Tomasz Adam Rawicz, Count Ostrowski, b. at Ostrow, Dec. 21, 1739. He took a very active part in the establishment of the constitution of May 3, 1791, and was appointed Minister of Finance, but resigned when the king shortly after joined the confederacy of Targowicza, and lived after the third division of Poland (1795) in retirement on his estates in the Ukraine. On the establishment of the duchy of Warsaw he was made grand marshal of the diet in 1809, and president of the senate Dec. 6, 1811. The Emperor Alexander I. also showed great confidence in him, and the Poles received their new constitution of 1815 from his hands. D. Feb. 5, 1817.—His son, Antoni Joannes, Count Ostrowski, b. at Warsaw, May 27, 1782, studied at the University of Leipzig; entered in 1806 the French body-guard; was made a member of the provisional government of the duchy of Warsaw; followed Napoleon to Dresden in 1813, and fought in the battle of Leipzig; entered the Polish senate after the death of his father, and opposed the arbitrary measures of the Grand Duke Constantine; was one of the leaders in the Polish revolution of 1830, fighting at last in the ranks on the walls of Warsaw, and wrote the manifesto which the last remnant of the Polish army issued (Oct. 4, 1831) to the kings and nations of Europe after crossing the Prussian frontier and laying down their arms. He afterward lived in France, and published *Le Panslavisme moscovite* (1842). D. in Paris in 1847.

Osu'na: an old, substantially but irregularly built town, in the province of Seville, Spain; 48 miles E. S. E. of the city of Seville; on a hill in a very fertile plain rich in wine, almonds, figs, and olives (see map of Spain, ref. 19–D). The castle of the Duke of Osuna is a large and magnificent building. There are manufactures of silk, linen, and leather. Pop. (1887) 19,376.

Osuna, Pedro Tellez Giron, Duke of: statesman; b. at Valladolid, Spain, in 1579; spent his childhood at Naples, where his grandfather was viceroy; was educated at Salamanca, and assumed the title of Duke of Osuna on his marriage with a daughter of the Duke of Alcala. He was at first unpopular at the courts both of Philip II. and Philip III., and was twice exiled, but having gained military distinction in Flanders, where the twelve years' truce of 1609 was advised by him, he was restored to favor at the Spanish court. He became Viceroy of Sicily 1611, but was transferred to Naples 1616. In the latter office he won great popularity by his defense of the people against the oppressions of the nobility and clergy. He was subsequently suspected of conspiring with foreign princes to make himself independent in Southern Italy; was recalled 1620, and subjected to a long and secret trial for high treason. Though not convicted, he was retained a prisoner in the Castle of Almeidas, where he died in 1624, either by suicide or poisoned by his wife.

Oswald, Saint: King of Northumbria; b. about 604; son of Ethelfrid, who was killed in 617 by Redwald, King of East Anglia; resided some years thereafter an exile in Scotland (or Ireland), where he was converted to Christianity; came to the throne 634; made war upon Cadwalla, King of Wales, whom he killed in battle; introduced Christianity into Wales; married Cyneburg, daughter of the West Saxon king Cynegil, on condition of her embraeing Christianity, and was killed at Maserfield Aug. 5, 642, by the heathen king Penda of Mercia. The events of his life as given by Bede and Alcuin are overgrown with miraculous legends, which were long popular, especially in Germany. He was canonized by the Roman Church.

Oswego: city; capital of Labette co., Kan. (for location, see map of Kansas, ref. 8–J); on the Neosho river, and the Mo., Kan. and Tex. and the St. L. and S. Fé railways; 13 miles S. by E. of Parsons. It derives good power from the river for manufacturing, and has several mills, a national bank with capital of

$50,000, a private bank, and three weekly newspapers. Pop. (1880) 2,351; (1890) 2,574; (1900) 2,208.

Oswego: city; capital of Oswego co., N. Y.: on Lake Ontario, at the mouth of the Oswego river; at the northern terminus of the Oswego Canal; on the Del., Lack. and West., the N. Y., Ont. and West., and the Rome, Watertown and Ogdensburg railways; 35 miles N. N. W. of Syracuse, and 328 miles N. W. of New York city (for location, see map of New York, ref. 3–G). It is beautifully laid out on three large, low hills, thus, having unsurpassed natural drainage, and is a noted summer resort. The streets have a uniform width of 100 feet and cross at right angles; the building blocks are 400 feet long by 200 feet wide; the paving is asphalt and brick. The city has five large public parks, delightfully shaded, with an average area of 5 acres. It has fine national, State, municipal, and other buildings, including the U. S. custom-house, which contains the post-office and the U. S. court-room, a spacious city hall, State armory, handsome new county jail, new county clerk's office, one of the most commodious court-houses in the State, and a U. S. life-saving station supplied with modern apparatus. Fort Ontario, on the east side of the river, commanding the entrance to the harbor, is a casemated structure, with moat and bastions, and is garrisoned by a company of U. S. infantry. It is one of the three fortifications that originally defended the city while a British possession. There are 20 churches. Oswego is noted for her educational facilities, having a State Normal and Training School, six large brick public schools, and many smaller ones, all graded, besides several parochial and private schools and business colleges. The number of pupils enrolled in the public schools in 1900 was 4,000; in the parochial schools, 1,425. The city contains a public library (founded by Gerrit Smith in 1855) with over 20,000 volumes, and a city-school and a normal-school library. It has a hospital and asylums for homeless old ladies and orphans. In 1900 the total receipts of the city were $378,207.10, and expenditures $371,682.06, and the assessed valuations were, real estate, $8,541,688; personal, $1,686,443—total, $10,429,791. There are 2 national banks, with a total capital of $300,000, and 2 savings-banks with total deposits of about $2,000,000, besides several aid and loan associations. The city has abundant water-power, supplied by the Oswego river, which divides it E. and W. and forms the outlet of a beautiful group of eleven lakes in Central New York. It has many manufacturing concerns, several of which are the largest of their kind in the U. S., such as starch-works, knitting factories, boiler-works, the Standard Oil Company's box-shops, malt-house, shade-cloth works, and a match factory. Other large local industries are a book-bindery, car-building and repair shops, sash and blind factory, and extensive lumber yards. During the past ten years Oswego has been transformed from a commercial to a manufacturing city. The lake shipping has been diverted because of the increased tariff rates on Canadian goods, but the industrial conditions have continued to be very prosperous. Here are located the famous Deep Rock Mineral Springs. The paid fire department is one of the best equipped and most efficient in the State. Oswego is one of the chief ports of entry in the U. S. A vast outer harbor is formed by a breakwater with parapet, over a mile long, and contains the D., L. and W. Railroad Company's immense coal-trestles. The old or inner harbor is formed by two piers at the river's mouth, and contains two large coal trestles. These harbors protect several miles of wharfage and accommodate the largest vessels. Coal is the main article of export, and 510,000 net tons were shipped during the year ending December 31, 1900. There were received during the same period 190,000 bushels of grain and 40,000,000 feet of lumber. The total revenue collected for the year was $117,386.69. A steamer runs three times a week from the city to the Thousand Islands during the pleasure season. Oswego has various outing clubs and a yachting club with a fine fleet and is a noted fishing resort. There are 2 daily and 3 weekly newspapers. The city is one of the oldest settlements in the State, and was incorporated as a city in 1848. It was the last point to be surrendered by Great Britain to the U. S. Government. Pop. (1880) 21,116; (1890) 21,842; (1900) 22,200.

JOHN M. HURLEY.

Otaheite, ō-tăă-hĕĕ'te: See TAHITI.

Ota'go [from Maori *Otakou*, red earth]: the most southern provincial district of the Middle island of New Zealand. Area, 25,487 sq. miles. The first settlement was made here in 1847, and in 1851 the number of settlers had increased to 1,740; but in 1861 gold was discovered in several districts, and in two years the population swelled to 48,907, of whom only 500 were natives. The gold-fields now comprise an area of 2,500,000 acres, and in other directions the province has made great progress; it is being extensively cultivated, and its natural riches are rapidly developing. Pop. (1891) 153,097. Capital, Dunedin.

Otari'idæ [Mod. Lat., named from *Ota'ria*, the typical genus, from Gr. *ὠταρός*, large-eared, deriv. of *οὖς*, *ὠτός*, ear]: a family of mammals of the order *Pinnipedia*, containing the sea-lions and fur-seals. The form is more like that of ordinary quadrupeds than in any other members of the order; the fore limbs are flippers, the hind limbs flexible forward; the head is bear-like; small linear ears are developed; the 34 or 36 teeth are present (M. $\frac{5-6}{5-5}$, C. $\frac{1}{1}$, I. $\frac{3}{2} \times 2$), and the incisors of the upper jaw are notched; the anterior limbs are about as large as the posterior; their digits decrease in a curved line and are destitute of claws; the posterior feet have all their digits nearly coterminal, and are furnished with long flaps extending beyond the tips; the three middle toes are alone provided with claws. The family has been variously subdivided, but by naturalists in the U. S. is regarded as being represented by five genera, viz.: (1) *Zalophus*, (2) *Eumetopias*, (3) *Otaria*, (4) *Arctocephalus*, and (5) *Callotaria*. The first is represented on the coast of California as well as Japan and Australia; the second is restricted to the North Pacific, *E. stelleri* descending, however, as far as California; the third and fourth belong to the southern seas; and the fifth to the North Pacific. The first three are "hair-seals" and the last two "fur-seals." *Arctocephalus* is hunted for its fur at widely distant places; *Callotaria*, however, is only sought for to any extent on the Pribyloff islands, Alaska, and Commander islands, Kamchatka. Revised by F. A. LUCAS.

Otfried: poet; a Frank by birth; studied at Fulda under Hrabanus Maurus (822–847), and also under Salomon I., Bishop of Constance (839–871); went to St.-Gall, and was afterward monk in the Benedictine monastery at Weissenburg, Alsace. Here he wrote, with the avowed purpose of displacing the worldly songs of the people, his famous *Evangelienbuch*, a paraphrase in verse of the Gospels. The first part of his poem he sent to Hartmuat and Werinbracht, monks of St.-Gall, another part to Bishop Salomon, and the complete work he finally dedicated about 865 to King Louis, the German, and to Archbishop Liutbert of Mentz. In an extremely interesting letter, written in Latin to Liutbert, he speaks of the aim of his poem and of the difficulties he encountered with the German language while composing it. The poetical merit of Otfried's work is very small. As one of the most extensive documents of the Old High German period, which, moreover, was composed in rhymes, Otfried's *Evangelienbuch* is, however, of the greatest value for the study of the German language and of German metrics. For the didactic parts of his poem, which are very frequent, Otfried used the works of Hrabanus, Beda, and Alcuin. See the editions of Otfried by J. Kelle, P. Piper, and O. Erdmann; K. Lachmann, *Kl. Schriften*, i., 449. J. GOEBEL.

Othman or **Osman I.**, GHAZI, the Victorious: founder of the empire and people, called from his name Ottoman or Osmanli; b. in 1259. After a romantic and adventurous youth, he succeeded his father, Ertogrul Shah, a Turkish chieftain, as principal commander of Alaeddin III., Seldjuk Sultan of Roum (1288). The Seldjuk empire falling to pieces (1299), Othman at Kara Hissar was proclaimed *Padishahi ali Osman*, Emperor of the Ottomans (1300). His kingdom comprised parts of Bithynia and Phrygia. Though his name was mentioned in the Friday prayer (one of the two distinctive attributes of sovereignty among the Mussulmans), he did not coin money or assume the title of sultan. His life was passed in petty but advantageous wars with the Byzantine empire, and in the organization of his conquests. Broussa was captured (1326) just before his death. He was brave, patient, sagacious, generous and frugal, and possessed the peculiar virtues and talents essential to the founders of empires.—OTHMAN II.: Ottoman sultan (1617–22): b. in 1604; succeeded Mustapha I. Though he was a warlike and intelligent prince, his reign was unfortunate, being convulsed by frequent rebellions of the janissaries and by a disastrous war with Poland. At the unsuccessful siege of Choczim 50,000 Ottomans perished. Imprudently threatening to suppress the janissaries, he was dethroned by them, and

strangled in the Seven Towers by the hands of the grand vizier, the first Ottoman sultan put to death by his subjects. —Othman III.: Ottoman sultan (1754–57); b. in 1700; succeeded Mahmoud I. He was effeminate and soured by his long seclusion in the seraglio, but his reign was uneventful.
E. A. Grosvenor.

Othman or **Osman-Ibn-Affan**: third caliph of the Mussulmans; b. about 574; an early convert to Islam, a relative and secretary of the prophet Mohammed, whose daughters Rubiya and Um-Sul-sum he married. On the assassination of Omar (644) he was chosen caliph, mainly through the influence of the Korëish. During his caliphate the first authentic copy of the Koran was compiled (652), Armenia and Asia Minor were partially subdued (646), and Cyprus, Crete, Rhodes, and Cos conquered by the first naval expedition ever sent out by the Arabs (649); but his reign was distracted by numerous insurrections, which he could not put down. He was a feeble and incapable ruler, indulgent and despotic by turns, and often unjust. When he ordered Mohammed, the son of Abubekir, to be put to death, the latter marched upon Medina without opposition, and stabbed the caliph on the pulpit steps (655). E. A. Grosvenor.

Otho: King of Greece; second son of Louis I., King of Bavaria; b. at Munich, July 1, 1815. Nominally chosen king by the Greeks (May 7, 1832) he was really appointed by France, Great Britain, and Russia, with scant regard to Greek aspirations. He married the beautiful Princess Amelia of Oldenburg, Sept. 22, 1836. Surrounding himself with Bavarians, insisting on German as the official language, despotic and reactionary in policy, he was soon detested by his subjects. The peaceful revolution of Sept. 14, 1843, forced the king to dismiss the foreigners and to grant a constitution, promulgated Mar., 1844. Its provisions he soon sought to evade or nullify. He gained a temporary popularity during the Crimean war by wishing to attack the Ottoman empire, but the Anglo-French fleet occupied the Piræus and prevented action. The popular hatred of his government soon returned, and showed itself in several attempts at insurrection, which were, however, easily crushed. The national outburst of Oct. 21, 1862, was successful. Boulgaris, Canaris and Kouffos formed a provisional government, and pronounced the deposition of the king, who returned to Bavaria, and died in obscurity at Bamberg, July 26, 1867. In Otho's behalf it may be said that British, French, and Russian intrigues at Athens complicated and increased his difficulties, and that the newly enfranchised Greeks were impatient of control. E. A. Grosvenor.

Otho, Marcus Salvius: Roman emperor from Jan. to Apr., 69 A. D. As a young man he was conspicuous as a companion of Nero, and a sharer in his revels: but the emperor's passion for the wife of Otho, Poppæa Sabina, was the cause of alienation, and finally of practical exile, Otho being sent to take charge of the remote province of Lusitania (Portugal). Here, on the revolt of the provinces against Nero, Otho joined the forces of Galba, hoping to be adopted by him, and thus designated as his successor. When, however, Galba adopted L. Calpurnius Piso, Otho by a daring stroke won over the prætorian guard, already somewhat disaffected, and was saluted by them as emperor. Galba and Piso were thereupon murdered by the guard, and on the same day the senate clothed Otho with the imperial dignities. Soon after his succession news was brought that Vitellius, commander of the legions on the lower Rhine, had been proclaimed emperor by his army, and that his forces were advancing on Rome to make good his claim. Otho with great promptness collected his forces, and met the advance of the enemy in the region of the Po. Here for a time his operations were successful, but, a portion of his army suffering defeat near Cremona, he lost heart, and put an end to his life. His brief reign gave promise of a liberal and vigorous administration.
George L. Hendrickson.

O'thoes (Egypt. *Tetà*): the name given by Manetho to the first king of the sixth Egyptian dynasty. According to Manetho (Africanus) Othoes-Teta ruled thirty years. He was the first king to assume the royal title, which was ever afterward customary, "Son of Ra." Particularly noteworthy is the fact that his pyramid at Saqqarah, opened in 1881, was one of those containing funereal texts, which have been published by Maspero (*Recueil de travaux relatifs à la philologie et à l'archéologie égyptiennes et assyriennes*, vol. v.). The name *Tetà* also belonged to the second king of the first dynasty, reported to have been a writer on medicine and anatomy, and later to the sixth king of the third dynasty, who is called Tosertasis by Manetho.
Charles R. Gillett.

Otho of Freising: historian; b. about 1114; a grandson of Henry IV., and the uncle of Friedrich I.; was educated for the Church, studied in Paris, entered the Cistercian monastery of Morimund in 1130, and was in 1137 appointed Bishop of Freising. D. Sept. 21, 1158. He took an active part in the various theological and political movements of his age, but he is principally known as a historian. Between 1143 and 1146 he wrote a work (*De duabus civitatibus*), an imitation of the work of Orosius, and, like that, based on Augustine. Especially the last book of the work is of great interest. His *Gesta Frederici*, a work of still greater interest, he left unfinished. His works have been edited by Wilman (Hanover, 1884) and in *Mon. Hist. Germ.*

Otid'idæ [Mod. Lat., from *O'tis*, name of a genus, from Lat. *o'tis* = Gr. *ὠτίς*, a kind of bustard with long ear-feathers, deriv. of *οὖς, ὠτός*, ear]: a family of birds containing the bustards, confined to the Old World. There are about twenty-five species, two of which occur in Europe, one in Australia, and the others in India and Africa. See Bustard.

Otis, Elwell S.: See the Appendix.

Otis, Fessenden Nott, A. M., M. D.: surgeon; b. at Ballston Spa, N. Y., May 6, 1825; graduated at the New York Medical College 1852; was resident assistant physician at Blackwell's Island Hospital 1852–53; surgeon to the U. S. M. Steamship Company 1853–60; surgeon of the New York police department 1861; lecturer on genito-urinary diseases at the New York College of Physicians and Surgeons 1862–71; superintending surgeon to Pacific Mail Steamship Company 1869–73; president of New York board of police surgeons 1870–72; surgeon to the Strangers' Hospital and president of its medical board 1871–73; Clinical Professor at the College of Physicians and Surgeons 1871; advisory physician to the Artists' Fund Society, and member of the medical board of the New York Charity Hospital 1873. He wrote *Landscape Perspective and Animal Drawing* (1849), *History of the Panama Railroad and the Pacific Mail S. S. Co.* (1861), and numerous monographs on urethral and syphilitic diseases, and invented a number of surgical instruments. D. May 24, 1900. Revised by S. T. Armstrong.

Otis, George Alexander, M. D.: surgeon; b. in Boston, Mass., Nov. 12, 1830; graduated at Princeton 1849, and at the medical department of the University of Pennsylvania 1851; studied surgery two years in London and Paris; established *The Virginia Medical Journal* 1853; entered the U. S. army in 1861 as surgeon; was assigned to duty July, 1864, in the office of the surgeon-general at Washington; published monographs on *Amputation of the Hip Joint* (1867) and *Excisions of the Head of the Femur for Injury* (1869); prepared in 1871 a *Report of Surgical Cases treated in the Army of the United States from 1867 to 1871*, forming a quarto volume; and in 1872 edited the surgical volume of the first part of the *Medical and Surgical History of the War*. He was curator of the Army Medical Museum at Washington. D. in Washington, D. C., Feb. 23, 1881.

Otis, James: political leader; b. in West Barnstable, Mass., Feb. 5, 1725; graduated at Harvard College 1743; studied law with Jeremiah Gridley, and began practice at Plymouth 1746; removed to Boston 1750; published in 1760 *Rudiments of Latin Prosody*; in 1761, when advocate-general of the admiralty, refused to argue in favor of the writs of assistance, and resigned his office to plead the people's cause; in 1762 was elected to the State legislature, and in 1765, on his motion, the Stamp Act congress met in New York, to which he was a delegate. His speeches and pamphlets placed him at the head of the patriotic party in Massachusetts; in 1769 he denounced in print the commissioners of customs, and on Sept. 9, meeting one of the commissioners in a coffee-house, he was attacked, and received a cut on his head which led to derangement; took part, however, in the battle of Bunker Hill; retired to Andover, where he was killed by lightning May 23, 1783. His published works include *Vindication of the Conduct of the House of Representatives* (1762); *Rights of the British Colonies asserted* (1765); and *Consideration on Behalf of the Colonists* (1765).

Otomis, or **Othomis**: a tribe of Indians inhabiting the mountain regions of the states of Querétaro, Hidalgo, and Guanajuato, with scattered bands in several other states of Mexico. They have been established in their present seats

from time immemorial, and occupied the valley of Mexico before the Toltecs and Aztecs. At present they maintain no tribal organization, are Mexican citizens, and usually speak Spanish in addition to their own language, which is one of the harshest and most guttural of all Indian dialects. It consists in a great measure of words of one or two syllables only, whence it has erroneously been supposed to belong to a different linguistic family from the neighboring tribes, and unsuccessful efforts have been made to connect it with the Chinese. Several catechisms and devotional works have been printed in Otomi, the best-known grammar being that of Neve y Molina (Mexico, 1767).

Otranto, Duke of: See Fouché.

Otranto, Terra di: See Lecce.

Otsego Lake: a body of water in Otsego co., N. Y.; 7½ miles long, 1½ broad, 1,193 feet above tide; the source of the main fork of the Susquehanna river. Its waters are clear and abound in fish. Cooperstown stands at its outlet.

Otsu: a town and garrison-station of Japan; at the southern end of Lake Biwa; about 7 miles from Kioto; the seat of government of the Shiga prefecture (see map of Japan, ref. 7–C). In a monastery on the hill is a famous bell, said to have been stolen by Benkei, the Japanese Hercules, in the twelfth century. On the western border of the lake, about 3 miles off, is the famous pine-tree of Karasaki, of extraordinary age and size. J. M. D.

Ottawa: city; capital of the Dominion of Canada, and of Carleton County, Province of Ontario; at the junction of the Ottawa, the Rideau, and the Gatineau rivers; on the Rideau Canal, and the Canadian Pacific, the Canada Atlantic, the Parry Sound, the St. Lawrence and Ottawa, the Ottawa and Gatineau Valley, the Pontiac and Pacific Junction, the New York and Ottawa, and several branch railways; 95 miles N. E. of Kingston, 120 miles W. of Montreal, 450 miles N. by W. of New York city (for location, see map of Ontario, ref. 2–H). It is on the south bank of the Ottawa river, from which it rises by a succession of bluffs to Parliament Hill, 160 feet above tide-water, on which the principal Government buildings have been erected, and is bisected by the Rideau Canal. The scenery at every turn is very beautiful, comprising a grand display of architectural skill, river, mountain, and forest attractions, and two picturesque waterfalls, Chaudière, on the W. of the city, and Rideau, about a mile E. of the center of the city. The city is laid out in wide and regular streets, which are ornamented with shade trees and drinking fountains, and is lighted with gas and electricity. It has an improved drainage system, and a water-works plant completed in 1874 at a cost of over $1,000,000, which brings water from an intake, some 3,000 feet above Chaudière Falls, to the city by direct pumping, rendering a reservoir unnecessary. There are a number of public parks and squares, including Parliament Hill and Major's Hill, both under control of the Federal Government; Lansdowne Park, on the Rideau Canal; Cartier Square, containing a brick drill-hall, used as a parade-ground by the local militia and as an athletic field by various societies; and Rockcliffe Park, a short distance N. E. of the city, which has become a popular place of recreation and a hot-weather resort. The city is connected with suburban towns and resorts by electric street-railway.

The most notable of the public buildings are those built on three sides of a quadrangle on Parliament Hill. They comprise the Parliament building, the Eastern Departmental building, the Western Departmental building, and the Langevin block, the latter on Wellington Street, nearly facing the Parliament building. They are separate buildings, almost pure Gothic in architecture, and with walks and drives occupy an area of 30 acres. The main building, used by the Senate and House of Commons, has a tower over 220 feet high, and the library building, in the rear of the main structure, is octagonal in shape, with a circular interior 290 feet in diameter. The Langevin block was erected in 1883 at a cost of $787,000, and the total cost of the Government buildings up to 1900 was about $6,000,000. Other Federal buildings are those occupied by the Supreme and Exchequer Courts, the geological and natural history survey, and the national art gallery and fishery exhibit, and the Cartier Square drill-hall. About a mile and a half from the Parliament building is Rideau Hall, in a domain of 78 acres, the official place of residence of the governors-general of the Dominion. The public buildings of the municipality include the city-hall, which cost $90,000; the court-house and jail, the normal and model schools, the University of Ottawa, the Collegiate Institute, the post-office and custom-house, Orphans' Home, Home for the Aged, Carleton General Protestant Hospital, Catholic General Hospital, St. Luke's General Hospital, Lady Stanley Institute for training nurses, Home for Convalescents, and the Rideau and Athletic clubs.

Ottawa is the seat of an Anglican bishopric and of a Roman Catholic archbishopric, and has over forty churches, representing almost every Christian denomination. At the head of the educational institutions is the University of Ottawa, which was founded as a college in 1848, made a university in 1866, and raised by the pope to the rank of a Roman Catholic university in 1889. There are also a model and normal school, a collegiate institute, the Coligny Young Ladies' College, a number of nunneries and convents, the Harmon Ladies' School, and a number of public and private institutions. There are twelve chartered banks, or branches of banks, with an aggregate paid-up capital of $38,745,960, and a reserve of $14,362,033.

Abundant water-power for manufacturing purposes is furnished by the Ottawa river, which is augmented in the vicinity of the city by the Rideau, the Gatineau, the Du Lievres, the Black, the Bonnechère, the Rouge, and the Mattawa rivers. The industrial establishments comprise paper-mills, railway car and repair shops, indurated ware, woodenware, match, carriage, stove, and furniture factories, foundries, planing and flour mills, and granite-works. Ottawa is one of the largest lumber-markets in the world. The first sawmill at Chaudière Falls was erected in 1853, and in that year was cut the first lumber exported from this district to the U. S. The sawed lumber trade has since increased till the capacity of the mills within the city limits alone is about 200,000,000 feet per season. The assessed valuation of Ottawa in 1900 for taxation was $25,067,205.

Ottawa was founded in 1826, when the construction of the Rideau Canal was begun under Lieut.-Col. By, of the Royal Engineers, and was known as Bytown till 1854, when it received a city charter under its present name. In 1858 it was selected to be the permanent seat of government of united Canada, and in 1867 it was made the capital of the Dominion. On Apr. 26, 1900, Hull and a large part of Ottawa were destroyed by fire, causing a loss of more than $15,000,000. Pop. (1881) 31,307; (1891) 44,154; (1900) 58,193. Hull, on the opposite or northern side of the Ottawa, connected by two fine bridges, has about 10,000 more. About one-third of the population of Ottawa is of French-Canadian blood, and about one-half the total population is Roman Catholic. Editor of "Journal."

Ottawa: city (settled in 1830, incorporated as a village in 1838 and as a city in 1853); capital of La Salle co., Ill. (for location, see map of Illinois, ref. 3–E); at the confluence of the Illinois and Fox rivers; on the Illinois and Michigan Canal, and the Burlington Route, and the Chi., Rock Is. and Pac. railways; 83 miles W. S. W. of Chicago, 98 miles E. of Rock Island. It is in a region abounding in coal, brick and pottery clay, and cement and glass-sand, has exceptional transportation facilities, and ships large quantities of grain, produce, and general merchandise. The city occupies a beautiful site, and is tastefully laid out, having several public parks, one of which, South Park, contains a noted medicinal spring. There are gas and electric lights, electric street-railway, sewerage system completed in 1892, water-works supplied by over 150 artesian wells and by suburban springs, 12 churches, 7 public-school buildings, including a high school, public-school property valued at $100,000, St. Francis Xavier's Academy, a driving-park association, 2 national banks with combined capital of $200,000, a private bank, 5 libraries (High School, Illinois Law, Odd Fellows', Reddicks Public, and Young Ladies' Temperance Union) containing about 20,000 volumes, and 3 daily and 8 weekly newspapers. The manufactures include window-glass, glass bottles, lamp-chimneys, pottery, drain-tile, sewer-pipe, fire-brick, tile-roofing, organs, cigars, carriages and wagons, agricultural implements, flour, saddlery and harness, pumps, and lumber. Pop. (1880) 7,834; (1890) 9,985; (1900) 10,588.

Ottawa: city; capital of Franklin co., Kan. (for location, see map of Kansas, ref. 6–J); on the Marais des Cygnes river, and the Atch., Top. and Santa Fé and the Mo. Pac. railways; 27 miles S. of Lawrence, 53 miles S. W. of Kansas City, Mo. It is the seat of Ottawa University (Baptist, chartered in 1860), and has 2 national banks, a private bank,

2 libraries (public and university) containing over 5,500 volumes, a new court-house that cost $50,000, and a daily, 4 weekly, and 2 monthly periodicals. Ottawa has railway repair and machine shops, flour-mills, castor-oil and linseed-oil mills, sorghum, sugar, and sirup factories, grain elevators, foundry, and soap and furniture factories. Pop. (1880) 4,032; (1890) 6,248; (1900) 6,934. EDITOR OF "REPUBLICAN."

Ottawa: village; capital of Putnam co., O. (for location, see map of Ohio, ref. 3–D); on the Cin., Ham. and Day. and the Findlay, Ft. Wayne and West. railways; 50 miles S. W. of Toledo. It is in an agricultural, lumbering, and stock-raising region, and has several flour and saw mills, a private bank, and three weekly newspapers. Pop. (1880) 1,293; (1890) 1,717; (1900) 2,322.

Ottawa Indians: See ALGONQUIAN INDIANS.

Ottawa River: in Canada; is the boundary between the provinces of Ontario and Quebec (except in the very lowest parts of its course). It rises on the divide between the basin of the St. Lawrence and Hudson Bay, and flows S. E. and E., communicating with the St. Lawrence at the west end of Montreal island. It sends off the Rivière des Prairies, between Montreal island and the Isle Jésus, N. of which the Ottawa flows, finally joining the St. Lawrence below the island of Montreal. It has numerous rapids, some of which are flooded out by dams and others surmounted by canals. It has a heavy trade in lumber. Its cataracts afford very great water-power. It is navigated by steamboats and canal-boats. It is connected with Lake Ontario by the Rideau Canal. Its valley contains much fertile land and is rapidly filling with settlers. Length, 791 miles.

Ottawa University: See the Appendix.

Ot'tendorfer, OSWALD: journalist; b. at Zwittau, Moravia, Feb. 26, 1826; studied law at Prague and Vienna; settled in New York 1850; became an editor of the *New Yorker Staats-Zeitung*, and subsequently its manager and proprietor. Under his auspices it became one of the leading German-American papers and a prominent advocate of the interests of the Democratic party. As president of the German Reform Association Mr. Ottendorfer took a leading part in the exposure of dishonesty in the city government in 1871, at which time his paper assumed an independent attitude in politics; was alderman 1872–74, and was an independent candidate for mayor 1874. He built and endowed an educational institution in Zwittau, founded a home for aged and indigent men on Long Island, and established the Ottendorfer free library in New York city. D. Dec. 16, 1900.

Otter: a long-bodied, short-legged animal, with a small, flattish head, long, stout, rounded or slightly flattened tail. Otters are carnivorous mammals, belonging to the family *Mustelidæ* and sub-family *Lutrinæ*. Most species have sharp nails and webbed feet, but those of the genus *Aonyx*, found in Africa, Java, and Sumatra, have the webs small and the nails short or even lacking on some toes. The general color of the long outer coat of hair is a rich brown; the under fur, which in northern species is thick and valuable, is much lighter. Otters are aquatic in their habits, dwell in burrows by the water, and feed on fish. They are fond of sliding down-hill on the snow or mud banks. The common European otter (*Lutra vulgaris*), which is found throughout a great part of Europe and Asia, attains a length of 3 ft. 6 in. and a weight of 18 to 24 lb. The North American species (*Lutra canadensis*), which occurs in favorable localities from Florida to Canada and from Maine to Alaska, is sometimes 4 ft. 6 in. long. Various species of otters inhabit South America, Africa, Asia, and Japan, but the coat of the tropical species is short and commercially of little or no value. In India and China otters are trained for fishing. The sea-otter (*Enhydris lutris*), the sole member of the sub-family *Enhydrinæ*, is a marine species, found from California northward through the Aleutian island to Kamchatka and the Kurile islands. It is a bulky animal, distinguished by its short head, large flattened hind feet, and short tail. It attains a length of 4 feet, feeds on crabs, shellfish and sea-urchins, and is strictly aquatic, being often found in the open sea, sleeping and rearing its young in the water. The fur of this animal, which is very thick, soft, and dark-colored, is extremely valuable, good skins bringing $400 to $600. Owing to this value the animal is much hunted, has become very scarce and is, at least on the American coast, threatened with extermination. F. A. LUCAS.

American otter (*Lutra canadensis*).

Ot'terbein, PHILIP WILLIAM: founder and bishop of the United Brethren in Christ; b. at Dillenburg, Germany, June 4, 1726; entered the Reformed ministry in 1749; went in 1752 to North America as a missionary; labored especially in Pennsylvania and Maryland; founded his new church near Frederick, Md., 1800; was chosen bishop; toiled with great earnestness and success. D. at Baltimore, Nov. 17, 1813. He was a man of learning and piety. See UNITED BRETHREN IN CHRIST, and his *Life*, by A. W. Drury (Dayton, O., 1884).

Otterbein University: the oldest institution of learning under the charge of the United Brethren in Christ; at Westerville, O.; 12 miles N. of Columbus. It was founded in 1847, and chartered with university privileges. There are three buildings at present: the main college building, 170 feet by 109, two and four stories high; Saum Hall, a ladies' dormitory; and the Conservatory of Music. Its new Christian Association building is the first of its kind in the State. The endowment is $90,000. There are four strong literary societies with elegantly furnished halls. The library contains about 9,000 volumes. There are two courses, the classical and philosophical, with three years of preparatory instruction. The faculty consists of eleven regular professors and four instructors. The institution has 300 students and some 500 alumni. In addition to the preparatory and the regular college class, there are post-graduate, normal, art, and music departments. The president, Thomas J. Sanders, A. M., Ph. D., was inaugurated June, 1892. T. J. SANDERS.

Otter Creek: a stream which rises near the south border of Rutland co., Vt.; flows through Rutland and Addison Counties, and reaches Lake Champlain at the town of Ferrisburg. It is 90 miles long, affords good water-power, and is navigable 8 miles to Vergennes.

Otto, WILHELM LUITPOLD: King of Bavaria; b. Apr. 27, 1848; succeeded to the throne June 13, 1886, on the death of his brother, Ludwig II.; but as he was mentally incapacitated for governing, the rule continued in the hands of Prince Luitpold, who had been appointed regent three days previously.

Ot'tocar II.: King of Bohemia from 1253 to 1278; b. about 1230, a son of Wenceslas I.; revolted against his father, but was defeated, and imprisoned for some time. He acquired Austria and Styria by marriage; made a crusade, after succeeding to the throne of Bohemia on the death of his father, against the heathen Prussians; conquered their country and founded Königsberg; defeated the Hungarians on the Marchfeld in 1260, and took possession of parts of Hungary; inherited Carniola and Carinthia in 1269, and ruled with vigor and intelligence his vast empire, which stretched from the Baltic to the Adriatic, and from the Inn, Bavaria, to the Raab, Hungary. In 1273 he opposed the election of Rudolph of Hapsburg as Emperor of Germany, and refused to acknowledge him; the consequence was a war, in which Ottocar was defeated and compelled to cede Austria, Styria, Carniola, and Carinthia. Once more he tried his fortune against Rudolph, but was again defeated, and fell in the battle of Jedenspeng, Aug. 26, 1278. In his internal government he strove to break the power of the feudal lords and encouraged industry and commerce.

Ottoman Empire: See TURKEY.

Otto of Roses: See ATTAR OF ROSES.

Ottumwa: city; capital of Wapello co., Ia. (for location, see map of Iowa, ref. 7–I); on the Des Moines river, and the Burlington Route, the Chi., Ft. Mad. and Des M., the Chi., Mil. and St. P., the Chi., Rock Is. and Pac., the Ia. Cent. and the Wabash railways; 75 miles N. W. of Burlington. It is in the center of the Iowa coal-fields, derives abundant

water-power from the river, and from the extent and variety of its manufactures has become known as "the Lowell of Iowa." The surface rises in terraces from the river to the summit of the bluff, and all the railways enter the city along the river-front. The city contains a U. S. Government post-office building, court-house that cost $150,000, 8 public-school buildings, public-school property valued at over $175,000, high school library, city library, 3 national banks with combined capital of $420,000, 2 savings and 1 State bank with capital of $250,000, and 3 daily and 7 weekly periodicals, an opera-house—one of the finest in the State—a union railway station, several large wholesale houses, a Y. M. C. A. building that cost $40,000, and a $50,000 Episcopal church. There are gas and electric light plants, water-works, electric street-railway, a steam-heating plant for residences and business buildings, and foundries, pork-packing establishments, starch-mill, oil-mill, iron-works, ruffler-works, bridge-works, fine office-furniture, and other factories. The city has a large trade, especially in coal. Pop. (1880) 9,004; (1890) 14,001; (1900) 18,197.

R. H. Moore, editor of "Democrat."

Otum'ba: a town of the republic and state of Mexico; 35 miles N. E. of Mexico city; on the railway to Vera Cruz (see map of Mexico, ref. 6–H). It was the ancient Indian *pueblo* of Otompan; Cortés, after his retreat from Mexico, defeated the Aztec forces here July 8, 1520. Pop. about 500. H. H. S.

Otway, Thomas: dramatist; b. at Trotton, Sussex, England, Mar. 3, 1651; was educated at Winchester and Christ Church, Oxford; became an unsuccessful actor; served for a time as cornet in the Low Countries; and then returned to London and wrote for the stage. His most successful plays were *Don Carlos* (1676); *The Orphan* (1680); *Caius Marius* (1680); *The Soldier's Fortune* (1681); *The Atheists* (1684); and especially *Venice Preserved* (1682), one of the best historical tragedies. D. in London, Apr. 14, 1685.

Revised by H. A. Beers.

Oude, or **Oudh**, owd: a province of British India, forming with the Northwest Provinces one of the thirteen local government and administrative divisions; bounded S. by the Ganges and N. by Nepal. It consists of a large plain watered by the Goggra, Gumti, Sye, and other tributaries of the Ganges. Area, 24,217 sq. miles; pop. (1891) 12,650,831, mostly Hindus. The soil is extremely fertile and well cultivated; all the choicest products of India grow in abundance. The inhabitants are very warlike; they serve in all Indian armies, and formed the famous Sepoy regiments in 1857. Capital, Lucknow.

Oudenarde: See Audenarde.

Oudinot, oo'dē̆'nō', Charles Nicolas, Duke of Reggio: marshal of France; b. at Bar-le-Duc, in the department of Meuse, France, Apr. 26, 1767; was commander of a battalion in 1792, brigadier-general in 1794, general of division in 1799, and distinguished himself especially in the battle of Friedland and at Wagram, when he was made a marshal and created duke. His greatest feat was his manœuver in order to protect the crossing of the Beresina in 1812. In the battle of Leipzig he was wounded, but recovered soon, and remained faithful to Napoleon to the very last. During the Hundred Days he stayed on his estates. After the Restoration he was made a peer of France and commander of the national guard. In 1823 he led the First Corps during the invasion of Spain. D. in Paris, Sept. 13, 1847.—His son, Nicolas Charles Victor: b. Nov. 3, 1791; general in 1835; commanded in 1849 the expedition against the Roman republic, and compelled the city of Rome to unconditional surrender July 2. He protested in the chamber of peers against the *coup d'état*, and was imprisoned, but shortly after was restored to liberty. D. July 7, 1863.

Ouida: See De la Ramé.

Ouimet, Joseph Alderic, LL. B., Q. C.: statesman; b. at St. Rose, P. Q., May 20, 1848; graduated LL. B. at Victoria College in 1869, and was admitted to the bar in 1870. He commanded a battalion during the Northwest rebellion campaign in 1885, and is chairman of the council of the Dominion Rifle Association. He has been a member of the Parliament of Canada since 1873; was Speaker of the House 1887–91; and May 20, 1891, was appointed a member of the Queen's Privy Council for Canada. N. M.

Oulachan, **Eulachon** [native (Amer.-Ind.) name], or **Candle-fish**: a fish of the smelt family (*Argentinidæ*), resembling the smelt and the capelin. Its scientific name is *Thaleichthys pacificus*. In the spring the oulachan enters in great shoals the harbors and fiords of British Columbia and Washington to spawn. The Indians take the fish in immense quantities for food and oil. The fish consist almost entirely of fat. A fish with a strip of bark drawn through it serves as a candle. The oil of the oulachan has been proposed as a substitute for cod-liver oil, but at ordinary temperatures it is white and solid like butter. It is one of the most delicately flavored and delicious of all food-fishes. Revised by D. S. Jordan.

Ouless, oo-less', Walter William: portrait-painter; b. at St. Heliers, Jersey, Sept. 21, 1848; became a Royal Academician 1881; was awarded a second-class medal at the Paris Exposition of 1878; third-class medal 1889. He is one of the most noted British portrait-painters. Studio in London.

W. A. C.

Ounce [from Lat. *un'cia*, a twelfth, especially of a pound or foot (whence O. Eng. *ynce* > Eng. *inch*)]: in troy weight, one-twelfth of a pound, or 480 grains; in avoirdupois weight, one-sixteenth of a pound, or 437½ grains troy. In the U. S. the apothecaries' ounce is the troy ounce; in Great Britain it is now the avoirdupois. In the U. S. the fluid ounce is one-twelfth of a wine-pint, in Great Britain the twelfth of an imperial pint.

Ounce [from Fr. *once*: Span. *onza*: Ital. *lonza* (the *l* may have been dropped in Fr. and Span. from confusion with fem. def. artic. *la*, *l'*) < Lat. *lynx* = Gr. λύνξ, whence Eng. *lynx*]: a large cat (*Felis uncia*) of Northern India and Tibet, resembling the leopard, but lower, rougher, paler, and with a longer and more hairy tail, a thicker fur, and more irregular spots. In parts of South America the jaguar is called the ounce. Revised by F. A. Lucas.

Ouray: town (founded in 1876 and named after a chief of the Ute Indians); capital of Ouray co., Col. (for location, see map of Colorado, ref. 5–B); on the Uncompahgre river, at the foot of Mt. Hayden, and on the Denver and Rio Grande Railroad; 15 miles N. of Silverton, 400 miles S. W. of Denver. It is in a region of grand scenery, at an elevation of 7,200 feet above sea-level; is the natural outlet for the extensive gold and silver products of the region, and is widely known as a resort for invalids because of its hot springs. It contains four churches, a national bank, a private bank, a miners' hospital, and a weekly newspaper. The entire expenses of the town are paid from high-license saloon fees. Pop. (1880) 864; (1890) 2,534; (1900) 2,196.

Editor of "Silverite-Plaindealer."

Ouro Preto, ō'rō-prā'tō, formerly **Villa Rica**: a city; capital of the state of Minas Geraes, Brazil; about 160 miles N. of Rio de Janeiro, with which it is connected by railway; 3,400 feet above the sea (see map of South America, ref. 6–G). It is irregularly built on hilly ground, but many of the more modern houses are well constructed and handsome. There is a thriving trade with the coast, principally in agricultural products, cheese, etc. The climate is very variable and at times insalubrious; rains and heavy fogs are frequent through the year. The place was formerly celebrated for its rich gold mines, and the hills are honeycombed with old works, most of which have been abandoned. Pop. (1892) about 20,000. Herbert H. Smith.

Ouse, ooz: a river of England; flows into the Trent and forms the estuary of the Humber. Its entire length is 60 miles; it is navigable from York, 45 miles from its junction with the Trent.

Ousel: See Ouzel.

Ouseley, ooz'lē̆, Sir Frederick Arthur Gore: musician; son of Sir Gore Ouseley, ambassador to Persia; b. in London, England, Aug. 12, 1825; graduated at Oxford 1846; was curate of a London church 1849–51; became precentor of Hereford Cathedral 1855, and incumbent of St. Michael's, Tenbury, Worcestershire, 1856; distinguished for his attainments in music as a science; took an active part in establishing St. Michael's College, Tenbury, of which institution he was warden; became Professor of Music in Oxford University 1855; author of several esteemed anthems, a *Treatise on Harmony* (1869), a *Treatise on Counterpoint and Fugue* (1869), and *A Treatise on Musical Form and Composition in General*, which are considered valuable contributions to musical literature, and editor of several collections of ancient and modern cathedral music: *Cathedral Services* (1853), *Anglican Psalter Chants* (1872, in conjunction with Dr. Monk), etc. D. in Oxford, Apr. 6, 1889.

Ouseley, Sir William, LL. D.: Orientalist; b. in Monmouthshire, Wales, in 1771; became cornet of dragoons

1788; left the army 1794; engaged in the study of Oriental languages at Leyden; published *Persian Miscellanies* (1795), *Oriental Collections* (3 vols., 1797), numerous other works on similar subjects, and translations from Oriental writers; was secretary to his brother, Sir Gore Ouseley, in his embassy to Persia 1810–12; published *Travels in Persia* (3 vols., 1819–23); brought to England valuable collections of Oriental literature. D. in England in 1842.—His brother, Sir Gore Ouseley (b. about 1768; d. 1844), long a prominent member of the diplomatic corps, was a distinguished Oriental scholar and collector of manuscripts; author of a posthumous work, *Biographical Notices of Persian Poets* (1846).

Ouseley, Sir William Gore, K. C. B., D. C. L.: diplomat; eldest son of Sir William; b. in London, England, July 26, 1797; entered the diplomatic service at an early age; was connected with the British legation at Washington in 1825, when he married a daughter of Gov. Cornelius P. Van Ness, of Vermont; filled difficult and responsible diplomatic posts in Rio de Janeiro, Buenos Ayres, Montevideo, and Asuncion during the wars originated by the dictator Rosas 1832–51; was employed on special missions in Central America and in the U. S. 1857–58; was author of *Remarks on the Statistics and Political Institutions of the United States* (1832); *Notes on the Slave Trade* (1850); *Views in South America, from Original Drawings* (1852); and many miscellaneous, political, and geographical writings. D. in London, Mar. 6, 1866.

Outagamie or **Fox Indians**: See Algonquian Indians.

Outlaw and **Outlawry** [*outlaw* is O. Eng. *ūtlaga*, outlaw; *ūt*, out + *lagu*, law]: in English law, an outlaw is one who has been placed out of the protection of the law on account of willfully avoiding the execution of legal process; and outlawry is the act or process by which he is deprived of the protection of the law. Outlawry has existed in England from ancient times, both in civil and in criminal proceedings, being first used, however, in criminal actions, no one being subject to be outlawed except for felony until some time after the Norman conquest. It was extended from cases of felony to misdemeanors and to civil cases, and is still applicable in criminal proceedings of every kind. In civil cases, originally, a person could be outlawed only in actions of trespass *vi et armis*, in which alone the defendant was then liable to arrest, but subsequently outlawry in civil cases was extended by statute to other actions, and it was used either to enforce the appearance in court of a person against whom a suit had been instituted or to enforce the payment of a judgment.

The process of outlawry in civil cases was early a means of oppression, and acts were passed in the reign of Elizabeth and later to prevent secret outlawries and to facilitate the reversal of outlawries; and the process was finally abolished by the Common Law Procedure Act of 1852, and by the Civil Procedure Acts Repeal Act of 1879. In criminal proceedings it is now but little used, but its existence is recognized by 33 and 34 Vict., c. 23, which act abolishes forfeiture for felony, but expressly provides that nothing therein shall affect the law of forfeiture consequent on outlawry. In some of the U. S. it has been retained as applicable in certain criminal cases, as in prosecutions for treason; but it is so seldom resorted to that it may be said to be wholly disused. Outlawry in civil cases has never existed in the U. S.

The mode of procedure in criminal and civil cases is practically the same. If summary process was issued against the defendant and failed to cause him to appear, and if the sheriff was unable to find the defendant and apprehend him upon the regular writs of arrest, a special writ was issued requiring proclamation to be made in five county courts successively that the defendant should surrender himself; and if the defendant then failed to appear, he was declared an outlaw. If afterward he publicly appeared he might be arrested and committed until the outlawry were reversed. A reversal in civil actions, where outlawry was resorted to to compel the defendant to appear, could readily be obtained upon any plausible cause, however slight, since the only object of the outlawry was to compel the appearance; but in outlawry to enforce a judgment a reversal could be had only upon satisfaction of the judgment.

Effect of Outlawry.—The maxim applicable to outlaws is, "Let them be answerable to all, and none to them." They are therefore liable upon all causes of action existing against them, but can not maintain actions for redress of injuries to them, nor are they deemed to have any legal rights enforceable by a suit at law. Anciently an outlawed felon was said to have a wolf's head (*caput lupinum*), so that any one might kill him as he would a wolf. A different rule, however, was early established, and the life of the outlaw could be lawfully taken only by a sheriff with a warrant.

Outlawry in cases of treason or felony is deemed equivalent to conviction and attainder for the offense charged, and is attended by the same penalties of forfeiture which formerly attached to such convictions; viz., in case of treason, a forfeiture of all his property, both real and personal; and in felony, a forfeiture of goods and chattels and of the profits of his freehold estates in land during his life. (See Forfeiture.) In civil cases and in cases of misdemeanor outlawry entailed the forfeiture of goods and chattels immediately and absolutely to the crown, and of chattels real and profits of real estate upon inquisition during the life of the outlaw. The plaintiff was permitted by the crown to collect his debt from the forfeited property of the outlaw. For further details, see Archbold's *Criminal Pleadings*; Daniel's *Chancery Practice*; Legge's *The Law of Outlawry* (London, 1779); Blackstone's *Commentaries*. F. Sturges Allen.

Outram, oo'trăm, Sir James, G. C. B.: soldier; b. in Derbyshire, England, Jan. 29, 1803; educated at Marischal College, Aberdeen; entered the military service of the East India Company 1819; distinguished himself in campaigns in Khandesh and against the wild Bhil tribes, from whom, after the peace, he formed an irregular military corps; pursued a similar policy respecting some rebel chiefs in Gujerat; was aide-de-camp of Sir John Keane in the Afghan war; took part in the capture of the Beluchi stronghold of Kelat, and, disguised as a native devotee, rode through the Bolan Pass, then held by the enemy, and conveyed the news to Kurrachee; appointed political agent in Lower Sind, with the brevet rank of major, and subsequently commissioner at Hyderabad; opposed Sir Charles Napier's aggressive policy, but had to defend the residency from attack by the populace; became resident at Satara 1845, at Baroda 1847, and at Lucknow 1854; was commander-in-chief of the British forces in the Persian war of 1856–57; arrived in India in the midst of the Sepoy rebellion; relieved Havelock at Cawnpur Sept. 15, then waived the command in favor of Havelock, whom he accompanied to the relief of Lucknow Sept. 25 in his capacity of chief commissioner of Oude; defended the residency and held the Alumbagh (Lucknow) during the subsequent siege by the rebels; aided Sir Colin Campbell in the final recapture of Lucknow Mar., 1858; was knighted and made lieutenant-general 1858; received the thanks of Parliament 1860; became a member of the supreme council of India; retired in broken health 1861. D. in Paris, Mar. 11, 1863. He was buried in Westminster Abbey, and statues of him have been erected in London and Calcutta. See his *Life*, by Sir F. J. Goldsmid (2 vols., London, 1880).

Ouvarovite: See Garnet.

Ouvrard, oov'raar', Gabriel Julien: financier; b. near Clisson, France, Oct. 11, 1770; became a merchant at Nantes, and, having secured in 1797 a contract from the Government for supplying the navy with provisions, made a profit estimated at 15,000,000 francs. He then established a large banking-house in Paris, secured other Government contracts, and undertook to discount the subsidy due from Spain and amounts due from the receivers-general, thereby obtaining control of a large part of the national finances. The scope of his financial operations continually widened. He entered into contracts for supplying the Spanish army and navy, and advanced money for the needs of the imperial court, but Napoleon, becoming distrustful of the company, forced it to give up its assets in 1806, and afterward caused the arrest and imprisonment of Ouvrard, who was confined, first at Vincennes and later at Ste.-Pelagie, till 1813. After the Restoration he gained favor with the Bourbon government, which adopted a financial system proposed by him, but falling again under suspicion of fraudulent conduct in connection with contracts for supplying the French army for the Spanish expedition of 1823, he was imprisoned for five years. He afterward lived in London, where he died in Oct., 1846. See the *Mémoires* written by himself (Paris, 1826).

Ouzel, or **Ousel**, ooz'l [M. Eng. *osel* < O. Eng. *ōsle*: O. H. Germ. *amsala* > Germ. *amsel*, blackbird; cf. Lat. *merula* (for **mesula*), blackbird, whence Eng. *merl*]: a name applied in England to several birds. Thus the "ousel-cock" of Shakspeare was the European blackbird (*Merula merula*); the ring-ouzel of the present day is a very similar bird, the *Merula torquata*. More frequently the name is applied to

the water-ouzel or dipper. (See DIPPERS.) Still other birds receive this name, among them the brook-ouzel (*Rallus aquaticus*), but nearly all are thrushes, or their allies.

Revised by F. A. LUCAS.

Oval [from Fr. *ovale*, egg-shaped, from Lat. *o'vum*, egg]: a curve bearing a resemblance to the section of an egg by a plane through its axis—as for instance, an ellipse. A semi-oval formed by arcs of circles of different radii and tangent to each other is sometimes used by engineers in the construction of arches. Such curves are often called basket-handled curves or basket-handled arches. The Carterian *oval* is a plane curve of the fourth order, first studied by Descartes, from whom it derives its name. The scientific interest attached to it arises from the fact that the surface generated by revolving it about its axis is a surface of *accurate convergence* (that is, a surface which must divide two media of different refracting power, in order that rays of light coming from one point may deviate so as to pass accurately through another point).

Ovam'po, or **Ovambo**: a Bantu people in the northern part of German Southwest Africa, living along the left bank of the Cunene river and some distance S. Ten divisions or tribes of this people have been described by explorers, and they are supposed to number about 100,000. Except near the coast the soil is fertile, but water is not abundant. The people are warlike, industrious, ingenious, and unusually honest. They regard stock-raising as of secondary importance, though they have many cattle. They raise great quantities of native grain. For agricultural purposes their land is the best in German Southwest Africa, but (1894) is undeveloped, owing to the sandy coast strip and lack of transportation facilities. Revised by C. C. ADAMS.

Ovan'do, NICOLAS, de: administrator; b. at Valladolid, Spain, about 1460. He was a distinguished knight of the Order of Alcantara, and held high positions in the Spanish court. In 1501 he was appointed governor of Española, with jurisdiction over all the Spanish discoveries in the New World, except those which had been granted to Pinzon and Ojeda. He left San Lucas Feb. 13, 1502, with the largest fleet which had yet been fitted out for the West Indies, consisting of thirty ships with 2,500 colonists; arrived at Santo Domingo on Apr. 15, and governed until July, 1509. During this period the colony was financially prosperous, but the greater part of the Indian population was destroyed through the system of enforced labor. He refused to let Columbus land in July, 1502. D. in Madrid, about 1518. H. H. S.

Ovaries [Lat. *ova'rium*, deriv. of *ovum*, egg]: the organs in any animal which produce the female reproductive bodies —ova or eggs. These organs have very different conditions in different groups, but a few general statements may be made. The ovary is one of the two sexual organs, or *gonads*, the other being the male organ, or *testis*, which produces the male generative element, or spermatozoa. While in most animals these two occur in different individuals—i. e. the sexes are separate, they may occur together in the same individual, and in exceptional cases the same organ may be ovary in one region, testis in another; or, again, it may act a while as testis and later produce eggs. These facts, with many others, show that ovaries and testes are homologons structures, no instance being known which would not fall in such a category.

In the Hydrozoa the gonads are ectodermal, in the Scyphozoa entodermal; in all other animals they arise from the middle layer (mesoderm; see EMBRYOLOGY), and, where a body-cavity (cœlom) is present, as specializations of its walls. In the lower forms the ovaries may be numerous, but in the higher animals there are usually two—right and left—but these may fuse to form an unpaired organ. In the vertebrates the number two holds, and the organs are placed on either side of the backbone.

The ovaries in adult women are situated on either side of the uterus, in the iliac fossæ; they are included in separate processes from the two pelvic duplicatures of the peritoneum, which are called the broad ligaments. Each ovary is also attached by a round fibrous cord, the ovarian ligament, to the side of the uterus, and by a lesser fibrous cord to the fringed edge of the Fallopian oviduct. These three ligaments support and retain the ovary in its proper position. The ovary is an oblong, ovoid, flattened body, of whitish color and uneven surface. It is one-third to half an inch thick, three-quarters of an inch wide, 1 to 1½ inches long, and weighs from 1 to 2 drachms. (For general description of the minute structure of the ovaries and of the development of the ova, see HISTOLOGY, *Genital Organs*.) The physiological function of the ovary is the formation of ova, their maturation, and their final discharge at periodic menstrual epochs. The distended follicle at the time of rupture

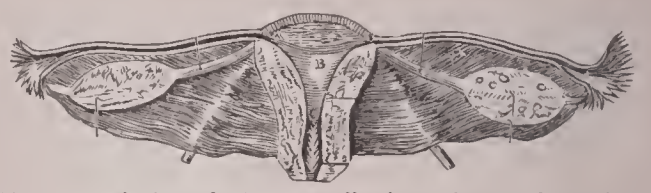


FIG. 1.—Relation of uterus, Fallopian tubes, and ovaries.

may equal in size one-third of the ovary, and many scars exist where former ruptures have taken place. When the ovule escapes from the Graafian follicle it is carried by a gentle current of fluid on the peritoneal surface of the broad ligament and tubo-ovarian ligament to the interior of the tube by which it is conveyed to the uterine cavity. The current setting toward the abdominal ostium of the tube is the result of the action of the ciliated epithelium within the tube and on its fimbria. It is unknown where the ovule is impregnated, although the majority hold that impregnation is in the tube; but intra-uterine impregnation is at least possible. Should impregnation not occur, the ovum disintegrates or passes off with the menstrual discharge. The activity of the ovary develops at puberty—usually the fifteenth or sixteenth year—and ceases with the climacteric—forty-fifth to fifty-second year. The remarkable functional activity of the ovary, including periodic congestions, ruptures, and cicatrization, renders it peculiarly liable to disease. Neuralgia, congestion, and inflammation of the ovary are frequent diseases in women—often temporary and slight, at times chronic, depressing strength and health, and causing hysteria and dementia. Solid tumors, fibrous and cancerous, affect the ovary less often than the uterus. Ovarian dropsy originates in the dropsical distension of one or more Graafian follicles by albuminoid serum. This may arise when the follicles are too deeply situated to rupture and discharge the contained ovum, or prevented by thickening of the surface from previous inflammation; it may also begin by accumulation in the cavity of the corpus luteum. A cyst may be *unilocular*, having but one cavity and arising originally from one follicle; or *multilocular*, having several compartments. In the latter case the mode of formation is yet in dispute, but it is something more than the simple distension of the Graafian follicles with fluid. A proliferation of connective-tissue elements with cystic degeneration, a proliferation of the egg cords in the primordial ovary, and a pathological development of the epithelial cells have been regarded as the cause. The ovarian cyst may contain many quarts of transparent, albuminoid serum.

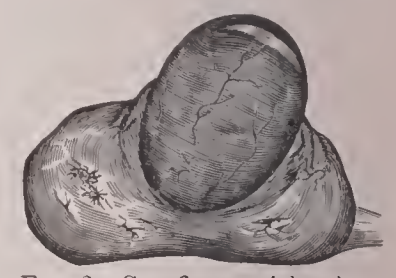


FIG. 2.—Graafian vesicle about to rupture: scars of former rupture.

Ovariotomy, the surgical operation of evacuating ovarian dropsy and eradicating the cyst, was first performed in America by Dr. Ephraim McDowell, of Kentucky; this first case resulted in recovery. Dr. McDowell operated thirteen times—eight successfully. It is now accepted and extensively performed in all countries. The improvement of technique in abdominal surgery has now made this one of the simplest and most successful operations in gynæcology, unless there should be complicating factors, like universal adhesions or suppuration of the sac. A complete list of ovarian tumors is as follows: Carcinoma, sarcoma, papilloma, fibroma, cysto-carcinoma, cysto-sarcoma, cysto-fibroma, cysto-papilloma, dermoid, myxo-adenoma (ovarian cysts, monocystic and polycystic), hydrops folliculorum (distension of the Graafian follicles with fluid). Dermoid cysts of the ovaries are the most peculiar tumors of the body. They are the result of implantation of epidermal structures upon the mass of cells from which the ovary develops during embryonal existence. As a consequence, structures like teeth, hair, sebaceous matter, quite foreign to the ovary itself, are discovered in the tumors. These cysts are prone to degenerative and inflammatory action, especially after childbirth. Aside from this complication, however, they are no more difficult to deal with than the commoner varieties of ovarian cysts. One of the most serious diseases of the ovaries is in-

fectious inflammation and suppuration, following usually childbirth or gonorrhœa, and commonly associated with pyosalpinx and pelvic peritonitis. A timely abdominal section will usually save the patient, but the pus from an ovarian abscess is peculiarly virulent, and diffuse septic peritonitis is always to be dreaded. Revised by B. C. Hirst.

Ovariot'omy: See Ovaries.

Ovary (of a flower): See Flower.

Ovenbird, or **Golden-crowned Thrush**: a North American bird (*Seiurus aurocapillus*) of the family *Mniotiltidæ*. It is called ovenbird from the shape of its nest, which is built upon the ground and roofed over with a dome-shaped covering. It is a shy, retiring bird, of an olive-brown color, 6 inches long, and is often seen running along the ground. The name ovenbird is also given to certain South American birds of the genera *Furnarius* and *Cinclodes*, belonging to the family *Furnariidæ*. They are remarkably bold little birds, and build a dome-shaped nest which is divided by a partition into two rooms, the innermost of which contains the eggs. Revised by F. A. Lucas.

Overbeck, Frederick: painter; b. at Lubeck, Germany, July 3, 1789; studied painting in Vienna from 1806 to 1809; settled in 1810 at Rome; embraced Roman Catholicism in 1814; was an apostle of the sentimental religious school in art; held beauty subordinate to piety; attempted to revive the devotional art of a former ascetic period, and founded a school which was numerously attended and celebrated in its day. His works expressed deep religious feeling, but are thin and artificial. Discarding as heresy the ideas of the moderns, he earned the title Nazarene, which was bestowed on the men of his school. He chose sacred subjects: *The Entrance of Christ into Jerusalem* (Lubeck); *Christ on the Mount of Olives* (Hamburg); *The Entombment* (Lubeck); and *The Triumph of Religion* (Frankfort). These are his best pieces. The great frescoes on the Monte Pincio and in the Villa Massimi were executed by Overbeck in conjunction with others. D. in Rome, Nov. 12, 1869.

Overbeck, Johannes Adolph: archæologist; b. at Antwerp, Belgium, Mar. 27, 1826; studied in Bonn; privat docent 1850; was called to Leipzig as professor of archæology and director of the archæological collections. His best-known works, alike distinguished for their learning and their style, are *Kunstarchäologische Vorlesungen* (1853); *Pompeii* (4th ed. 1884); *Die antiken Schriftquellen zur Geschichte der bildenden Künste bei den Griechen* (1868); *Griechische Kunstmythologie* (5 parts, 1871–87); and *Geschichte der griechischen Plastik* (2 vols., 4th ed. 1892), his masterpiece. Alfred Gudeman.

Overbeek de Meijer, Gillis, van, M. D.: surgeon and hygienist; b. at Rotterdam, Holland, in 1831; studied in the military medical school in Utrecht 1847–51; was a surgeon in the Dutch navy 1851–66; graduated M. D. from the University of Leyden in 1865; was sanitary inspector of the provinces of Gelderland and Utrecht 1866–77; in 1877 was appointed Professor of Hygiene and State Medicine in the University of Utrecht. His most important work is *Scheepsgezondheidsleer* (Tiel, 1861). S. T. A.

Overberg, Bernhard: ecclesiastic and author; b. at Höckel, in the principality of Osnabrück, Hanover, May 1, 1754; was educated in the Franciscan gymnasium at Rheine-on-the-Ems; studied theology at Münster; was ordained a priest in 1780, and was in 1783 appointed teacher in the episcopal seminary. In 1789 he took up his residence in the house of the Princess Galitzin as her confessor, and he exercised a great influence not only on her, but also on her children and on her whole circle. In 1809 he was made director of the episcopal seminary—a position which gave him control over all educational affairs of the diocese. D. at Münster, Nov. 9, 1826. He published *Christkatholisches Handbuch* (1804; 7th ed. 1854); *Katechismus der christkatholischen Lehre* (1804; 24th ed. 1831); *Haussegen* (1807), etc. His *Life* was written by C. F. Krabbe (Münster, 1831; Eng. trans., Derby, 1843). See Josef Galland, *Amalie von Galitzin* (Cologne, 1880). Revised by S. M. Jackson.

Overbury, Sir Thomas: statesman and author; b. at Ilmington, Warwickshire, England, in 1581; educated at Queen's College, Oxford, and graduated 1598; traveled on the Continent; became a resident of Edinburgh 1601, where he was an intimate friend of Robert Carr, afterward Viscount Rochester and Earl of Somerset; was knighted 1608; traveled on the Continent 1609; wrote *Observations upon the State of the Seventeen United Provinces*; incurred the enmity of his former friend, Lord Rochester, and of the Countess of Essex, by his opposition to their criminal intrigues; refused a foreign mission offered him as a means of removing him from the kingdom, and was thereupon thrown into the Tower, where he was cruelly treated, and died Sept. 15, 1613. In 1619 Lord Rochester, then Earl of Somerset, and his countess were convicted of having poisoned Overbury. His popular volume of *Characters* was published posthumously in 1614. Revised by H. A. Beers.

Overreaching: See Farriery.

Overskou, Thomas: dramatist; b. in Copenhagen, Denmark, Oct. 11, 1798. He was first apprenticed to a joiner, but in 1818 took to the stage and played minor parts. His first comedy, *1826* (1826), was a failure, but three dramas, published anonymously (1828), were successfully performed. Of these, *Östergade og Vestergade*, in the style of Sheridan, is his best work. Of his other comedies *Capriciosa* still keeps its place in the repertory of the Royal Theater; but Overskou's most important contribution to literature is *Den danske Skueplads i dens Historie fra dens Begyndelse til vor Tid* (History of the Danish Theater, 7 vols., Copenhagen, 1854–76). D. Nov. 7, 1873. D. K. Dodge.

Overt Act: an open act from which criminal intent is inferred.

Overture [from O. Fr. *overture* (> Fr. *ouverture*), an opening, deriv. of *ovrir*, open]: the name given to the introductory movement, symphony, or elaborate prelude occurring in oratorios, operas, cantatas, and similar compositions. The overture, though complete in itself, is generally so framed as to bring the mind of the hearer into a correspondence of tone and sympathy with the leading traits of the work to which it is prefixed. To effect this it is sometimes sufficient to exhibit in the overture the prevailing sentiment or coloring of the earlier movements (at least) of the work it announces. In other cases the composer ingeniously weaves into the overture some of the leading ideas of the work itself by brief anticipations of its melodies, or anything striking in its modulations, harmonies, or rhythmical forms, thereby predisposing the mind of the hearer to enjoy the recurrence of those points in the after-part of the performance. The introduction of the overture as a distinct and highly wrought species of composition is ascribed to Scarlatti, a Neapolitan of the latter part of the seventeenth century, before whose time its place was occupied by meager preludes or prefatory symphonies, of little account beyond that of an ordinary opening strain. Revised by Dudley Buck.

O'verweg, Adolf: explorer; b. at Hamburg, Germany, July 24, 1822; studied natural science, especially geology, at Bonn and Berlin; joined Barth and Richardson on their explorations of Central Africa in 1850. D. near Lake Tchad, Sept. 27, 1852. His observations, among which was the discovery that the Desert of Sahara is an elevated plateau, and not, as had hitherto been supposed, a depressed plain, were communicated in *Monatsberichte der Gesellschaft für Erdkunde* (Berlin, vols. viii. and ix.), and Petermann's *Zeitschrift für allgemeine Erdkunde* (Gotha, vol. i.).

O'veryssel: a province of the Netherlands, lying between the Zuyder Zee in the W., and Hanover and Westphalia in the E.; area, 1,291 sq. miles. The province is intersected by numerous canals; the soil is mostly light, in many places sandy and covered with heath, in others affording good pasture-grounds. Rye, barley, oats, hemp, potatoes, and buckwheat are raised. Cattle-rearing, digging of turf, and linen manufactures are extensively carried on. Pop. (1899) 333,337. Chief cities, Zwolle, Deventer, and Kampen.

Ovibos: See Musk-ox.

Ovid, or (full Latin name) **Publius Ovidius Naso**: poet; b. Mar. 20, 43 B. C., at Sulmo, in the country of the Pæligni, about 90 miles from Rome, of a rich equestrian family: received an elegant education in the schools of the rhetoricians; traveled afterward in Greece, Asia Minor, and Sicily, and lived then for many years in Rome, idle, frivolous, but brilliant; was intimately connected with Macer and Propertius; acquainted with Horace, moving with freedom and ease in the court circles; admired by all for his wit and his verses, and enjoying, as it seems, to the very dregs, all that could be enjoyed at Rome, until, in the latter part of the year 8 A. D., Augustus suddenly banished him to Tomi. The reason is not known with certainty. Augustus was doubtless offended by the obscenity and immoral tendency of the

Ars Amatoria, but the book had been in free circulation for ten years before this time, and this can not have been more than a pretext. It is more probable that the direct cause was some participation as a confidant in the intrigue of Silanus and Julia, the granddaughter of Augustus, who suffered banishment in the same year with Ovid. At Tomi, a small Getic town on the frontier of the empire, at the delta of the Danube, the fastidious favorite of the metropolis found life intolerable, and month after month sent the most humble supplications to Augustus, but the emperor was immovable, and the poet died in exile in 18 A. D. His works comprise *Heroides*, twenty-one letters from heroines to their lovers, of which fourteen are regarded as genuine; *Amores*, love-elegies, in three books; *Ars Amatoria*, in three books; *Remedia Amoris*; *Metamorphoses*, in fifteen books; *Fasti*, an unfinished poetical commentary on the Roman calendar, in six books; *Tristia*, five books; *Epistolæ ex Ponto*, four books; *Ibis*, a bitter invective directed against an unknown person; *Halieutica*, a fragmentary didactic poem on fishes. The tragedy *Medea* is lost. The most remarkable editions of his collected works are the *editio princeps* (Rome, 1471), that by Heinsius (Leyden, 1629), and that by Burmann (Amsterdam, 1727); recent text editions by Riese (Leipzig, 1871–74), and Merkel and Ehwald (Leipzig, 1888); separate editions, especially of the *Metamorphoses*, are very numerous. Among the translations, likewise very numerous in all modern languages, is one of the *Metamorphoses* by Dryden, Addison, Congreve, and others, edited by Garth. Of all Latin poets Ovid stands nearest to modern civilization, partly on account of his fresh and vivid sense of the beauties of nature—a point in which the Latin literature is generally deficient—partly because his subject is love. His representations of this feeling are often sensuous, but they are graceful and strikingly true. He also excels other Latin poets in the elegance of his form, especially in the character and rhythm of his verses. Revised by M. Warren.

Oviducts: See Fallopian Tubes.

Ovie'do: town of Spain; capital of the province of Oviedo, formerly called Asturias (see map of Spain, ref. 12–D). It is finely laid out, with a large and elegant public square in the center, from which the four main streets lead in opposite directions. It has a beautiful cathedral dating from the eighth century, which contains the remains of fourteen early kings and queens of Asturias; a splendid aqueduct, which provides eleven fountains with abundance of good water; a university (founded in 1574) with a large public library; and manufactures of arms, hats, linen, and leather. In the vicinity are hot springs, which are much used for bathing. Pop. (1887) 42,716.

Oviedo, or **Oviedo y Valdés**, ō-vĕe-ā'dō-ĕe-vaăl-dās', Gonzalo Fernandez, de: historian; b. in Madrid, Spain, in 1478. He was long attached to the Spanish court, witnessed the first return of Columbus 1493, and was intimate with most of the prominent explorers of the New World. In 1514–17 he was with Pedrarias at Darien as a treasury officer; subsequently he was governor of Cartagena, and *alcaide* of the fort at Santo Domingo, and he crossed the Atlantic several times. Appointed royal historiographer he devoted himself especially to the history of America, for which his experience especially fitted him. His principal work is *Historia natural y general de las Indias*, in fifty books. Of these nineteen were published at Seville, 1535, and the twentieth at Valladolid soon after. There were numerous editions and translations of these twenty books, but the first complete edition was published by the Madrid Academy 1851–55. The *Historia* was the first general account of the discoveries in America, and it has remained a standard authority. Oviedo also wrote chronicles of the reigns of Ferdinand and Isabella and Charles V., but these, with his other writings, have never been published. A history of Nicaragua, translated into French from his manuscript, was printed in the Ternaux-Compans collection. D. at Valladolid, 1557. Herbert H. Smith.

Ovip'arous Animals [*oviparous* is from Lat. *ovi'parus*; *o'vum*, egg + *pa'rere*, bring forth]: those animals which bring forth eggs. The term is largely one of convenience, not of strict scientific value, for all animals reproduce by eggs, the difference consisting in the stage of development in which separation from the mother is effected. Strictly speaking, then, oviparous animals are those in which the egg (see Ovum) leaves the maternal body before it has proceeded far in development. In some cases, as in many sharks and snakes, an intermediate condition exists. Here the egg, inclosed in protective membranes, is retained inside of the mother until the young is fully formed, without, however, any intimate (placental) connection existing between parent and offspring. For these forms the term *ovoviviparous* is used. In the contrasted or *viviparous* forms the egg is small, and the young receives nourishment throughout its whole fœtal life from the mother. All mammals, except the Monotremata (which are oviparous), are viviparous.

J. S. Kingsley.

Ovisacs: See Graafian Vesicles.

Ovoca: See Avoca.

O'vule [from Mediæv. Lat. *o'vulum*, dimin. of Lat. *o'vum*, egg]: in botany, a young seed, especially before fertilization. The ovule is morphologically a surface outgrowth, and is to be regarded as a trichome structure, homologous with hairs, scales, prickles, etc. In its earliest stages it is a few-celled mass of cells, projecting above the surface, and having a hemispherical or conical, and later a cylindrical, form, which may remain straight or become somewhat curved upon itself. As it grows a ridge arises upon it encircling it like a collar, and this by extension finally becomes a coat which incloses it. In many plants a second coat forms below (outside of) the first (Fig. 1).

When an ovule has completed the growth of its one or two coats we may then distinguish the stalk (*funiculus*), the integument, and the ovule body (*nucellus*). At the summit of the ovule the integument does not quite close, leaving a minute opening (*micropyle*).

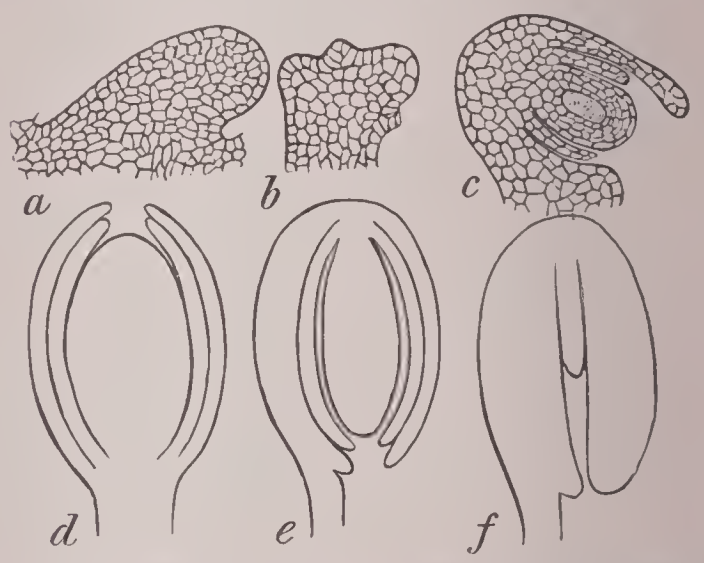


Fig. 1.—*a b c*, development of ovule of evening primrose; *d*, straight (orthotropous) ovule; *e*, inverted (anatropous) ovule; *d e*, with large nucellus, and two coats; *f*, with small nucellus and one thick coat.

In the lower Monocotyledons and Dicotyledons the nucellus is relatively large, but in the higher orders of both sub-classes (Orchidales and most Gamopetalæ) it is relatively very small, consisting of an axial row surrounded by a single layer of cells. The ovules of all, or nearly all, Monocotyledons have two coats, as is the rule with the choripetalous Dicotyledons, while in the Gamopetalæ there is usually but one coat.

Early in the growth of the nucellus an axial cell enlarges (at this stage known as the *archesporium*) and undergoes division, usually into three to four, or rarely into many cells. One of these daughter-cells, commonly the lowermost, enlarges at the expense of the others, and becomes the "embryo-sac." In Gymnosperms the nucleus divides repeatedly, and the daughter-nuclei become the nuclei of cells which are massed together in a rounded or egg-shaped prothallium. In the latter flask-shaped archegones are developed, each of which contains a single germ-cell (oösphere or egg-cell).

In Angiosperms the development of the embryo sac is somewhat different (Fig. 2, *a* to *i*). The primitive nucleus divides, each daughter-cell moving to opposite ends of the cell. Here each divides again, and afterward each couple divides once more, thus giving rise to four nuclei at each end. Now a nucleus from each tetrad moves to the center of the cell, where they unite into a single nucleus, the nucleus of the embryo sac. The nuclei at the base of the sac become invested with protoplasm and soon form a mass of cells, the *endosperm*. In the meantime the upper nuclei also have become surrounded by protoplasm, and two of these cells are elongated and enlarged; these are the synergidæ.

The third nucleus usually lies a little deeper, and with its protoplasm constitutes the germ-cell (oösphere or egg-cell).

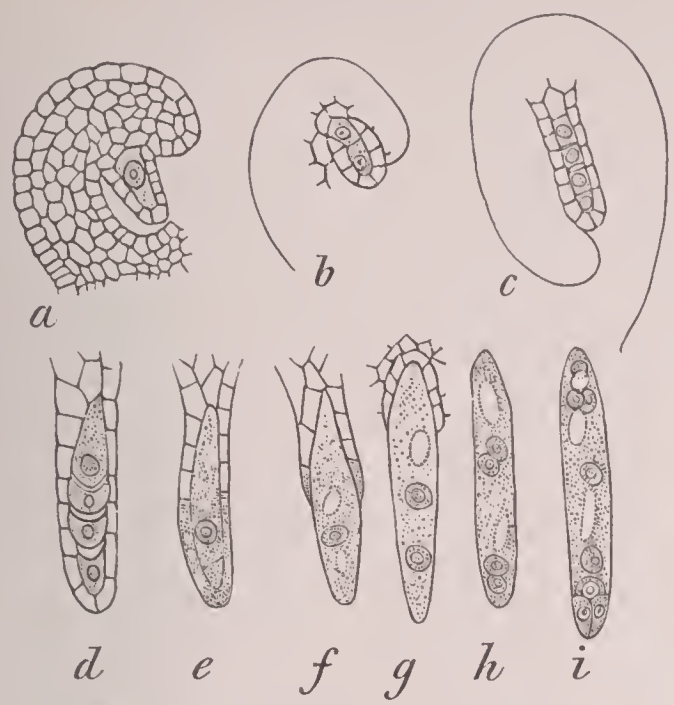


Fig. 2.—Development of the embryo-sac of *Aster* and *Solidago* (after Martin).

After the germ-cell is fertilized (by union with the nucleus of the pollen-tube) it clothes itself with a wall of cellulose, thus constituting the first cell of the new plant. The subsequent development of the embryo belongs to Embryology (*q. v.*). See also Flower. Charles E. Bessey.

Ovum [= Lat., egg]: the female reproductive body in all animals. In its simplest condition it is merely a cell of the body specialized for the purpose of the reproduction of the species, and distinguishable from the other cells chiefly from its larger size. In most forms, however, it has additional features of a nutritive or protective nature. Thus to the protoplasm of the cell there may be added *food-yolk* which is to nourish the germ, and which is frequently so abundant as to render the egg very large. This food-yolk may be variously arranged, and according to its distribution the subsequent development of the egg (see Embryology) is modified. In some cases (e. g. the fresh-water Hydra) protective envelopes are absent. In others they occur, and may be grouped in two categories, primary and secondary. To the first belong the *vitelline membrane*, usually a thin but firm envelope covering the egg and secreted either by the egg or by the tissue in which the egg was formed. This envelope frequently has an opening (*micropyle*) for the entrance of food, and later for the entrance of the impregnating spermatozoön. In some cases, too, the vitelline membrane is perforated by fine tubules, in which case it is called a *zona radiata*. The secondary envelopes are formed by the ducts which convey the egg from the place of its origin (ovary) to the exterior. Of these the most prominent are the shell of the eggs of birds and reptiles, and homologous structures in other forms. The egg as it leaves the ovary is not ready for development; it has first to undergo processes of maturation and impregnation (see Embryology), although in exceptional cases (see Parthenogenesis) the egg may develop without the latter process. The common hen's egg contains not only the essential cell with nucleus and protoplasm, but yolk, membrane, white, and shell. In the hen's egg, as laid, development has proceeded some distance, its products being found in the light spot invariably uppermost on the yolk. See Histology (*Generative Organs*). J. S. Kingsley.

Owatonna: city; capital of Steele co., Minn. (for location, see map of Minnesota, ref. 11–F); on the Straight river, and the Chi. and N. W. and the Chi., Mil. and St. P. railways; 71 miles S. of Minneapolis, 90 miles W. of Winona. It is the seat of Pillsbury Academy (Baptist, chartered in 1877), which in 1894 had six buildings that cost over $300,000, and of the State School for Dependent Children. There are 10 churches, 2 national banks with combined capital of $140,000, electric light, water, and sewerage plants, and 2 weekly newspapers. The city is a trade center for a large section, and has 3 flour-mills and manufactories of churns, seeders, fanning-mills, soap, carriages and wagons, and patent medicines. Pop. (1880) 3,161; (1890) 3,849; (1900) 5,561. Editor of "Journal."

Owego: village; capital of Tioga co., N. Y. (for location, see map of New York, ref. 6–F); on the Susquehanna river, and the Del., Lack. and W., the Erie, and the Lehigh Valley railways; 237 miles W. of New York city. It is in an agricultural region, has a large lumber-trade, and is a popular summer resort. It contains a public library (founded in 1868) with over 5,000 volumes, 3 national banks with combined capital of $250,000, and a daily and 3 weekly papers, and has flour, planing, and woolen mills, foundries, and machine-shops, wagon-works, and other manufactories. Pop. (1890) 5,141; (1900) 5,039. Editor of "Record."

Owen, David Dale, M. D.: geologist; son of Robert Owen, the socialist; b. at New Lanark, Scotland, June 24, 1807; was educated at Hofwyl, Switzerland; went to the U. S. with his father in 1823 to assist him in his social experiment at New Harmony; subsequently studied geology and other natural sciences. In 1837 he made a geological reconnoissance of the State of Indiana; subsequently made an examination of the mineral lands of Iowa, and in 1848 was employed by the Government to take charge of a geological survey of Wisconsin, Iowa, and Minnesota. The results of this survey were published in a quarto volume by Congress in 1852. From 1852 to 1857 he was employed in a geological survey of Kentucky, the results of which were published in four volumes. In 1857 he was appointed State geologist of Arkansas, and the report of his survey was subsequently published in one volume. D. at New Harmony, Ind., Nov. 13, 1860.

Owen, John, D. D.: theologian; b. at Stadham, Oxfordshire, England, in 1616; was educated at Queen's College, Oxford, 1628–37; was an early advocate of the parliamentary cause, and an adversary of Laud's measures; received the living of Fordham, Essex, 1642, which he exchanged for a Presbyterian pastorate at Coggeshall, near by, 1646, where he introduced independent church government. In 1649 he became private chaplain to Oliver Cromwell; in 1651 dean of Christ Church, Oxford; was vice-chancellor of the university 1652–57; was deprived of his deanery 1660, and retired to Stadham; declined a call to Boston, Mass., 1663, and an invitation to become president of Harvard College in 1670; removed to London in 1673; thence, after his second marriage, 1677, to his wife's estate at Ealing, Middlesex, where he died Aug. 24, 1683. He was a man of great piety, learning, and magnanimity, the author of more than eighty theological works, doctrinal, practical, and polemical. His *Exposition of the Epistle to the Hebrews* (1668–84) is his chief work. Though a zealous opponent of Arminianism, Presbyterianism, Episcopacy, and papacy, all parties held him in high esteem. His works, in W. H. Goold's edition (Edinburgh, 1850–55), occupy 24 vols. 8vo; reprinted in Philadelphia (17 vols., 1865–69). See his *Life* by W. Orme (London, 1820). Revised by S. M. Jackson.

Owen, John Jason, D. D., LL. D.: teacher and author; b. at Colebrook, Conn., Aug. 13, 1803; graduated at Middlebury College, Vt., in 1829, and at the Theological Seminary, Andover, Mass., in 1831; entered the Presbyterian ministry in 1832; became in 1836 president of Cornelius Institute, New York; Professor of Latin and Greek in the New York Free Academy 1848, and its vice-principal in 1853; vice-president of the College of the City of New York 1866; prepared editions, with notes, of Xenophon's *Anabasis* (1843); Homer's *Odyssey* (1844); of the *Cyropædia* (1846); of *Thucydides* (1848); of the *Iliad* (1851); the text of the Acts of the Apostles, with notes (1850); a Greek reader (1852); a *Commentary on the Gospels* (3 vols., 1857, *seq.*). D. in New York city, Apr. 18, 1869.

Owen, Sir Richard, K. C. B., F. R. S., LL. D., D. C. L., etc.: comparative anatomist and palæontologist; b. at Lancaster, England, July 20, 1804; served for a time in the navy; studied medicine at Edinburgh and St. Bartholomew's, London; succeeded Sir Charles Bell as Hunterian professor in the Royal College of Surgeons in 1836; became superintendent of the natural history department of the British Museum in 1855, and retired in 1884. He was Fullerian professor in the Royal Institution, a member of many learned societies, and the recipient of many honors. Owen succeeded Cuvier as the leading vertebrate palæontologist of the world. His most important general works are *Lectures on the Comparative Anatomy and Physiology of Invertebrate Animals* (1843); *Lectures on the Comparative Anatomy and Physiol-*

ogy of Vertebrate Animals (1846); *Odontography* (1840–45); *On the Archetypes and Homologies of the Vertebrate System* (1848); *On the Nature of Limbs* (1849); *Palæontology* (1861). He was also a voluminous contributor to the memoirs of scientific societies. D. at Richmond Park, Surrey, Dec. 18, 1892. Revised by G. K. Gilbert.

Owen, Robert: social reformer; b. at Newtown, Montgomeryshire, North Wales, Mar. 14, 1771; the son of poor parents, was forced to earn his own living while still a boy, but was very successful in business, and at the age of eighteen became a partner in a cotton-mill. He induced his firm to buy the cotton-mills of New Lanark, Scotland, where he put into effect a co-operative scheme for the benefit of his employees. It worked well at first, and New Lanark became famous for the prosperity of its inhabitants. He then directed his attention to social questions on a broader scale, publishing in 1812 *New Views of Society, or Essays upon the Formation of the Human Character*, and subsequently *Book of the New Moral World*, in which he advocated doctrines of human equality and the abolition of class distinctions. Having won a large fortune in his business, he was able to give these works and various tracts embodying his views a wide circulation. The Duke of Kent became his patron, and his followers were numerous. His religious views exposed him to much obloquy and a bitter opposition, and after the death of his patron he went to the U. S. in 1823 and founded at his own expense a communist society at New Harmony, Ind. The scheme proving a failure, he returned to England, where he tried several similar experiments with the same result. He also failed in an attempt to establish a "labor exchange" in London. In 1828, by invitation of the Government of Mexico, he went to that country in the hope of carrying out his socialistic schemes, but was disappointed. In spite of his failures he was universally esteemed for his integrity and benevolence. His later years were spent in efforts to promote a religion of reason and to improve the condition of the working-classes, and in his old age he became a believer in Spiritualism. D. at Newtown, Nov. 19, 1858. His followers bore the name of Owenites, and were among the founders of the English Chartist movement. Revised by F. M. Colby.

Owen, Robert Dale, LL. D.: author; eldest son of Robert Owen; b. in Glasgow, Scotland, Nov. 7, 1801; educated at Fellenberg's College, near Berne, Switzerland; removed to the U. S. with his father in 1823, and assisted him in his efforts to found the colony of New Harmony, Ind. On the failure of that experiment he visited France and England, but returned to the U. S. in 1827 and became a citizen; he settled in New Harmony, Ind., where for three successive years (1835–38) he was elected a member of the Legislature. From 1843 to 1847 he represented the first district of Indiana in Congress, acting with the Democratic party; took an active part in the settlement of the northwestern boundary question; introduced the bill organizing the Smithsonian Institution, and served for a time as one of the regents. It was through his efforts that Indiana conferred independent property rights upon women. He was minister to Naples 1855–58. During the civil war in the U. S. he was an earnest advocate of the policy of emancipating the slaves, and his letters on that subject to the President and the members of the cabinet were widely read. His chief works are *Outlines of the System of Education at New Lanark* (Glasgow, 1824); *Moral Physiology* (New York, 1831); *Discussion with Origen Bachelor on the Personality of God and the Authenticity of the Bible* (New York, 1832); *Pocahontas*, an historical drama (New York, 1837); *Hints on Public Architecture*, illustrated (New York, 1849); *Footfalls on the Boundary of Another World* (Philadelphia, 1860); *The Wrong of Slavery and the Right of Freedom* (Philadelphia, 1864); *Beyond the Breakers*, a novel (Philadelphia, 1870); *The Debatable Land between this World and the Next* (New York, 1872); *Treading my Way*, an autobiography (New York, 1874). Mr. Owen received the degree of LL. D. from the University of Indiana in 1872. D. at Lake George, N. Y., June 24, 1877.

Owens, John Edward: comedian; b. in Liverpool, England, May 4, 1824; was taken by his father to the U. S. in 1834. He was educated in Philadelphia, and for some time employed there in business. On Aug. 20, 1846, he made his *début* in the Masonic Hall, Philadelphia, and immediately gained the interest and sympathy of the public by a peculiar blending of humor and pathos. In 1849 he was manager of the Baltimore museum, in 1854 of the Charles Street theater of Baltimore, in 1859 of the Varieties theater of New Orleans. In 1852 he made his first tour in England. His two greatest creations were probably *Solon Shingle* (first played at the opening of the Adelphi theater in London, 1865) and *John Unit* (first played in New York in 1869). In 1882 he accepted an engagement with the New York Madison Square Company, and played in *Esmeralda* in many of the larger cities of the U. S. His declining health during his last few years caused him to retire from the stage. D. near Towson, Md., Dec. 6, 1886. Revised by B. B. Vallentine.

Owensboro: city; capital of Daviess co., Ky. (for location, see map of Kentucky, ref. 3–E); on the Ohio river, and the Louisv. and Nashv. and the Louisv., St. L. and Tex. railways; 40 miles S. E. of Evansville, Ind., 150 miles S. W. of Louisville. It is in the center of the Kentucky and Indiana coal-fields, and in an agricultural, tobacco, timber, building-stone, and brick-clay region; has an elevated site, and is connected with several important places on the river by a line of packets. The city contains 18 churches, a high school, and 4 ward schools, public-school property valued at $85,000, a female college, a public-school library (founded in 1886), a U. S. Government building that cost $50,000, 2 national banks with combined capital of $185,000, 6 State banks (capital of 5 reported $592,500), an incorporated bank with capital of $100,000, and 2 daily and 6 weekly newspapers. The tobacco industry has 23 factories and stemmeries, in which 2,000 persons are employed and 18,000,000 lb. of tobacco handled annually, and the whisky industry has in the city and its vicinity 14 distilleries, operated on a capital of $1,500,000, and yielding sourmash whisky to the value of $5,500,000 annually. There are 4 planing and 3 flour mills, steam-shingle mill, 2 foundries and machine-shops, several brickyards, and ice, sewer-pipe, furniture, and cigar factories. Pop. (1880) 6,231; (1890) 9,837; (1900) 13,189. Editor of "Inquirer."

Owen Sound: port of entry and capital of Grey co., Ontario, Canada; at the head of Owen Sound (a part of Lake Huron); 45 miles W. N. W. of Collingwood (see map of Ontario, ref. 3–C). It has a good water-power, several lumber-mills, foundries, etc. There is a good trade in lumber and grain. Pop. (1891) 7,497.

Owens River: a stream which rises in Southeastern California, S. of Mono Lake; flows southward through a desert valley bordered by lofty and exceedingly rugged mountains for a distance of about 100 miles, and empties into Owens Lake. Like most desert streams, it varies greatly in volume with the seasons, and many of its branches are dry during the summer. Owens Lake, in the western part of Inyo co., Cal., is 18 miles long and 10 miles wide. It is without outlet, and is highly charged with saline matter.

I. C. Russell.

The eagle owl.

Owl [O. Eng. *ūle*: O. H. Germ. *ūwila* < Germ. *eule*]: a general name for the birds of prey of the order *Striges*, most of which are nocturnal in their habits, although a few, like the snowy and hawk owls, hunt by day. They appear strongly built (but this is largely due to their long feathers), have large heads and large eyes, directed forward and surrounded by a circle of radiating feathers. The plumage is soft, flight noiseless, and sense of hearing acute. There are some 200 species of owls distributed throughout the world. They range in size from the great eagle owl (*Bubo maximus*) of Europe and Asia, over 2 feet long, to

the little gnome-owls (*Glaucidium*) of South America, some of which are less than 6 inches in length. Owls breed in old buildings, holes in rocks, and most of all in hollow trees. The smooth, white eggs are from two to four in number. A few exceptional species eat fish, but birds, and especially small rodents, form the chief food of owls. They are of more service to the farmer than any other bird.

F. A. Lucas.

Owl-parrot, or **Kakapo**: a peculiar parrot (*Stringops habroptilus*) restricted to the forests of New Zealand, so called from its owl-like appearance and nocturnal habits. It is a little over 2 feet in length, heavily built, of a sap-green color mottled with brown and yellow. The bird is flightless, for while the wings are of moderate size there is no keel to the sternum, and the breast muscles are small and overlaid with fat. The kakapo climbs low trees, but passes most of its time on the ground, feeds largely on mosses, and lives in holes or fissures in the rocks. Since the introduction of dogs it has diminished in numbers.

F. A. Lucas.

Ownership: See Property.

Owosso: city; Shiawassee co., Mich. (for location, see map of Michigan, ref. 7–J); on the Shiawassee river, and the Detroit, Gr. Haven and Mil., the Mich. Cent., and the Toledo, Ann Arb. and N. Mich. railways; 25 miles N. E. of Lansing, 78 miles N. W. of Detroit. It derives power for manufacturing from the river; is connected with Corunna, the county-seat, by a street-railway; and contains gas and electric light plants, water-works, graded public schools, 2 libraries (Ladies' and Y. M. C. A.), an incorporated bank with capital of $100,000, a private bank, a daily and 5 weekly newspapers, and sash, door, and blind, furniture, casket, tool, cart, and other factories. Pop. (1880) 2,501; (1890) 6,564; (1900) 8,696. Editor of "Reporter."

Ox: See Cattle and Musk-ox.

Oxalates: See Oxalic Acid.

Oxalic Acid [*oxalic* is deriv. of *Oxalis*, name of a botanical genus in which the acid occurs]: an acid consisting of carbon, hydrogen, and oxygen combined in certain proportions. Salt of sorrel, which is an acid potassium oxalate, has for a period unknown been procured in Germany from certain species of oxalis and rumex. Savary first obtained oxalic acid from it in 1773 by sublimation. Scheele afterward obtained it from the same source by precipitation as oxalate of lead and subsequent decomposition of this. This latter chemist also first proved that the acid previously known as prepared by the action of nitric acid on sugar is oxalic acid. Besides the plants above mentioned there are sea-shore plants, *Salsola* and *Salicornia*, which contain it as sodium oxalate. It is found as insoluble calcium oxalate in a great number and variety of plants, and in certain morbid conditions this latter salt is formed largely in the animal body, passing off by the urine, and forming what is called the "mulberry calculus" in the bladder.

All the oxalic acid of commerce is prepared by artificial processes, of which two are in common use: 1. By the action of nitric acid on sugar, starch, or molasses. 2. By fusing a hydrate of an alkali with starch or cellulose. Sawdust is generally used. Potassium hydrate gives more than sodium, and two of potassium to one of sodium hydrate gives still more. In the latter case, when the product is treated with a strong solution of sodium carbonate, potassium carbonate dissolves and sodium oxalate, by virtue of its low solubility, remains behind. From this oxalic acid is readily prepared. When required *pure* for chemical purposes it is sublimed. Great care must be taken in this case not to inhale the vapor, which is highly dangerous. The commercial crystallized acid has the composition $C_2H_2O_4 + 2H_2O$. When heated, it first loses water and becomes $C_2H_2O_4$. By further heating this breaks down, yielding water, carbon monoxide, CO, and carbon dioxide, CO_2. It dissolves in about nine parts of cold and one part of boiling water. When to its solution or that of an oxalate a lime-solution is added, there is thrown down calcium oxalate, an exceedingly insoluble substance, and for lime in solution it is the most delicate test. Except in very weak solutions, it is an exceedingly dangerous, fatal, and rapid poison, and its universal sale in shops and common use in households are greatly to be reprehended. It has been known to produce death in ten minutes, preceded by horrible agonies. It is used in the arts for cleaning leather, for discharging colors in calico-printing, and in scouring metals. For the latter purpose, cleaning brass and copper, it is now much used in households, as well as for removing ink-stains from fabrics. The greatest care should be exercised that it be not mistaken for Epsom salt, which it almost exactly resembles in appearance.

Oxalates.—These are compounds formed by the action of oxalic acid on bases. "Salt of sorrel" is a mixture of the acid potassium salt, KHC_2O_4, and another acid potassium salt of the formula $KH.C_2O_4.C_2H_2O_4 + 2H_2O$.—*Calcium oxalate*, $CaC_2O_4 + H_2O$, is very difficultly soluble in water, and is used for the purpose of detecting calcium. Calcium oxalate is found in nature in the tissues and cells of plants.—An oxalate of iron occurs in the mineral humboldtine, in brown coal.

Revised by Ira Remsen.

Ox'alis [Mod. Lat., from Lat. *o'xalis* = Gr. *ὀξαλίς*, a kind of sorrel, deriv. of *ὀξύς*, sharp, pungent]: a genus of dicotyledonous plants, commonly known as wood-sorrel, and belonging to the Geranium Family (*q. v.*). The sepals and petals are five each, the stamens are ten, in two alternating whorls, and the pistil is composed of five united carpels. The leaves are compound, usually palmately three-foliate, sometimes four-foliate, or even pinnately many-foliate. The species (205) are mostly natives of the sub-tropical regions N. and S. of the equator. A few are natives of Europe (two or three) and North America (fourteen or fifteen); among the latter are the common wood-sorrel (*O. acetosella*), violet wood-sorrel (*O. violacea*), yellow wood-sorrel (*O. corniculata*, var. *stricta*). Many species are cultivated in greenhouses for their fine foliage and pretty flowers. Among these are *O. bowiei*, *O. cernua*, *O. hirta*, and *O. variabilis* from the Cape of Good Hope; *O. crenata*, *O. rosea*, and *O. valdiviensis* from South America; and the curious *O. tetraphylla* from Mexico. Charles E. Bessey.

Oxalu'ria [Mod. Lat.; *oxal-ic* + Gr. *οὖρον*, urine]: a morbid condition of the general system which favors the excessive excretion of oxalic acid by the kidneys. It is also known as the *oxalic acid diathesis*. Theories of the nature of this disorder have varied widely in the past, but it is now pretty generally conceded that oxaluria is merely a symptom of disordered metabolism—that is, the oxalic acid in the urine results from improper transformation of food or tissue elements in the processes of nutrition. This faulty metabolism is very closely allied to that which causes increase of uric acid in the blood and urine, and which constitutes the disease *gout*. Indeed oxaluria in a majority of instances is probably an expression of aberrant gout. It may, however, occur in a variety of affections, such as neurasthenia, anæmia, phthisis, and others, not at all similar to gout. The mere presence of the oxalate of lime in the urine, even in large quantities, must not be taken as sufficient to establish the diagnosis; for after a diet including rhubarb, cranberries, and other vegetables, oxalates are quite naturally present in the urine. The constant excretion of large quantities of oxalic acid in the urine is, however, highly significant. In such cases a characteristic train of symptoms is usually noted, such as emaciation, nervousness, painful susceptibility to external impressions, and hypochondriasis. The patients are incapable of exerting themselves in the least without suffering from fatigue; they are irritable and easily excited. A prominent symptom is a severe and constant pain or sense of weight across the loins. It will be noted that these symptoms are largely of a dyspeptic type. In typical cases of oxaluria of gouty origin we rarely fail to find these symptoms, and especially the nervous and melancholic tendency, but oxaluria may exist and go on to the formation of concretions of oxalate of lime in the kidney without any symptoms at all. Oxalate of lime occurs in the urine in the form of minute octohedral or dumb-bell-shaped crystals, varying in size from a ten-thousandth to a thousandth of an inch in diameter. The formation of oxalic acid in the blood is occasioned by the malassimilation of certain articles of diet, but in exactly what manner has not yet been determined by physiologists. Sugar and all saccharine or starchy matters should be avoided as much as possible, because, as in lithæmia, the readily oxidizable sugars and starches consume all available oxygen and interfere with albuminous transformation. Attention should be paid to the general health, and particularly to the digestive organs. As medicines, the mineral acids, given either alone or combined with tonics, are the favorite remedies.

Revised by William Pepper.

Oxbird: See Dunlin.

Ox'enden, Ashton, D. D.: bishop; b. at Broome Parke, near Canterbury, England, in 1808; educated at University

College, London; was rector of Pluckly-with-Pevington, Kent, 1848–69; became honorary canon of Canterbury Cathedral 1864, and Bishop of Montreal, primate, and metropolitan of Canada 1869; resigned his bishopric in Apr., 1878, feeling himself no longer equal to the fatigues of his diocese, but was instituted to the vicarage of St. Stephen, near Canterbury, in May, 1879. He has published *Decision*; *Prayers for Private Use*; *Sermons on the Christian Life*; *God's Message to the Poor*; *A Plain History of the Christian Church*; *The Pathway of Safety*; *Baptism simply Explained*; *The Lord's Supper simply Explained*; *Lectures on the Gospel*; *The Pastoral Office*; *Fervent Prayer*; *The Barham Tracts*, etc. His writings have had a very large circulation both in Great Britain and in the U. S.

Revised by W. S. Perry.

Oxenford, John: playwright and translator; b. at Camberwell, London, England, in 1812; was called to the bar 1833; was many years theatrical critic for the London *Times*; wrote several dramas and songs, and translated a number of German poems and prose works. Among his works for the stage are *My Fellow-clerk* (1835); *Twice Killed* (1835); *A Day well Spent* (1836); *Porter's Knot* (1869), etc. Among his translations are *Autobiography by Goethe*; *Conversations of Eckermann with Goethe*; and Kuno Fischer's *Essay on Lord Bacon and his Philosophy*. D. in London, Feb. 22, 1877. Revised by H. A. Beers.

Oxenham, Henry Nutcombe: theologian; b. at Harrow, Middlesex, England, Nov. 15, 1829; was educated in the school of his native town and in Baliol College, Oxford; studied theology; became curate of Downinghall, Bucks, in 1854, of St. Bartholomew's, Cripplegate, London, in 1856; joined the Roman Catholic Church in 1857, and was for a time a member of the London Oratory, afterward successively professor of St. Edmund's College, Ware, and master at the Oratory school, Birmingham. D. Mar. 23, 1888. Among his works were *Poems* (1854; 3d ed. 1871); *Church Parties* (1857); *Catholic Doctrine of the Atonement* (1865; 3d revised and enlarged ed. 1881); *Letter to Father Lockhart on Dr. Pusey's Eirenicon* (1866; 2d ed. 1871); *Catholic Eschatology and Universalism: an Essay on the Doctrine of Future Retribution* (1876; 2d ed. 1878); *Eirenicon of the Eighteenth Century*, with introduction, notes, and appendices (1879); *Short Studies, Ethical and Religious* (1888); besides translations of various works by Döllinger, Hefele, and others. Revised by W. S. Perry.

Oxenstjerna, ox'*e*n-sher-nää, Axel, Count: statesman; b. at Fånö, Upland, Sweden, June 16, 1583; studied theology and jurisprudence at Rostock, Jena, and Wittenberg, and was employed, after his return to Sweden in 1602, by Charles IX. in several important diplomatic negotiations, which he carried through with great sagacity and dignity. On the accession of Gustavus Adolphus in 1611 he was made chancellor of Sweden, and as such he negotiated the Peace of Knäröd with Denmark in 1613 and of Stolbowa with Russia in 1617, and the armistice with Poland in 1629, and accompanied Gustavus Adolphus during his campaigns in Germany, taking charge of all diplomatic affairs. After the fall of Gustavus Adolphus at Lützen in 1632 he was empowered by the Swedish representatives to continue the war, and at the congress of Heilbronn in 1633 the Protestant princes chose him head of the league against the emperor. He concluded an alliance with Holland and France, and returned in 1636 to Sweden as chief of the government during the minority of Gustavus Adolphus's daughter Christina. When she became of age in 1644 his influence decreased, and when she abdicated he retired altogether into private life. He died in Stockholm, Aug. 28, 1654. The second part of *Historia Belli Sueco-Germanici*, of which Chemnitz wrote the first part, is generally ascribed to Oxenstjerna, who was an accomplished scholar.

Revised by R. B. Anderson.

Oxford: an old and famous city of England, the capital of Oxfordshire. It is situated 52 miles W. N. W. (63 by rail) of London, on the Thames (here called the Isis), near its junction with the Cherwell, among rich and beautiful surroundings, and contains a great number of splendid edifices (see map of England, ref. 11–I). Its trade and manufactures are comparatively insignificant; it is as a seat of learning it has acquired its fame, its university being the oldest and most celebrated institution of the kind in the United Kingdom. (See Oxford University.) It is also the seat of a bishopric, and it returns one member to Parliament. Pop. (1891) 45,741; (1901) 49,413.

Oxford: city (laid out in 1836, burned down during the war of 1861–65); capital of Lafayette co., Miss. (for location, see map of Mississippi, ref. 4–G); on the Illinois Central Railroad; 73 miles S. E. of Memphis, Tenn., 157 miles N. by E. of Jackson. It is the seat of the University of Mississippi (*q. v.*), of Union Female College (Cumberland Presbyterian, chartered in 1854), and of Warren Female Institute (Baptist, opened in 1866); and contains 5 large brick church buildings for white people and 3 frame ones for colored, graded school building that cost $15,000, U. S. Government building, 2 State banks with combined capital of $110,000, and 2 weekly newspapers. The industrial works include a cotton mill and gin, cotton-compress, planing-mill, and a canning-factory. Pop. (1880) 1,534; (1890) 1,546; (1900) 1,825. Editor of "Weekly Eagle."

Oxford: town; capital of Granville co., N. C. (for location, see map of North Carolina, ref. 2–G); on the Southern Railway; 46 miles N. of Raleigh. It is in a grain and tobacco growing region, has several large tobacco warehouses and manufactories, and contains an orphan asylum, a private bank, and two weekly periodicals. Pop. (1880) 1,349; (1890) 2,907; (1900) 2,059.

Oxford: village; Butler co., O. (for location, see map of Ohio, ref. 6–B); on the Cin., Hamilton and Dayton Railroad; 39 miles N. W. of Cincinnati. It is the seat of Miami University (*q. v.*), of Oxford College, and of Western Female Seminary, and has a national bank with capital of $50,000, and 2 daily papers and 2 monthly periodicals. Pop. (1880) 1,743; (1890) 1,922; (1900) 2,009. Editor of "News."

Oxford; borough: Chester co., Pa. (for location, see map of Pennsylvania, ref. 6–I); on the Lancaster, Ox. and South. and the Phila., Wil. and Balto. railways; 28 miles W. of Wilmington, Del., about midway between Philadelphia and Baltimore. It is in an agricultural region; contains 8 churches, 3 schools, public library, water-works supplied from artesian wells, electric lights, 2 national banks with combined capital of $200,000, a private bank, and a weekly newspaper; and has a flour-mill and candy and carriage factories. It is the seat of Oxford Academy (Presbyterian), and Lincoln University (Presbyterian) for colored students is 3½ miles N. E. of the borough. Pop. (1880) 1,502; (1890) 1,711; (1900) 2,032. Editor of "Press."

Oxford, Robert Harley, Earl of: statesman; b. in London, England, Dec. 5, 1661; raised a cavalry regiment for the service of the Prince of Orange 1688; entered Parliament 1690 as an extreme Whig, but gradually changed his political views until they reached the opposite extreme of Toryism; was chosen speaker Feb., 1701; re-elected in the two succeeding Parliaments; was made chief Secretary of State 1704, chiefly through the influence of Miss Abigail Hill (afterward Lady Masham) with Queen Anne; was made Chancellor of the Exchequer Aug., 1710; was stabbed at the council board by the Marquis of Guiscard, a Frenchman, Mar. 12, 1711, to which event he owed a new lease of public and royal favor; was created Earl of Oxford and Mortimer May 24, and Lord High Treasurer May 29 of the same year; enjoyed from this time very great power, having completely supplanted Marlborough in the queen's favor, and consolidated his own popularity by the Peace of Utrecht, Apr., 1713, but was in turn supplanted by Bolingbroke and dismissed July 27, 1714. Regarded with distrust by George I., he was impeached of high treason by Parliament Aug., 1715; committed to the Tower; acquitted June, 1717; lived thenceforth in retirement; accumulated immense collections of books and manuscripts (see Harleian Collection), and was author of some pamphlets of little merit. D. in London, May 21, 1724.

Oxford Movement: See Tractarianism.

Oxfordshire: an inland county of England, bordering S. on the Thames, and on the other sides on Bucks, Gloucestershire, Warwickshire, and Northamptonshire. Area, 755 sq. miles. The surface is mostly level, but undulating in the southern part, where a branch of the Chiltern Hills rises to a height of nearly 700 feet. The county is watered by several streams, including the Windrush, Evenlode, Cherwell, and Thame, which are affluents of the Thames. The soil is a mixture of gravel and loam, and very fertile. Agriculture and dairy-farming are in an advanced state. Wheat, barley, turnips, butter, and cheese are produced in large quantities. Ironstone is worked near Banbury, while blankets are manufactured at Witney, and paper at Henley and Shiplake. Pop. (1901) 137,118. Principal town, Oxford.

Oxford University: an institution of learning at Oxford, England. The first fairly authenticated notice of Oxford as a seat of learning dates from the time of Edward the Confessor. The first charter was granted to the university by John; in 1201, according to Anthony Wood, the university numbered within its walls 3,000 students. Later on, in the time of Henry III., Wood states that there were 30,000 students at Oxford; "but among these a company of varlets, who pretended to be scholars, shuffled themselves in, and did act much villainy by thieving, whoring, quarrelling, etc." The distinguishing characteristic of the Universities of Oxford and Cambridge is the existence of a number of separate corporations or colleges. There have been colleges at many universities, but nowhere have they ever reached anything like the same influence and importance as at Oxford and Cambridge. The origin of the colleges was due to benevolent persons who desired to relieve a certain number of poor scholars from some of the hardships of their life at the mediæval universities, and in order to do this provided a building in which such scholars could live a common life, and also an endowment for their maintenance. From Henry III.'s time date the foundations of three colleges—University (1249), erected on the site of a much earlier foundation; Baliol (1263), Merton (1270). In the time of Richard II. many members of the university warmly espoused the doctrines of Wyckliff, and in the persecutions that followed on this avowal many of the colleges were thinned, some, indeed, being quite deserted for a short time. The university found a generous patron in Richard III., who, among other bounties, granted the privilege to the university of importing or exporting books at will. During the reign of Edward VI. royal commissioners were appointed, with full powers to examine the affairs of the university. In consequence, the form of government in the university was completely altered; but in the next reign the old order of things was re-established. Queen Elizabeth's reign is remarkable in the history of Oxford University for the foundation by Sir Thomas Bodley of the Bodleian Library, and for the passing of the act which confirmed the university as a corporate body; also Jesus College was established in this reign. Shortly after the succession of James I. the two universities had the privilege granted of sending each two members to Parliament. During the troublous times of Charles I. the university sided throughout with the king, and suffered severely in consequence. In 1650 Cromwell was elected chancellor of the university, when several of the more obnoxious among the royalists were removed, to be reinstated at the Restoration. Under the tyranny of James II. the university came violently into collision with the crown; on the refusal of Magdalen College to receive a president forced upon it by the king all the members of that college, with the exception of two, were expelled. However, at the approach of William of Orange they were reinstated by the tyrant. From this period the university has proceeded on an even course.

Following is a list of the colleges, with statistics for 1900:

Founded.	COLLEGES.	Income from endowments.	Contributed to University	Undergraduates.	Members of convocation.
1437	All Souls	£14,995	£4.400	4	87
1262	Baliol	6,845	168	252	428
1509	Brasenose	10,786	968	131	325
1532	Christ Church	22,616	3,037	313	744
1516	Corpus	10,095	1,819	84	228
1314	Exeter	3,683	80	174	537
1874	Hertford	.....	17	100	145
1571	Jesus	10,795	628	123	134
1869	Keble	... ..	.....	223	208
1427	Lincoln	4,816	.....	85	183
1456	Magdalen	27,846	4,500	172	313
1270	Merton	12,676	2,631	140	255
1386	New College	19,653	1,778	200	353
1326	Oriel	7,533	813	140	227
1624	Pembroke	3,928	52	85	180
1340	Queen's	16,518	312	109	268
1555	St. John's	16,499	627	158	331
1554	Trinity	4,821	385	191	332
1249	University	6,276	150	185	307
1613	Wadham	3,389	178	108	222
1714	Worcester	2,323	41	101	243
	HALLS.				
1269	St. Edmund	.....	.....	32	35
1333	St. Mary	.....	.....	5	33
....	Grindle's	.....	.....	8	1
....	Marcon's	. ....	.....	26	3
....	Clarke's	.....	.....	13	.....
....	Hunter Blair's	.....	.....	3	.....
1868	Non-coll. students.	.. ...	.....	191	98
	Totals	.....	.....	3,446	6,220

The highest officer in the university is the chancellor; the election is determined by the members in convocation, and the office is held for life. For the last 200 years it has been the custom to elect some distinguished nobleman who has been educated at Oxford; the Marquis of Salisbury is the present chancellor. There is no stipend attached to this office. The chancellor's deputy, the vice-chancellor, is nominated by the chancellor from among the heads of colleges; the office is held for four years, and is endowed with a salary of £600 a year. To assist the chancellor and vice-chancellor two other officers are appointed—the high steward and deputy steward. The appointments are at the disposal of the chancellor, subject to the approval of convocation. The business of the university is transacted in two separate assemblies—the house of congregation and the house of convocation. In the former the business is confined to granting ordinary degrees and confirming the nomination of examiners made by the vice-chancellor and the proctors. All other business is conducted in the house of convocation. To facilitate the ordinary legislation of the university there meets every week during term time the hebdomadal council, composed of the heads of colleges and others. Not the least important among the university officers are the proctors. The business of these gentlemen is to guard against any breach of discipline on the part of members of the university. The proctors are two in number, and are assisted by four pro-proctors. Both proctors and pro-proctors must have attained the standing of master of arts, the former for at least four years previous to election.

Before entering the university a preliminary examination, the matriculation, must be undergone, varying in difficulty according to the status of the college. Shortly after entering the student is confronted by responsions, the first public examination; for this a slight knowledge of classics and mathematics is required. In order to get a degree the student must have resided at least twelve continuous terms at the university, and must have passed the necessary examinations. The study of ancient literature, history, and philosophy—*literæ humaniores*—is the study most largely encouraged at Oxford; the degree is usually acquired in the classical schools. There are also schools in modern history, civil law, and theology, in which the examinations are usually attended by men who have passed through the classical schools. For those who go to study mathematics, natural science, etc., there are also schools in those subjects. Attached to each college are fellowships and scholarships, awarded in most cases by open competition. Until lately fellowships were nearly all clerical, but now, to a great extent, restrictions have been removed, and the fellowships are thrown open to the whole university as they become vacant. In most colleges the fellowships are held for life, so long as the holder remains unmarried; but a sensible change is now largely adopted by making the fellowships tenable for ten years, whether the holders choose to marry or not. Scholarships are awarded after competition to undergraduates who have not exceeded a certain number of terms from matriculation, and to young men entering the university; there is in most colleges a limit of age. The value of the scholarships is about £80 or £100 a year, tenable for five years. Instruction is conducted mainly by the college tutors; lectures are also delivered by the university professors. The university year is divided into four terms—Michaelmas, Hilary, Easter, and Trinity. The intervals between terms are short, with the exception of the long vacation, which lasts from the first or second week in June to Oct. 10. *Oxford and her Colleges*, by Goldwin Smith (New York, 1894), is a delightful sketch of the university. See also *Historical Register of the University of Oxford* (1888).

Revised by C. H. THURBER.

Ox-gall: the bile of the domestic ox (*fel bovinum*). It is used in the arts in scouring wool, since into its complicated composition there enters abundance of soda, which gives it a soapy quality. When properly refined from its coagulable and coloring matters it is used by artists in mixing colors, which it often improves in tint, while it fixes them and makes them flow better. It is also used in some kinds of artists' varnish and in cleansing ivory tablets for artists' use. In medicine it is sometimes given when a deficiency of bile is suspected to exist, to aid digestion of fats in the small bowel; in enemata it is believed to dissolve scybalous masses, and as an external application some practitioners consider it powerfully discutient. Revised by H. A. HARE.

Oxides: See OXYGEN.

Oxley, James Macdonald, LL. B.: author; b. in Halifax, Nova Scotia, Oct. 22, 1855; educated at Dalhousie, Halifax, and Harvard Universities; was admitted to the bar, and practiced from 1877 till 1883, when he was appointed legal adviser to the Marine Department, Ottawa. He resigned this office in 1891, and engaged in the life-insurance business in Ottawa, and in 1892 in Montreal. Many of his books have been republished in England. Among his published works are *Nova Scotia Decisions* (3 vols., Halifax, 1880–83); *Young's Admiralty Decision* (Toronto, 1882); *Bert Lloyd's Boyhood* (Philadelphia, 1889); *Up among the Ice Floes* (1890); *The Chore-boy of Camp Kippeway* (1891); *Donald Grant's Development* (1892); *Fergus MacTavish* (1892); *The Good Ship Gryphon* (1893); *In the Swing of the Sea* (1897). Neil Macdonald.

Oxlip: See Primrose.

Oxpecker: See Beef-eater.

Oxus, Amoo′, or **Amu**, also called **Amoo Darya** (anc. *Oxus*; Arab. *Gihon*): a river of Western Asia, which rises on the Belur Tagh, nearly 15,000 feet above the level of the sea; receives many affluents from the mountains of Turkestan and the Hindu Kush, flows through Turkestan, and falls into the Aral Sea. The length of its course is 1,610 miles. According to the treaty of peace concluded in July, 1873, between Russia and Khiva, this river became the permanent boundary-line between Khiva and Bokhara.

Oxychlo′rides, sometimes called **Basic Chlorides**: a class of compounds sometimes formed by the direct action of an oxide of a metal upon the chloride of the same metal, as in the cases of lime, magnesia, zinc, etc. In the latter two cases important cements are founded upon the formation of such oxychlorides. Other classes of oxychlorides are formed by the partial decomposing action of water upon the chlorides of some metals, acting by removing a portion of the acid, as in the cases of antimony and bismuth. There are some native mineral oxychlorides, as atacamite and tallingite, oxychlorides of copper, and matlockite and mendipite, oxychlorides of lead. Other elements besides the metals form oxychlorides, such as silicon, carbon, sulphur, selenium, nitrogen, phosphorus. Oxychloride of phosphorus, $POCl_3$, is a compound of considerable interest.

Oxygen [Gr. *ὀξύς*, sharp, acid + *-gen* of Gr. *γεννᾶν*, and Lat. *genera're*, produce]: the most abundant of all the elements existing in the earth.

Name.—The word oxygen was applied by Lavoisier to represent the generalization which he had arrived at, and which in his day was almost universally accepted, that oxygen was the sole "acidifying principle." Since then it has become more and more apparent that the class of substances called "acids" does not owe its characteristics to the presence of oxygen, and that hydrogen is far better entitled to the designation of the "acidifying principle," if there be any such thing. Thus the term oxygen must be recognized as one of the most remarkable and unfortunate cases we have of a name founded upon a fragmentary and entirely incorrect generalization. In the German language, likewise, oxygen is *Sauerstoff* (acid stuff or material), again perpetuating Lavoisier's view. Condorcet called it "vital air." Scheele called it *Feuerluft*, fiery or fire-supporting air.

History.—Priestley, Aug. 1, 1774, first discovered and prepared in a pure state the life and fire-sustaining gaseous principle of air, which he called "dephlogisticated air," as he was, even up to the time of his death, an adherent of the phlogistic theory of Stahl. He prepared pure oxygen by heating red oxide of mercury, which is dissociated by heat into metallic mercury and oxygen gas. Priestley, who, from his many important discoveries and inventions relative to different gases and the manipulation of gaseous bodies, is known as the "father of pneumatic chemistry," knew well how to collect, preserve, and experiment upon the new gas. He thus easily proved its identity with the active element of the air. To commemorate this great event in scientific history the chemists of the U. S. assembled Aug. 1, 1874, 100 years later, at the grave of Priestley, on the banks of the Susquehanna, at Northumberland, Pa., to celebrate the "centennial of chemistry." One year later than Priestley, in 1775, the great Swedish chemist Scheele made independently the same discovery. Lavoisier may be justly regarded as the discoverer or propounder of the true theory of fire, oxidation, and combustion, as consisting in combination with oxygen of the air. Grotthuss, and especially H. Davy, investigated flame, and advanced some steps in a theory thereof.

Occurrence in Nature.—Oxygen is in an enormous degree the most abundant, as it is in many respects the most important, of the elements of matter, upon our earth at least. The only other element that can compare with it in abundance is silicon, the special element of mineral silicates. Even in these oxygen preponderates largely. The following figures show the proportions of oxygen and silicon in some of the commonest of the minerals that make up nearly the whole mass of the known earth:

MINERALS.	Oxygen per 100.	Silicon per 100.
Quartz	54·0	46·0
Feldspar (orthoclase)	46·75	29·6
Mica (muscovite)	48·27	21·0
Pyroxene	44·6	25·3
Amphibole	46·8	27·6
Limestone	48·0—carbon.	12·0

Oxygen constitutes nearly half the total weight of known matter, and silicon not far from one-third. Of water, the liquid part of the earth, oxygen forms eight-ninths. Of living matter, vegetable and animal, oxygen also forms by far the largest element, by reason of the fact that water is so predominant a constituent of these. Apart, however, from the water existing as such in living beings, much oxygen is contained in their solid or "plastic" constituents when perfectly dry. Thus cellulose and starch both contain 49·38 per cent. of oxygen, albumen 23·5, and gelatin 27·5. Of normal atmospheric air oxygen constitutes from 20·8 to 20·9 per cent. by volume, and by weight about 23 per cent.

Preparation.—Of accomplishing this there are many methods besides that of Priestley above referred to. Peroxides of manganese and barium both evolve oxygen when strongly heated. Peroxide of barium will take the oxygen up again at a lower temperature from a current of moist air, and the alternation of these two operations upon this peroxide, or, which is the same thing, upon anhydrous baryta, constitutes Boussingault's method of making oxygen. The method of Tessie du Motay, by which oxygen has been manufactured for illuminating purposes, consists in the exposure alternately of a salt of manganic acid to a current of air and to one of steam. Sulphuric acid will evolve oxygen from a number of substances when heated therewith, such as bichromate of potash, permanganate of potash, peroxide of manganese, peroxide of lead, etc. It may also be obtained by electrolysis of water. Deville and Debray proposed two new methods, both of which furnish it at first in admixture with sulphurous oxide gas, one being to pass sulphuric acid in vapor over heated platinum, the other to heat white vitriol, or sulphate of zinc, to a high temperature. The method in most general use, both in chemical laboratories and in the manufacture of oxygen for commerce, is to heat potassium chlorate to fusion. The evolution of the oxygen is greatly facilitated and hastened by pulverization of this substance and mixture with small proportions of peroxide of manganese.

Chemical Properties.—Oxygen is a colorless and inodorous gas which has been liquefied by Cailletet in Paris, by Pictet at Geneva, and by Dewar in London, by the application of great pressure and cold. It is magnetic—more so than any other gaseous substance. Its density, air being unity, is 1·10561. Bunsen found that ice-cold water can hold in solution 4·111 per cent. of its volume of oxygen, and water at 20° C. (= 68° F.) only 2·838 per cent. When pure, it manifests the most energetic affinities. A combustible body, as a charred splinter of wood, a candle, or the like, if having but a spark of fire adherent, instantly kindles into flame when immersed in oxygen. In this way it may be distinguished from all other gases except laughing-gas, which has the same power. Oxygen will itself burn with flame in an atmosphere of a combustible gas like hydrogen. Even gaseous ammonia may be substituted for the hydrogen in this experiment. When it burns with hydrogen, two volumes of the latter combine with one volume of oxygen, and the three volumes condense to two volumes of steam. The product of the union of oxygen with another element is called an oxide. Thus when lead is heated in contact with the air it combines with oxygen, forming lead oxide, PbO; charcoal, or carbon, burns, forming carbon dioxide, CO_2; phosphorus burns, forming phosphorus pentoxide, P_2O_5.

Uses of Oxygen.—Outside of the applications of oxygen as a purely scientific and analytical agent in the chemical laboratory, its practical uses have not yet been developed to any great extent, in consequence of the large expense of obtaining it free from nitrogen. Dr. Hare's applications of

it for producing intense heat for fusing metals, and intense light by the invention properly called Hare's lime-light, remain yet the most important uses. In France some hundreds of pounds of platiniridium have been melted at once by Hare's method.

Ozone.—This is a modification of oxygen which, up to this time, stands almost if not altogether alone in some respects. Allotropic modifications of solid and liquid substances are exceedingly common, but those of gaseous bodies are little known, ozone being the only one that has been at all studied. As in the case of all allotropic changes, when oxygen passes to the form of ozone there is found to be a change of volume. Ozone is formed when oxygen is submitted to various agents and operations. The electric spark and the slow oxidation of phosphorus are two of the most familiar. The oxygen formed by electrolysis contains it; also that evolved from a mixture of sulphuric acid and permanganate of potash. It is always readily detectable, when masking odors are absent, by its very singular and characteristic odor, which, once perceived, is always recognizable again. Revised by Ira Remsen.

Medicinal Uses of Oxygen.—Oxygen is locally irritating to raw surfaces, exciting inflammation if too long applied. Inhaled in health with proper precautions to remove carbonic acid and other products of expiration from the inspired gas, it is perfectly respirable, and does not produce much substantial change in the rate of performance of the functions. This circumstance is accounted for by the fact, proved by experiment, that in health the blood can take up as much oxygen from ordinary atmospheric air as when supplied with the pure gas—in other words, as much as it is capable of absorbing—the only difference in the two cases being that where oxygen alone is breathed, the highest point of saturation is reached more speedily than where air is employed. When from any cause there is defective respiration, and the system suffers in consequence from imperfect oxygenation of the blood, the inhaling of pure or slightly diluted oxygen, by enabling something like the normal quantity of the gas to be presented to the blood at each inspiration, affords prompt and decided relief, and is, of course, *pro tanto*, of great benefit. Hence in such affections as asthma, pulmonary emphysema, croup, diphtheria, dyspnœa from heart disease, etc., inhalations of oxygen are often exceedingly useful. In other diseases, generally those of mal-nutrition, such as consumption of the lungs, anæmia, severe dyspepsia, indolent ulcers, etc., experience has shown that in some cases much benefit has followed inhalations of oxygen. Where ulceration or active inflammation is present, the use of the gas requires care, lest its irritant effects do harm. Oxygen for medicinal use must be perfectly pure, and is best prepared by decomposition of potassium chlorate. It is inhaled from a bag connected with the mouth by a tube provided with a proper mouthpiece to keep the expired air from mixing with the gas; and the nostrils being left free, enough air is at the same time inspired to dilute the oxygen somewhat. Inhalations morning and evening of from 1 to 4 gal. generally suffice in chronic affections, but in acute disease the amount must be determined by the necessities of the case. For medicinal use, cylinders holding from 100 to 200 gal. of gas compressed into a moderate compass are exceedingly convenient as portable reservoirs from which to supply the inhaling apparatus. See Hydrogen Peroxide for local uses.

Revised by H. A. Hare.

Oxygenated Water: See Hydrogen Peroxide.

Oxyhæmoglobin: a combination of hæmoglobin, the coloring-matter of the blood, with oxygen. This compound readily renders up its oxygen to the tissues when reduced hæmoglobin results, which in turn becomes oxyhæmoglobin after the blood is aërated in the lungs. The bright-red color of arterial blood is due to this compound, while the darker color of venous blood is due to reduced hæmoglobin.

W. P.

Oxyhy'drogen Blowpipe: an apparatus invented in 1801 by Dr. Robert Hare, of Philadelphia, for the purpose of producing a very high temperature by burning hydrogen and oxygen together. It is now extensively used for melting platinum and for producing the calcium light, by rendering a piece of lime intensely hot. (See Lime-light.) The best form is a jet consisting of a tube for the delivery of oxygen, with a larger tube around it, the hydrogen being delivered through the annular space.

O'yer [from Anglo-Fr., from O. Fr. *oïr* > Fr. *ouïr* < Lat. *audi're*, hear]: in law, a hearing by the common-law rules of pleading. A party to an action who alleged in his pleading any deed upon which he based his claim or his justification in defense was required to make profert of such deed (that is, produce it in court), and thereupon the other party was entitled to demand oyer of the deed, or to hear it read, in order that he might have an opportunity to learn its contents or ascertain its genuineness, and thus be able to prepare his answer or defense. Anciently, when the pleadings were oral, profert consisted in actually bringing the deed into court, and upon a demand of oyer it was read aloud by the party introducing it; but when pleading was conducted by written instruments, profert was made by a merely formal allegation that the deed was brought into court, and a demand of oyer was made in writing upon the party alleging the deed, who was then bound to deliver it into the other's hands for inspection, and, if required, to leave with him a copy. Oyer was demandable only of deeds or instruments under seal, and of letters testamentary or letters of administration, and not of private writings having no seal. The practice of demanding oyer has been superseded in England and generally in the U. S. by more convenient methods, prescribed by statutes, as discovery under oath by one party upon an order obtained by the other, or the inspection of papers upon an order or due notice. See Pleading.

Abridged by F. Sturges Allen.

Oyer and Terminer [from Anglo-Fr. *oyer* (from O. Fr. *oïr*), hear, and *terminer*, limit, determine]: in England, a phrase forming part of the designation of certain higher criminal courts of original jurisdiction, and of the Commission (*q. v.*) by which they are directed to be held. General commissions of oyer and terminer are issued to the justices of Assize (*q. v.*) and other special persons (generally at the same time with the commission of Jail Delivery, *q. v.*) directing them to hear and determine all treasons, felonies, and misdemeanors arising within their jurisdiction. This commission differs from the commission of jail delivery principally in the circumstance that the justices of oyer and terminer can proceed only upon an indictment taken before themselves, whereas justices of jail delivery must try all found in the prison they are to deliver. A special commission of oyer and terminer is issued when there is a sudden insurrection, or riot, or public outrage which demands speedy redress, to hasten the administration of justice and assist the regular courts. The courts of oyer and terminer are of very ancient origin, and their constitution has been hardly altered at all since the time of Edward III. In the U. S. the phrase oyer and terminer is sometimes used in designating criminal courts, but the jurisdiction and organization is generally prescribed by statute. In the State of New York the court of oyer and terminer is the highest court of original jurisdiction. F. S. Allen.

Oyo, or **Awyaw**: the capital of Central Yoruba, in West Africa, N. of the Slave Coast. It is the center of one of the most important native agricultural regions in Africa. The people are fully clothed in well-dyed native cloths, and live in adobe houses built around court-yards. Pop. (1891) estimated, 60,000. See Yoruba.

Oyster [from O. Fr. *oistre* > Fr. *huître* < *os'trea*, *os'treum* = Gr. ὄστρεον, oyster]: the English name common to the species of the family *Ostreidæ* and genus *Ostrea*. All the species of the genus are much alike, and agree in the following characters: The animal has the mantle margin double and finely fringed; the gills are nearly equal; the lips plain; the palpi triangular and attached; the shell is irregular and rough; the left valve adherent and convex; the right free and flat or concave; the hinge toothless. The genus is almost cosmopolitan in range, but is not represented in the polar seas. About seventy recent species have been recognized by various authors, but the true species are probably considerably less. The most notable are the oysters of Europe (*Ostrea edulis*) and the Eastern U. S. (*Ostrea virginiana*). The former is a comparatively small species, found generally in the European seas, and has a coppery flavor; the latter is the common large American species; it has none of the coppery taste characteristic of the European species. The European species is hermaphroditic, the American dicœcious. Both species are subject to considerable variation in form, and the American has by some authors been differentiated into two—a northern roundish form (*Ostrea borealis*), and a southern longish one (*Ostrea virginica*). Revised by J. S. Kingsley.

Oyster-catcher: a name applied to the wading birds of the genus *Hæmatopus*, because they feed on small oysters and other molluscs. There are six or eight widely scattered species, all readily recognized by their stout, brightly colored, compressed bills, and striking black and white plumage, whence the English name of sea-pie. The American oyster-catcher (*Hæmatopus palliatus*) is about 18 inches long; the head and neck are glossy black; back, wings, and outer part of tail blackish brown; under parts, base of tail, and a conspicuous wing patch white. The European bird (*H. ostrilegus*), which is a straggler to Greenland, is slightly smaller, and is darker. F. A. Lucas.

Oyster-culture and **Oyster-fisheries**: the method of raising oysters for market and the means employed for taking them. The shell-heaps of Europe and North America testify to the antiquity of oyster-fisheries. At an early date the Romans imported oysters from Britain, while the oyster industry is still an important branch of the fisheries of various nations, notably of the U. S., Great Britain, and France, in the order given. Oysters are found at various depths, largely depending on the temperature of the water, but in the U. S. the majority are taken in water from 15 to 30 feet deep, although dredges are used down to 15 fathoms. The French and British dredge ordinarily down to 30 fathoms. In shallow water oysters are taken with "tongs," implements like a pair of huge, long-handled rakes, so hinged together as to open and shut like a pair of scissors. In deeper water dredges are used, these being essentially coarse-meshed nets of heavy twine or iron chainwork, secured to a rectangular iron frame, which scrapes over the bottom. The frame is about twice as wide as high, being usually 3 or 4 feet across, and the long sides are sharpened, or more usually furnished with large projecting teeth. The dredge is attached by a long rope to a small winch worked by one or two men, and the larger vessels carry two dredges. Tonging is prosecuted from small boats, dredging from larger vessels, these ranging from 5 to 50 tons burden, and while some exceed this size, the majority are under 30 tons. Oysters are taken at all seasons of the year, but during the warm months, roughly speaking from May to September, the oysters are spawning and are protected by law on public beds. The number of oysters consumed is enormous, so much so that, in most cases, the natural supply can by no means keep pace with the demand, and, as Mr. Stevenson puts it in a recent report on the oyster industry of Maryland, "in every region of the world where the oyster industry has assumed any commercial importance, it has passed, or is apparently passing, through the following four stages: First, the natural reefs in their primitive condition, furnishing the entire supply of oysters; second, those reefs somewhat depleted, producing small oysters, many of which are transplanted to private grounds, and under individual protection permitted to mature; third, the public beds so far depleted that the supply available is very irregular and uncertain, and consists almost entirely of small oysters, which are transplanted to private areas; fourth, the entire dependence of the industry on areas of ground under individual ownership or protection.

"In Europe the greater number of the oyster-producing localities are in the condition of the fourth stage. In the U. S. . . . the industry still depends largely on the public reefs; but were it not for the supply of seed oysters obtained from more southern waters, all those States N. of Connecticut would be practically in the condition of the fourth stage. Connecticut, New York, New Jersey, and Delaware . . . are rapidly passing from the third to the fourth condition. The oyster industry of Chesapeake Bay is in the second stage, but the history of the fishery in other States and countries excites grave fears as to its long continuance in this condition." Oyster-culture proper, that is the raising of oysters from the spawn or spat produced upon the spot, is most extensively and successfully practiced in France. The spawn is collected upon wooden hurdles or tiles, from which the young oysters are removed and transferred to the beds to grow. In the U. S. considerable attention has been paid to the extension or preservation of private oyster-beds by throwing over quantities of oyster or seallop shells on which the spat can collect, but so far it has been found most profitable to transplant young or small oysters from the public grounds to private beds. This practice may be said to have been initiated in Europe by Sergius Orata, who "bedded" oysters at Baiæ 95 B. C. The Japanese are successful ostreaculturists, and the art has been practiced by the Chinese for 1800 years.

The following table from *The Oyster Industry of Maryland* (1894) shows the oyster product of the world:

COUNTRY.	Bushels.	Value.
U. S.	29,796,387	$16,638,805
Great Britain	2,760,000	6,200,000
France	2,000,000	5,000,000
Holland	70,000	444,000
Italy	65,000	200,000
Canada	152,580	183,846
Germany	13,000	75,000
Miscellaneous	400,000	600,000
Totals	35,256,967	$29,341,651

In the U. S. Maryland leads with 11,632,117 bush., having a value of $5,866,120. Connecticut leads in oyster-bedding, while California is remarkable for her rapid development of the oyster industry, her product being worth $698,257. The secondary products of oyster-fisheries, in the shape of shells, have a considerable value. Formerly oysters, raw or burned into lime, were extensively used for manure along the eastern seaboard of the U. S., and the poorer qualities are still so employed in some parts of the Southern States. The refuse shells from the large canneries are burned into lime for use in making gas, or are used as a flux in the manufacture of certain kinds of iron. For information concerning the oyster-fishery, see the Quarto Fishery Reports: the special bulletin of the tenth census of the U. S. on the *Oyster Industry*, by Ernest Ingersoll; the bulletins of the U. S. Fish Commission; *Oysters and All About Them*, by John R. Philpots (London, 1890). F. A. Lucas.

Oyster-plant: See Salsify.

Ozæ'na [Mod. Lat., from Lat. *ozæ'na* = Gr. ὄζαινα, a fetid polypus in the nose, deriv. of ὄζειν, smell]: a disease of the nose, characterized by a discharge of fetid muco-purulent matter from the nostril. Any case of chronic catarrh of the nose may become ozæna if the condition of the patient is depressed. It may depend upon caries, and may be a symptom of cancer, syphilis, glanders, or scurvy. It often follows scarlatina, or even a severe cold. General tonic treatment, good food, and weak local disinfectants are indicated in simple ozæna; but if there be caries, or any specific disease of which it is a symptom, such disease will require attention.

Ozark Mountains: a series of steep and heavily timbered ridges of Southern Missouri, extending into Arkansas and the Indian Territory. They are nowhere of great elevation. They are believed to possess great mineral wealth.

O'zerov, Vladislav Aleksandrovich: poet; b. in the government of Tver, Russia, Sept. 29, 1770. He was well educated, and after a career of some years in the army he entered the civil service. His first literary ventures met with scant success, but in 1804 his tragedy *Œdipus at Athens*, though little more than a translation from the French writer Ducis, at once achieved great popularity. In the following year his *Fingal* (taken from Ossian) was equally fortunate, and in 1807 he won his greatest triumph with his *Dimitriĭ Donskoĭ* (name of an early prince of Moscow, who defeated the Tatars), a patriotic piece first put on the stage a few days before the battle of Eylau and full of allusions to the struggle then going on between Russia and France. His last play, *Polyxena* (1809), if not up to its predecessors, was nevertheless favorably received by the public. D. Nov., 1816. Ozerov is commonly regarded as the last Russian dramatist of the classical school, but he belongs to the romantic in the choice of some of his subjects and in the sentimentality of his works. His style is stately, his verse smooth and melodious, and his feeling usually genuine and well expressed (8th edition of complete works, 1856). His *Fingal* has been translated into French verse (by Dalmas, St. Petersburg, 1818) and prose. A. C. Coolidge.

Ozokerite [from Gr. ὄζειν, smell + κηρός, wax]: a brownish-yellow, wax-like substance found in bituminous sandstones. The largest deposits are in Moldavia and in Utah. In combination with India-rubber, asbestos, etc., it is used to insulate electrical conductors.

Ozone: See Oxygen.

P

: the sixteenth letter of the English alphabet.

Form.—The form P is that of the Roman alphabet derived from the early Greek ⌜, ⌝, or in its square-cornered form ⌐. The Semitic form of the letter was ⌝. Its original shape was an ellipse, and hence its Semitic name.

Name.—The Semitic name of the letter was *pē*, i. e. mouth, which became in Greek πεῖ, later πῖ. The Latin phonetic name *pe* passed through the French *pé* into English as *pe*, now pronounced as rhyming with *tree*.

Sound.—It is a voiceless labial explosive, formed by breaking a closure at the lips with voiceless breath, as in *pat*, or by effecting a check through closing the lips, as in *up*. Sometimes there is in the latter case an additional after-puff caused by again breaking the closure; thus after *s*, as in *asp*, where the after-puff constitutes the only characterization of the sound. Before *n*, *s*, *t*, the *p* is silent, as in *pneumatics*, *psalm*, *receipt*, *Ptolemy*, also in *cupboard*, *raspberry*, and after *m* finally or before *t*, as in *jump*, *tempt*, it has the effect of giving a sharp and definite conclusion to the nasal.

Source.—The sound *p* represents in Teutonic words a Teutonic *p* < Indo-Eur. *b*, which was, however, of rare occurrence, and initially did not exist. Hence no genuine Teutonic word in English begins with *p*. Example of non-initial *p*: *sleep* < O. Eng. *slēpan*: Germ. *schlafen*; cf. O. Bulg. *slabŭ*, weak: Lat. *laba're*, totter. The sound is secondarily developed in, e. g., *empty* < O. Eng. *ēmtig*, *Hampton* < O. Eng. *Hāmtūn*. Otherwise *p* occurs in loan-words, (*a*) from Latin through O. Eng., as *pound* < O. Eng. *pund*, Lat. *pondo*; (*b*) from Latin through O. Fr., as *people* from O. Fr. *pueple* < Lat. *po'pulus*; (*c*) from Lat. through some other Romanic language, as *piazza*, Ital. < Lat. *platea* (Gr. πλατεῖα); (*d*) from Latin or Greek direct, as *pastor*, *pathos*; (*e*) from various other sources, as *plaid* (Celtic), *punch* (Hindi).

Symbolism.—P. = phosphorus (in chemistry); Publius (in Latin); *pondere*, by weight; P. C. = *Patres Conscripti* (Latin); P. M. = *post meridiem*, afternoon; postmaster; Pontifex Maximus (Latin); Pb = plumbum, lead (in chemistry). See ABBREVIATIONS. BENJ. IDE WHEELER.

Paca, paa'kăă [Portug., from the native name]: one of the largest of rodent mammals (*Cœlogenys paca*), a native of South and Central America. It is 2 feet long and generally dark brown with streaks and patches of white. The zygomatic arch is prodigiously developed, so that the cheek pouches are protected by a bony case. Its tail is very small.

The brown paca.

It is destructive to sugar-cane and other growing crops, burrows in the earth, and is remarkably cleanly in its habits. It is clumsy in build, but very active. When wild it bites fiercely if hard pressed. In captivity it is harmless and somewhat stupid. It is valued as food, but is usually very fat and oily. Its fur is worthless, but its thick skin makes a good leather.

Paca, WILLIAM: jurist and Governor of Maryland; b. at Wye Hall, Harford co., Md., Oct. 31, 1740; graduated at Philadelphia College 1758; studied law in the Middle Temple, London, and became a lawyer at Annapolis, Md.; was a leading patriot in 1774; was in Congress 1774–79, and again 1786; signed the Declaration of Independence; was in the State Senate 1777–79; chief justice of Maryland 1778–80; chief justice of the State court of appeals for admiralty and prize cases 1780–82; Governor of Maryland 1782, 1786; was in the convention of 1788 which ratified the U. S. Constitution; was a U. S. district judge 1789–99. D. in 1799.

Pacchio'nian Bodies [Mod. Lat. *glan'dulæ Pacchioni*, Pacchionian glands, named in honor of their discoverer, Antonio Pacchioni (1665–1726)]: a group of numerous small whitish bodies found, in man, on the inner surface of the dura mater, and also within the superior longitudinal sinus and on portions of the pia mater, whence indeed they are originally developed, making their way outward into the dura mater and producing, by pressure and absorption, little depressions in the inner surface of the skull. They are very rarely found in subjects under three years of age, and are sometimes absent in adults. They are not glands, but fibrocellular nodules. Their use is not known.

Pachmann, VLADIMIR, de: See the Appendix.

Pachu'ca: capital of the state of Hidalgo, Mexico; on a branch of the railway from Mexico to Vera Cruz; 55 miles N. N. E. of Mexico city (see map of Mexico, ref. 7–H). It lies in a valley at the foot of a mountain chain which separates it from the valley of Mexico, and 8,150 feet above the sea. Pachuca is noted for its silver mines, which are among the most important in the republic. It is said that they were worked by the Aztecs before the conquest. The Spaniards early took possession of them, and it was here that the amalgamation or *patio* process was discovered by Bartolomeo Medina in 1557. In 1893 there were 14 reduction-mills, and from 70,000 to 90,000 tons of ore are reduced annually. Pop. (1895) 52,189. HERBERT H. SMITH.

Pachyderm'ata [Mod. Lat.; Gr. παχύς, thick + δέρμα, δέρματος, skin]: a name applied by Cuvier to an order containing the horses, tapirs, pigs, elephants, and related forms, including all non-ruminating ungulates. The sea-cows, and even the walrus, have been placed in this "order" by some writers, but the members of this heterogeneous group are now distributed in other orders. F. A. L.

Paci'ficator, The: See FERRY, PAUL.

Pacific Ocean: that part of the aqueous envelope of the earth which separates America from Asia and the East Indies. It is the most extensive and the deepest of the oceans. On the S. it merges with the southern ocean, the parallel of 40° being usually taken as an arbitrary limit. On the N. and E. it is separated from Asia and the Indian Ocean by a chain of seas more or less inclosed by islands and peninsulas. These—the Bering, Okhotsk, Japan, Yellow, China, Sulu, Celebes, Banda, Java, and Arafura Seas—are all regarded as its dependencies. The ocean proper has an area of 50,000,000 sq. miles, or three-eighths of the water-surface of the globe; with its dependencies, 55,500,000, or two-fifths. Its mean depth is 2,475 fathoms, and it contains about three-sevenths of the water of the globe. Counting also the dependencies, the mean depth is 2,285 fathoms, and the ratio of volume five-elevenths. The mean depth is also the general depth, three-fourths of the bottom lying between the planes of 2,000 and 3,000 fathoms.

Configuration of the Bed.—The most extensive plateau lies in the southwestern part of the ocean, and is of an extremely irregular character. From the island of New Guinea it extends E. by S. to the Friendly islands, including also the Fiji, Samoan, Ellice, and Salomon islands, and the New Hebrides. A southward arm extends to New Zealand; another southward arm, bearing New Caledonia, extends to Queensland, and a branch from this joins New Zealand. The area thus indicated rises above the 2,000-fathom line, and considerable parts of it approach within 1,000 fathoms of the surface, while a great number of peaks reach the air. The Caroline islands occupy another plateau, from which narrow branches extend southward to New Ireland and

northwestward, viâ the Ladrone islands, to Japan. Other plateaus of some extent are occupied by the Marshall and Low groups, and a narrow ridge, 1,600 miles in length, extends W. N. W. from the Sandwich islands, sending a few peaks to the surface. An extensive but imperfectly surveyed plateau lies off the coast of Chili.

There is a broad deep between New Zealand and Chatham island on the W. and the Isle of Maria Theresa on the E. A more extensive deep of irregular outline follows the coast of the Kurile and Japanese islands and extends E. in lat. 25° N. Its deepest portion lies close to the line of islands, and includes soundings of about 5,000 fathoms. The vast bed of the Pacific has been surveyed with care in only a few districts, but in those it has been found to be very irregular in detail, abounding in mountains and valleys. It is believed that the peaks whose summits are known as islands and shoals constitute but a small part of the Pacific mountain system.

Circulation.—The parts of the ocean lying N. and S. of the equator are called respectively the North Pacific and the South Pacific, and though the assumed dividing line is arbitrary, it coincides approximately with a natural division related to the system of currents. Each part has its own great eddy, set in motion by the planetary winds, and the reverse current which separates these lies but a few degrees N. of the equator. In the North Pacific a great current runs westward in the tropics, another great current eastward in the temperate zone, and the circuit is completed by a southward current along the California coast and a northward current along the coasts of the Philippine and Japanese islands. The heat-bearing northward current is known along the coast of Japan as the Kuro Siwa, and is the counterpart of that portion of the North Atlantic circulation called the Gulf Stream. N. E. of the principal eddy is a secondary eddy occupying the Gulf of Alaska. It follows the Alaskan coast from Charlotte island northward, westward, and southwestward to the vicinity of Unalaska, where it turns to the S. and E. A monsoon current, following the coast of Central America and Southern Mexico, runs to the northwestward in summer and is reversed in winter. The great eddy of the South Pacific flows westward near the equator and eastward in middle temperate latitudes, where it joins with the circumpolar eddy of the southern ocean and follows the South American coast northward to Cape Blanco. The return southward current is divided by the islands into many streams, and a distinct eddy is recognized between Australia and New Zealand. This is not a reverse eddy, like that of the Alaskan Gulf, but turns from right to left like the great eddy with which it is associated, following the New Zealand coast northward and the Australian southward.

Islands.—The Pacific is distinguished by the abundance of islands, pelagic and continental. The pelagic, which are of great number, are of small extent, and are the summits of conical volcanic mountains built by submarine eruption from the bottom of the sea. Many of those lying within the tropics are capped or surrounded by coral reefs. The continental islands, containing not only volcanic but sedimentary rocks, are for the most part of greater extent and are grouped about the western margin.

See also OCEAN, DEEP-SEA EXPLORATION, and the names of the various islands and archipelagoes. G. K. GILBERT.

Pacinian Corpuscles [named from Filippo Pacini, an Italian anatomist; b. May 25, 1812; d. July 9, 1883]: peculiar structures found as peripheral nerve terminations. They are met with in the subcutaneous layer on the palms of the hands and soles of the feet; on the sympathetic nerve plexuses; behind the peritoneum near the pancreas; and sometimes in the mesentery. Their shape in man is oval or like an egg; the diameter is from one-twentieth to one-sixth of an inch. The structure seems to consist of several concentric layers of connective tissue surrounding the terminal extremity of a nerve-fiber. The corpuscle seems to be one of the modes of termination of the nerves of general sensibility. See HISTOLOGY (*Peripheral Terminations of the Nerves*).

Pacinotti, pä-chē-not'tē, ANTONIO: electrician; b. at Pisa, Italy, in 1841. He is the author of a number of interesting investigations in electricity, but is chiefly known through his invention (1860) of a dynamo-electric machine having a ring armature with closed coils, identical in principle with that subsequently used by Gramme in his well-known dynamos. E. L. N.

Packard, ALPHEUS SPRING, M. D., Ph. D.: entomologist; b. at Brunswick, Me., Feb. 19, 1839; graduated at Bowdoin College 1861; studied natural history under Agassiz, devoting himself particularly to entomology; graduated in medicine at the Maine Medical College 1864; made several scientific expeditions; was for several years lecturer on entomology at Bowdoin College, a curator of the Peabody Academy of Sciences at Salem, Mass., and one of the editors of *The American Naturalist*; in 1878 was appointed Professor of Geology and Zoölogy in Brown University, Providence, R. I.; for several years was a member of the U. S. Entomological Commission. His writings have been very numerous, the principal ones being *Observations on the Glacial Phenomena of Labrador and Maine, with a View of the Recent Invertebrate Fauna of Labrador* (1867); *A Guide to the Study of Insects* (1869); *Our Common Insects* (1873); *Half Hours with Insects* (1875); *Life Histories* (1876); *Zoölogy* (1879); *Entomology for Beginners* (1888), and many more technical papers, chiefly on insects and Limulus.

Revised by D. S. JORDAN.

Packfong: the name in common commercial use for Paktong, or German silver. See PAKTONG.

Pacto'lus (in Gr. Πακτωλός, now *Sarabat*): a small stream, barely 10 feet wide and a foot deep, of Lydia in Asia Minor, which flows from Mt. Tmolus into the Hermus. It was formerly famous for the gold contained in its mud, and was the mythical source of the wealth of Crœsus; but for many centuries no gold has been obtained here. See Perrot and Chipiez, *History of Art in Phrygia, Lydia, Caria, and Lycia* (London, 1892; pp. 247–253). J. R. S. S.

Pacu'vius, MARCUS: dramatist; b. at Brundisium, Italy, about 220 B. C.; nephew of the poet Ennius; lived in Rome; became celebrated as a painter as well as a writer; retired when an old man to Tarentum, where he died about 132 B. C. Pacuvius wrote *saturæ* after the manner of Ennius, and at least one historical drama (*prætexta*), with the title *Paulus*, but his fame rested chiefly upon his tragedies, in which he followed Greek models (Sophocles and Euripides). The fragments of twelve tragedies which have come down to us are found in Ribbeck's *Tragicorum Latinorum Fragmenta* (Leipzig, 2d ed. 1871). See also L. Müller, *De Pacuvii Fabulis* (Berlin, 1889). M. WARREN.

Padang': a division of the Dutch dominions on the west coast of Sumatra, consisting of the districts of Upper and Lower Padang, and containing the city of Padang, occupied by the Dutch since the seventeenth century. The territory comprises some of the loveliest regions found anywhere in the tropical zone. Only the low and marshy coast-land is oppressively hot and unhealthful; the slopes of the high, volcanic mountains have a most agreeable climate and a very fertile soil. The products are coffee, pepper, indigo, and caoutchouc, and gold, iron, copper, and quicksilver. Coffee is extensively cultivated, especially in Upper Padang. Pop. of the district about 1,000,000. The city, which is the residence of the governor, contains a Malay population living in bamboo huts on the left bank of the river, and a population of Europeans and Chinese living in houses of stone on the more elevated right bank. The place is the most prosperous on the west coast and has a large trade. Pop. 25,000. Revised by C. C. ADAMS.

Paddle-fish: popular name of a fish of the Mississippi basin; remarkable for having the nose prolonged into a thin, flat, bony, paddle-shaped appendage, sometimes about as long as the body. Its scientific name is *Polyodon spathula*. It has no scales, has a tough but shark-like flesh, and uses its snout for the purpose of digging in the mud in search of food, which consists of small organisms. It is also called spoonbill and duckbill catfish. Revised by D. S. JORDAN.

Paddock, BENJAMIN HENRY, S. T. D.: bishop; b. at Norwich, Conn., Feb. 28, 1828; graduated at Trinity College, Hartford, 1848; was assistant teacher in the Episcopal Academy, Cheshire, Conn., 1848–49; graduated at the General Theological Seminary 1852; was made deacon 1852, and became assistant minister in the Church of the Epiphany, New York; ordained priest 1853, and became rector of St. Luke's, Portland, Me., but resigned on account of ill-health, and became rector of Trinity Church, Norwich, Conn.; became rector of Christ Church, Detroit, Mich., 1860; declined the missionary bishopric of Oregon and Washington Territory 1868; took charge of Grace Church, Brooklyn, N. Y., 1869; elected bishop of Massachusetts, and consecrated in Brooklyn, Sept. 17, 1873. D. in Boston, Mass., Mar. 9, 1891. Among his published writings are *Ten Years in the Episcopate* (1883) and *The First Century of the Diocese of Massachusetts* (1885).

Pa'derborn: town; in the province of Westphalia, Prussia; 50 miles S. W. of Hanover (see map of German Empire, ref. 3–E). It has a cathedral built at different dates, from the eleventh to the thirteenth century, under which the sources of the Pader burst forth, many good educational institutions, breweries, distilleries, and manufactures of tobacco, oil-cloth, hats, and paper. Pop. (1890) 17,986.

Paderewski, pă̆-dā-rev'skĕe, Ignace Jan: pianist; b. at Podolia, Poland (Russia), Nov. 6, 1860; began to play the piano when three years old; received instruction from local teachers; in 1872 went to Warsaw, and later to Berlin, continuing his studies in both cities. When eighteen years of age he was nominated professor in the Warsaw Conservatory; in 1884 abandoned teaching, and took a course of three years' study at Vienna under Leschetitzky, and made his *début* as a professional pianist in 1887 in Vienna. Since then he has given many concerts, everywhere awakening the greatest enthusiasm. Beginning in 1891 he has made several concert tours in the U. S. which have added to his fame and very materially to his wealth. He produced a successful opera in 1901. D. E. Hervey.

Padilla, pă̆-deel'yă̆, Juan, de: Spanish revolutionist; b. about 1484; joined in the revolt of the Castilian towns against the Flemish officials of Charles V. in 1520, and soon became the leader of the movement. The rebellion was at first partially successful. The insurgents deposed the regent, Cardinal Adrian, of Utrecht, placed the queen-mother at the head of the Government, and demanded of Charles V. a reform of the constitution in the interests of the people; but the nobility, alienated by the democratic spirit of these measures, opposed Padilla, and succeeded in supplanting him in the command by a noble of inferior ability. The insurgents after several reverses recalled Padilla, but, though he gained some advantages, the policy of the revolutionary junta in granting an armistice permitted his ill-disciplined forces to melt away. The royalists forced a battle at Villalar Apr. 23, 1521, defeated the rebels, and captured Padilla, who was executed on the following day.—His widow, Maria Pacheco, held out against the royalists till the spring of 1522, when she fled to Portugal. D. there in 1531.

Pad'ua (Ital. *Padova*, Lat. *Pata'vium*): a city of North Italy; 23 miles W. by S. of Venice; on two branches of the Bacchiglione, just above their confluence with the Brenta (see map of Italy, ref. 3–D). The city is a triangular inclosure, surrounded by a wall 8½ miles in length, the base of the triangle being toward the W. Its streets are not generally attractive; the houses are high, and built upon arcades; but some of the squares and public buildings are very fine. The municipal palace is a rhomboidal structure, built on arches and surrounded by *loggie*, and containing a highly ornamented hall, the Sala della Ragione, which has given its name to the whole building, and is said to be the largest vaulted room in Europe. The university originated in the early part of the thirteenth century, but the present buildings date from the close of the fifteenth. There were (1891) 63 teachers and 1,316 students. The university library, with 158,500 volumes and 2,500 MSS., is in the Palazzo del Capitanio. The Church of St. Antony (1232–1307), of mixed architecture, is surmounted by seven cupolas, the center one of which is over the chapel containing the bones of St. Antony. Padua is a town of great antiquity. At the beginning of the Christian era it was the largest and most prosperous town of Northern Italy. It was plundered by Alaric and Attila, and only partially recovered under Charlemagne, and suffered varying fortunes until in 1405 it was conquered by Venice, in whose possession it remained until it was given in 1797 to Austria, which held it, except from 1805–14, until 1866, when it was united to the kingdom of Italy. There is yet very little commercial or industrial activity in the city. Pop. (1892) 79,500.

Paducah: city (laid out in 1827, incorporated in 1856); capital of McCracken co., Ky. (for location, see map of Kentucky, ref. 4–C); at the junction of the Ohio and the Tennessee rivers; on the Chesapeake, Ohio and S. W., the Paducah, Tenn. and Ala., and the St. Louis, Alt. and Terre Haute railways; 48 miles N. E. of Cairo, 140 miles S. W. of Evansville. It is in a coal, iron, agricultural, and hardwood region, and is principally engaged in manufacturing, agricultural, and river trade. There are lines of daily packets up and down the Ohio river, semi-weekly packets on the Ohio and the Cumberland rivers, and tri-weekly packets on the Tennessee river. The city has gas and electric light plants, a fine system of water-works, electric street-railway, paid fire department, 3 public parks, 6 hotels, 2 hospitals, and U. S. Government building. It is the second primary tobacco-market in the country, having several tobacco-factories and 5 acres of tobacco-warehouses. Other industrial establishments are a ship-yard where steamboats and barges are built, marine railways, ship-timber mill, and wheel-factory. There are 12 churches for white people, and 7 for colored, 7 public-school buildings, public-school property valued at over $92,000, 3 national banks with combined capital of $550,000, 2 State banks with capital of $200,000, and 4 daily and 5 weekly newspapers. Pop. (1800) 8,036; (1890) 12,797; (1900) 19,446.

Editor of "News."

Padus: See Po.

Pæan [Lat. = Gr. *παιάν*, a hymn to Apollo as helper; later to other gods; *παιάν* is the Doric form, *παιών* the Attic]: among the ancient Greeks, a hymn of thanksgiving and joy, such as was sung especially before and after battles. The pæan was originally addressed to the Pythian Apollo, afterward to other gods and even to men. The word is now used to signify a loud and joyous song.

Pædogen'esis [Mod. Lat., from Gr. *παῖς*, *παιδός*, child + *γένεσις*, production]: that acceleration in the life-history of certain animals (as, for instance, the Mexican axolotl and certain flies—*Cecidomyidæ*) in which the larvæ are capable of reproduction. In the latter forms the larvæ produce other larvæ, which feed upon the parent, and eventually escape from the body by its complete destruction. J. S. K.

Pæonine: See Rosolic Acid.

Pæs'tum (in Gr. Ποσειδωνία, mod. Ital. *Pesto*): an ancient town of Southern Italy, on the Gulf of Salerno, about 40 miles S. E. of Naples (see map of Italy, ref. 7–F). It was originally a Greek colony from Sybaris, called Posidonia; it was afterward taken by the Lucanians, who named it *Pæstum*, then by the Romans, and it was finally burned by the Saracens in the ninth century. The ruined walls form a pentagon 3 miles in circumference, the north and east sides being best preserved; one of the eastern gates still exists, and an old street of tombs is traceable beyond the ruins of another. Three very ancient Doric temples remain in a good state of preservation. The largest, that of Neptune, is pure in style, is 196 feet in length and 79 feet in width, with a peristyle of 36 fluted columns (28 feet in height, 7½ feet in diameter), supporting an architrave without moulding, and frieze with the usual triglyphs; the pediments at the two ends are surrounded by a cornice, and are of similar architecture. The cella is of the same form as the exterior, has two rows of eight columns each, and these are surmounted by smaller ones to support the roofs of the aisles, the cella itself having been hypæthral or uncovered. The temple of Ceres (some say of Vesta) has thirteen columns on its flanks and an open vestibule within the peristyle. Between these two temples are the ruins of, probably, a Roman theater and amphitheater. The so-called basilica, S. of the temple of Neptune, is remarkable for having nine columns on its front, with a row of eighteen running down the center of the cella.

Paez, paa'ăth, José Antonio: general; b. in the province of Barinas, Venezuela, June 13, 1790. He joined the patriots in 1810; quickly attained prominence as a leader of the *llanero* cavalry; was made general of division in 1819; took a leading part in the victory of Carabobo 1821; and captured Puerto Cabello, the last Spanish port in Venezuela, in 1823. From 1823 to 1826 he was military commandant of Caracas; having been superseded, he led a rebellion, but was pardoned by Bolivar, and given the military and civil command of Venezuela, with the title of *jefe superior* (1827). In 1829 he headed the revolutionary movement which resulted (1830) in the final dissolution of the old republic of Colombia and the complete independence of Venezuela. Under the centralist constitution, which was then adopted, he was president of Venezuela Mar. 18, 1831, to Feb. 9, 1835. After commanding the army for four years, and putting down two rebellions, he was again president Feb. 1, 1839, to Jan. 28, 1843. In Jan., 1848, he declared against Monagas, but after more than a year of civil war he was defeated, imprisoned for ten months, and finally banished for several years. In 1860 he was minister to the U. S. On the deposition of Gual (Aug. 29, 1860) Paez was proclaimed dictator by the army. He held the post during nearly three years of almost constant civil war, and was finally defeated by the federalists under Falcón and Guzman

Blanco, May, 1863. Most of the remainder of his life was passed in New York, where he died May 7, 1873. He published his *Autobiography* in 1867. HERBERT H. SMITH.

Paganini, pä̆-gä̆-nee'nĕĕ, NICOLO: violinist; b. at Genoa, Italy, Feb. 18, 1784; son of a commission broker; gave, when nine years of age, his first public concert as a violin-player in his native city, and produced an extraordinary enthusiasm by his performance of *La Carmagnole* and the variations upon this air. From 1805 to 1808 he was first violinist to the Princess Eliza of Lucca, a sister of Napoleon. Afterward he led for many years a most adventurous life, sometimes playing for bread in a market-place and sometimes refusing to play though a fortune was offered him. From 1828 to 1833 he made a concert tour from Vienna through Germany, to Paris and London, astonishing every one by his extraordinary playing. Wealthy, but with broken health, he returned in 1834 to Parma, where he bought the Villa Gagona. D. at Nice, May 27, 1840. His compositions, of which the *Carnival of Venice* is one of the most famous, include a sonata, *Napoleon*, composed for one string. None has great musical worth, but for the violinist they are of great interest. His most successful imitator was his pupil Savori.

Paganism [from Late Lat. *paganis'mus*, deriv. of *paga'nus*, pagan, liter., villager, peasant (as the old religion lingered longest in the villages), deriv. of *pa'gus*, district, the country]: a name for heathenism, now used as a general term including all polytheistic religions in opposition to Christianity, Judaism, and Mohammedanism; in the Middle Ages it also included Mohammedanism. In Germany it is also applied to tendencies within Christianity itself which are deemed polytheistic in their nature, such as the worship of the Virgin and the saints in the Roman Catholic Church. Revised by S. M. JACKSON.

Page, DAVID PERKINS: educator; b. at Epping, N. H., July 4, 1810; for his education spent two terms in Hampton Academy, and then taught school, receiving, in 1845, the principalship of the newly established Albany Normal School, where he served till his death Jan. 1, 1848. He possessed in a rare degree the qualities of a great teacher. His *Theory and Practice of Teaching* (1847) has had a prodigious influence. C. H. T.

Page, THOMAS NELSON: author; b. at Oakland, Hanover co., Va., Apr. 23, 1853. His great-grandfather on his mother's side was THOMAS NELSON (*q. v.*); on his paternal side his great-grandfather was Col. John Page, one of the foremost patriots of the Revolution, member of committee of safety, and Governor of Virginia 1801–03. Thomas Nelson Page was educated at Washington and Lee University and the University of Virginia for the law; still practices in Richmond, Va.; is author of *In Ole Virginia, or Marse Chan and Other Stories* (1887); *Two Little Confederates* (1889); *Befo' de War*, dialect poems published with A. C. Gordon (1890); *On Newfound River* (1891); *Elsket and Other Stories* (1891); *Among the Camps* (1891); *The Old South*, essays social and political (1892); *Pastime Stories* (1894); *Red Rock* (1899).

Page, WILLIAM: painter; b. at Albany, N. Y., Jan. 23, 1811. He studied with Herring, the portrait-painter, and with S. F. B. Morse; painted portraits in Albany and New York with eminent success; executed a few compositions, a *Holy Family*, *The Infancy of Henri IV.*, and others; resided in Rome and Florence several years; returned to New York in 1860, and resided there. Page was known as an experimenter in color, and painted many extraordinary pictures to illustrate his ideas—a *Flight into Egypt*, *Moses and Aaron on Horeb*. His *Venus* became famous; it was an attempt to embody what the artist thought the practice of Titian. Page was president of the National Academy, and wrote and lectured on art. He was a man of enthusiastic temperament and daring genius, poetic, and eloquent. D. at Tottenville, N. Y., Oct. 1, 1885.

Pagès: See GARNIER-PAGÈS.

Pag'et, Sir JAMES, F. R. S., LL. D., D. C. L.: surgeon; b. at Yarmouth, England, Jan. 11, 1814; studied in St. Bartholomew's Hospital, London; in 1836 became a member and in 1843 a fellow of the Royal College of Surgeons; became assistant surgeon, surgeon, and consulting surgeon to St. Bartholomew's; sergeant-surgeon to the Queen; surgeon to the Prince of Wales; vice-chancellor of the University of London; was made a baronet in 1871; is president of the Royal College of Surgeons. In his earliest surgical studies he paid great attention to pathology, and through his efforts its importance was recognized throughout English-speaking countries, and for years his *Lectures on Surgical Pathology*, a work that has passed through many editions, has been a text-book in the medical colleges of Great Britain and the U. S. In 1857 he delivered the Croonian lectures, his topic being the cause of the rhythmic motion of the heart. In 1877 he delivered the Hunterian oration. In 1882 he delivered the Bradshawe lectures, on some rare and new diseases. In 1887 he delivered the Morton lecture on cancer.
S. T. ARMSTRONG.

Paget, VIOLET: author; b. in England, 1857. She has resided for many years in Italy, and under the pseudonym of *Vernon Lee* has published many brilliant and suggestive studies of art, literature, and general æstheties. Among her books are *Studies of the Eighteenth Century in Italy* (1880); *Belcaro* (1882); *Ottilie* (1883); *Euphorion* (1884); *Miss Brown* (1884); *Baldwin* (1886); and *Juvenilia* (1887).

Pago'da [from Portug. *pagoda*, from Pers. (and Hind.) *but-kadah*; *but*, idol + *kadah*, house; cf. Chinese *peh-kuh-t'a*, pagoda, liter., white bone tower]: a name applied to a great variety of tower-like, many-storied buildings in the East Indies, China, Japan, etc., used originally to contain relics and other objects of veneration or worship.

Pago Pago: See the Appendix.

Pahlavī, pe-le-vee', or **Pehlevī**: the mediæval Persian of Sassanian times (A. D. 226–651); in a broader sense, Persian from the period of the Achæmenidæ to the rise of the modern language after the Mohammedan conquest. By its etymology the term *Pahlavī* means Parthian (Old. Pers. Inscr. *Parthava*, whence *Pahlav* and *Pahlavī*, relating to the Parthians). In mediæval Oriental literature the appellation *Pahlavī*, owing to the greatness of the Parthian sway, is sometimes extended to denote anything ancient Persian. The restricted usage, however, limiting the application of the name to the language and writings of the Sassanian Zoroastrians down to the ninth century is the more correct, and is in modern times the general one.

1. *Pahlavī Language.*—The Pahlavī is preserved in the form of inscriptions and in an extensive written literature. The language, though it is Persian, presents a strange non-Iranian appearance; there is a curious admixture of Semitic (Aramaic) words and Iranian elements. The fundamental words, those of commonest usage, are Semitic, and Semitic words also stand beside Iranian equivalents; but they are often treated in a way that is quite un-Semitic, or, again, they assume an Iranian look by receiving Iranian endings. This Semitic preponderance, however, is superficial rather than real. Pahlavī, when written, is indeed largely Semitic, but when read it becomes Iranian. We have the authority of Ammianus Marcellinus (xix., 2, 11), and more explicitly of the Arab writer, Ibn Moḳaffa', for the fact that, although Semitic words were written, the Persians in reading Pahlavī regularly substituted Iranian equivalents for Semitic vocables, and the speech when sounded became all Iranian. For example, in Pahlavī *bisrā* (Aramaic), meat, was written, but *gōšt* (Persian) was pronounced; again, *laḥmā*, bread, may have been written, but *nān* (Persian) was read; although the Semitic *malkān malkā* was inscribed on the monuments, the Persians called their "king of kings" *shāhān shāh* in true Iranian style. The phenomenon is thus to be explained: The Persians of Parthian times adopted a Semitic alphabet, but, beside using its characters for writing their own words, they went a step further and adopted for convenience a certain number of written Semitic words to stand for their Iranian equivalents, which were regularly read as if Iranian—much as on a small scale in English the Latin *i. e.*, *e. g.*, *viz.*, *&*, *etc.*, £ (*libra*) are read by us as "that is," "for example," "namely," "and," "and so forth," "pound," being foreign to the eye when written, but becoming native to the ear when read. In Pahlavī there were some 400 of these Semitic logograms, beside about 100 obsolete forms of actual old Iranian words for which the ordinary current Persian words were substituted in reading. This disguised and obsolete element in Pahlavī is known as the *Hūzvārish* portion of the language. In strict reality, therefore, the *Hūzvārish*, or *Uzvārish* (misreading for *Aūzvārishn*), is a form of writing rather than a form of speech. Etymologically the term *Aūzvārishn* has been explained by Haug and West as "antiquity, decrepitude," or perhaps "obsolete," although Darmesteter suggests the explanation "perversion, alteration, disguise," as applicable to the peculiarity of writing.

It often happens that the disguised Pahlavī is transliterated into Avestan or Modern Persian characters, and the Semitic element is eliminated by substitution and ambiguity

disappears; such a text is called Pāzand (Avesta *paitizaiñti*), re-explanation, a term which is applied also to the purely original part of the Pahlavī texts themselves which do not require transposing. This designation was also originally applied to the "re-explanation" of the Pahlavī version of the Avesta, which itself was an explanation, interpretation, or commentary. (See AVESTA.) The appellation *Parsī* is also sometimes given to this transcribed Pāzand.

The two forms above mentioned in which the Pahlavī language is preserved are (1) inscriptions and coins, (2) manuscripts. The earliest rock-inscription, belonging to the first Sassanian monarch, Artakhshīr Pāpakān (A. D. 226–240), is a trilingual record, being engraved in Greek and in the characters of the so-called Chaldæō-Pahlavī and Sassanian Pahlavī. The early inscriptions are of great service in helping toward the solution of the problems which Pahlavī presents—problems arising not so much from the grammatical and syntactical structure of the language as from the defective alphabet and the peculiar manner of writing the speech. The book-Pahlavī alphabet has only fourteen letters to discharge the duty of a complete alphabet; owing to this paucity a single sign has to assume a number of offices; the separate signs, moreover, are further obscured by being combined into ligatures whose elements are exceedingly difficult to decipher. The single symbol  , for example, may denote *s, yī, yad, yag, yaj, dī, dad, dag, daj, gī, gad, gaj, jī, jad, jag, jaj*. The difficulty of determining the precise reading of an obscure group of letters may therefore be imagined, but with regard to the meaning there is generally not a great deal of difficulty; old glossaries, moreover, have been preserved which give useful assistanee on the subject. It may be added that Pahlavī is an analytic language, and its declensional and inflectional system is much reduced, which renders the grammar and the syntax simple.

2. *Pahlavī Literature.*—Omitting the rock-records of Artakhshīr Pāpakān (A. D. 226–240) and his successors above referred to, as well as some early impressions on coins, the extent of Pahlavī literature may be estimated to be about the same as that of the Old Testament. In point of time the literature may be placed between the years A. D. 226 and A. D. 881. Nearly a hundred works have been preserved; these are in part translations of older Avesta texts, or they are works written on religious subjects, though some of them deal with legendary or miscellaneous topics. The principal literary monuments of the language are: (*a*) the Pahlavī version of the Avesta (see AVESTA); (*b*) *Bundahish*, a sort of Iranian Genesis and Revelation; (*c*) *Dīnkarḍ*, on matters of religion; (*d*) *Dāḍīstān-ī Dīnīk*, religious discussions; (*e*) *Maīnōg-ī Khiraḍ*, spirit of wisdom, doctrinal teaching; and (*f*) *Arḍā-ī Vīrāf nāmak*, an Iranian apocalypse; as well as other works chiefly religious in character. The most important of the Pahlavī texts have been translated by West, the most eminent authority on Pahlavī; translations of separate works have also been contributed by other scholars. Pahlavī literature is indispensable for the study of Zoroastrianism, and is important in connection with theological and philosophical studies in general.

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(*b*) *Dictionaries.*—Haug, West, and Hoshangji, *An Old Zand-Pahlavī Pahlavī-Pāzand Glossary* (Bombay, 1867–70); Jamaspji Minocheherji, *Pahlāvi Dictionary* (Bombay and London, 1877–82).

(*c*) *Texts and Translations.*—Spiegel, *Avesta sammt der Huzvāresch-Uebersetzung* (Leipzig, 1851–58); Geiger, *Die Pehlevi version des Ersten Capitel des Vandīdād* (Erlangen, 1877); Westergaard, *Bundehesh textus* (1851); Justi, *Der Bundehesh* (Leipzig, 1868); West, *Mainyo-i Khard* (Stuttgart and London, 1871); Andreas, *Mainyō-i-Khard text* (Kiel, 1882); Fr. Müller, *Beiträge zur Erklärung des Mīnōīg Chrat* (*Sitzber. Wien. Ak.*, 1892); Haug, West, and Hoshangji, *Ardā Vīrāf, with Glossary* (Bombay and London, 1872–74); Barthélemy, *Ardā Virāf traduit* (Paris, 1887). Horn and Steindorff, *Sassanidische Siegelsteine* (Berlin, 1891); Peshotan Behramjee Sanjana, *The Dinkart*, text and translation (Bombay, from 1874): West, *Pahlavi Texts Translated* (in *Sacred Books of East*, Oxford, 1880, etc.)

A. V. WILLIAMS JACKSON.

Pah-Ute Indians: See SHOSHONEAN INDIANS.

Pailleron, pāā'ye-rōṅ', ÉDOUARD JULES HENRI: poet and dramatist; b. in Paris, France, Sept. 17, 1834. He began life as a notary's clerk, but in 1860 appeared as an author with a volume of satiric verse, *Les Parasites*, and a one-act comedy, *Le Parasite*. He continued to write successfully for the theater, at first in verse, producing among other pieces *Le Mur mitoyen* (1861); *Le Dernier Quartier* (1863); *Le Monde où l'on s'amuse* (1868); *Les Faux Ménages* (1869); *Hélène* (1872); *L'Âge ingrat* (1879). His greatest success was made by *Le monde où l'on s'ennuie* (1881). He wrote also *Le Narcotique* (1882) and *La Souris* (1887). He was elected to the Academy in 1882. D. in Paris, Apr. 20, 1899.

Pain: a peculiar sensation of discomfort or suffering caused by disturbances of the sensory nerves or nerve-cells, which cause a condition of over-excitement. Any of our sensations may become painful if the stimulus is sufficiently strong and prolonged—thus the skin touched lightly affords normal tactile sensations, but if the pressure is severe the impressions become painful; moderate light does not prove of discomfort to the normal eye, but if intense the pain may be severe. Pain may be caused by mechanical, thermal, chemical, electrical or other means, but it is generally due to injuries and various disorders of nutrition and inflammation. There are many varieties—it may be sharp, shooting and lancinating, as in neuralgias; sharp and intermittent, as in colic; sharp, severe and constant, as in peritonitis; dull and gnawing, as in inflammation of the bowels; dull and sickening, as in certain disorders of the ovaries and testicles; throbbing, as in toothache and suppurations; burning, as in inflammations; pressing, constricting or boring, as in various forms of headaches; dragging, as in womb troubles.

Pain is seldom constant in its degree, being generally subject to intermissions or periodic exacerbations. It also varies greatly in its intensity and quality, depending upon the degree of irritation and the special nerve that is excited. Some nerves are infinitely more sensitive than others, so that the same degree of irritation applied to two different nerves may cause severe pain on the one hand and but an insignificant effect on the other. Pain experienced in different parts may be of the same intensity, yet one is borne much easier than another owing to the difference in its quality. The exquisiteness of the pain when the nerves of the teeth or ear are affected is not equaled by that produced in any other part of the body. Pain is said to be referred by the mind to the particular part of the body which is irritated, but this is not strictly true—thus in case of severe toothache the irritation may be confined to the root of a tooth, yet sensations of pain may be referred to the whole side of the face, indeed even to both sides. Irritation of a sensory nerve at any part gives rise to sensations of pain which are referred to the peripheral distribution of the nerve; thus it is that people who have suffered the loss of arms or legs often experience pain just as though the sensations were actually coming from the parts that have long since been amputated—in such cases the cut ends of the nerves in the stump are excited, and the sensations thus produced are referred by the mind to the parts formerly supplied by their fibers.

It is important to observe that the presence of pain invariably indicates an abnormal condition, and that it is one of the most frequent and potent means of nature to warn us of disordered states. Pain is relieved by various methods, the first and most important being the removal of the cause. The use of the hot-salt bag is often efficient in relieving toothache, pain in the bowels, etc.; cold is similarly but less successfully resorted to. The use of drugs, such as opium, morphine, anæsthetics, narcotics, etc., is dangerous, except in the hands of a physician. E. T. REICHERT.

Pain and Pleasure: certain conditions of consciousness which depend upon physical and mental events. No adequate definitions can be given: pain and pleasure must be *felt*. Yet the physical and mental conditions which give so-called hedonic *tone* to consciousness may be pointed out.

1. *Too much stimulation is a cause of pain.* This is true, in the first place, of high *intensities* in stimulation. The actual experience of such painful intensities in the cases of special sensation leads us to look for it in all forms of sensibility. A blinding light is painful; a loud noise

very close to the ear, rapid friction of the skin, great pressure upon the muscles, etc., all give rise to painful feeling. It is true also that very strong tastes and decided odors are disagreeable or soon become so; but the case of these sensations seems to differ in some respect from that of the senses which report acute pain, properly so called. Sensations of temperature, again, either heat or cold, give us positive pain when the degree of either stimulus is very intense. It is possible that the apparent difference between taste and smell and the other sensations, in this respect, may be due to the fact that in them the end organ seems to have a chemical function, while the other end organs are largely mechanical; but it is enough here to point out the fact that some tastes and odors seem to be always pleasurable, and others always unpleasant. The same cause of pain is also seen when the stimulation is of long *duration*, and when it is widely *extended* on the skin, etc. A number of pin-points drawn over the skin give pain, when one of them would not.

2. *Inflammation* is painful, both when local in the muscles and skin, etc., and also when the nervous system is in a state of high excitability.

3. *Summation of stimuli* as a cause of pain. By summation is meant the adding up of processes on the nervous centers so that a greater result is worked in consciousness. Several electric sparks become painful to the eye by stimulation when one is not.

4. *Appetites or impulses when denied* give rise to pains of want. Such pains are usually periodical, and indicate a lack injurious to the organism.

Besides the above, several more special conditions bring about a painful reaction. Exposure to air is a cause of pain to tissue normally protected by the skin; disuse, or too slight stimulation, occasions pain in the more complex of the special senses, as sight; lack of accommodation of the organ to its stimulus has sometimes disagreeable tone, which is exaggerated when the stimulation is intense. The tone of the organic feelings seems to arise from any obstruction of the organic functions, such as laceration, cramp, repletion, etc. Intermittency of stimulation is also a frequent cause of pain, probably from the failure of the organ to accommodate to the broken stimulus.

Empirical Facts concerning Pain.—There are, in addition, certain facts brought out by physiologists which throw light upon pleasure and pain. First may be mentioned the *intermittence of pain*, the greater or less intensity of painful feelings at successive moments, the stimulus remaining constant. It is plainly seen in electrical stimulation—a clear rhythm, or rise and fall, of the painful tone. A headache usually proceeds by throbs, a toothache by jumps, and a felon on the finger changes its feeling from a dull ache to a paroxysm of overpowering severity. That it is due to nervous causes, and indicates the ebb and flow of central processes, is claimed from such phenomena as intermittent fever; but in some cases it evidently depends upon the rhythm of the vascular system, the distension and reaction of the blood-vessels. Another kind of intermittence is brought about by the coming and going of the *attention*. The effect of the attention in increasing the intensity of affective states is familiar; hence we would expect that the concentration and withdrawal of the attention would have a marked influence upon the rise and fall of pain. Further, we know that the attention, even when concentrated as steadily as possible, is rhythmical. Another fact of painful feeling is what is called its irradiation or *diffusion*. The locality of a painful stimulus is less circumscribed as the stimulation becomes intense. Besides the intensity, or quantity, this feeling becomes massive or spread out. It is probably due to a real spreading of the cause of the painful feeling over a greater area, both on the periphery and in the central seat.

Again, we may note a *delay* in the conscious awareness of pain compared with the appearance of the sensation with which it seems to be connected. Even when the stimulation is a very strong one, the sensation is clear in consciousness before any pain is felt. A blow, for example, is felt as contact or pressure a fraction of a second before we begin to suffer from it; a burn is particularly long in reporting itself as pain. This delay may be measured by comparing the reaction time of a painful stimulus—say the decided prick of a pin—with that of a simple contact sensation at the same point on the skin. It is probably due to the fact that the full force of the pain-stimulus is not reported at once, but that the organ accommodates itself to it by a series of partial transmissions. These transmissions are summated at the center, and the result is a sufficiently intense central stimulus to occasion a painful reaction.

Further, the duration, or *lasting quality*, of a painful state of sensibility is remarkable. Pains do not pass away, as painless sensations do, when the stimulation ceases. The recovery of the organism is very slow. What is called an after-image of some sensations seems here to be more truly an after-*fact*. It is probably due to the fact that the intenser degree of stimulation necessary to pain gives more decided and lasting character to the nervous change it works than feeble stimuli do. This is supported by the observation that pains are more distinctly and easily revivable than other affective experiences. A painful experience seems to hover constantly around us, and thrust its unwelcome presence into our gayest hours. When we remember that a revived image occupies the seat of the original experience, we only have to assume a more lasting effect to have resulted from a painful sensation, to account for its more easy reproduction. Finally, pain lowers the temperature of the painful region.

Analgesia, or insensibility to pain, under conditions usually painful, may be brought about by various agencies. Cold of very great intensity has this effect, pain becoming very acute and then subsiding altogether, as the temperature is lowered. The withdrawal of blood from an organ makes it insensible to pain. Lowered sensitiveness to pain, however, is likely to be preceded by exalted sensitiveness, as in the evident case of cold. Apparent absence of pain is experienced when the intensity of a painful stimulus is suddenly lowered, even though the second intensity would be painful under other circumstances.

Pain as Feeling and as Tone.—The conditions of pain now pointed out are conditions in the operation of the various modes of sensibility, general or special; that is, we have been observing pain as hedonic *tone*. The important question arises: Is pain always thus dependent on a definite form of sensibility, or is it itself, as a form of sensibility, ever found independent of its presence as tone? There are some facts which would indicate that pain has a functional independence, whatever we may say as to its anatomical independence—i. e. whether there are special nerve-fibers which conduct pain, a point on which experimental results are conflicting. For instance, pain may be destroyed without impairing any of the other sensibilities, as in analgesia brought on by chloroform; and in general, under the influence of anæsthetics, pain and memory disappear first and together. On the other hand, other sensations may be destroyed, while the painful quality of their stimuli remains. Thus, under pressure, sensations of touch, temperature, and muscular movement may be destroyed while pain remains. So, also, under loss of blood in a member, sensations of touch disappear before pain, and both before temperature, electric feelings, etc.

Conditions of Pleasure.—It is not so easy to point out the physical conditions of pleasure; but in general we find them opposed to those already indicated as carrying painful tone. 1. *Moderate stimulation is pleasurable.* This is readily seen in the exercise of the special sense functions; the eye is pleased with mild colors, and the ear with pure tones. Gentle touch, quiet muscular reaction, moderate tastes are usually agreeable; and it is true of moderate durations and areas of stimulation, as well as of moderate intensities.

There are striking exceptions, however, to this rule. A great many sensations are always painful; when not giving a painful reaction, the organs involved do not affect consciousness at all. So the organic feelings. Certain tastes and odors, also, are always disagreeable. Further, the condition of neutrality seems very nearly reached in the normal exercise of some of the sense functions, as, for example, sight and hearing.

2. *Pleasure arises from the adjustment of an organ to its stimulus.* Muscular sensations are pleasurable within the range of easy effort. Stimuli of longer duration, which give time for the full adjustment of the organ, pass from the painful to the pleasurable. Feelings for which we are ready by anticipation are enjoyable. Yet this is also subject to the qualification that perfect adjustment seems in many cases (eye and ear) to have no feeling accompaniments whatever, either of pleasure or pain.

3. *Activity is enjoyable.* By this is meant function within the limits set by the two conditions already mentioned. If activity is pleasurable, it is the moderate activity of a well-adjusted organ. Yet there seems to be more massive organic

conditions of activity which are pleasurable, even when such a general function involves some particular pain. The foot-ball player enjoys his sport, even though he is never free from the pain of bruises or scratches. In such cases, the vigor and energy of the larger organs brought into play seem to overpower the protests of the smaller, and silence their complaints. A pain which would make one wretched if suffered in passive silence is forgotten altogether in the pleasure of diligent employment. This larger activity, however, which brings pleasure, must itself conform to the conditions of moderation and adjustment. Moreover, these pleasures of activity, such as pleasures of the chase, of sports, of general vigor, are more positive apparently than any other physical pleasures. The claim already noticed, that in the absence of pain many states are not really pleasurable, but merely neutral as regards tone, does not seem to be well taken in this case. A condition of fresh muscular vigor seems to intrude itself into consciousness of its own force, and we become aware of pleasant occupation with no evident reference to the corresponding state of pain. Indeed, the opposite pleasures which result from a cessation of muscular pain—the so-called pleasures of rest—are something quite distinct from these pleasures of activity. Under this head, also, as including any function, and not simply muscular activity, the pleasures arising from the gratification of the organic appetites and instincts appear to fall. They are functions of periodical exercise, and their normal working involves periodical stimulation. They seem to involve pleasure over and above the prompting of painful appetite, though this again is in dispute. Yet it could hardly be said that all the pleasures of the table are due to the cessation of the pangs of hunger.

Relativity of Pleasure and Pain.—The fact referred to above, that many physical pleasures are only relief from preceding states of pain, finds place with other similar phenomena, under the law of relativity. First, we may say that the existence of either state may under certain circumstances arise from the cessation of the other. Cases of seeming pleasure, which is explained as absence of pain, have already been mentioned. Similarly, the cessation of an active pleasure may give us temporary pain and be the only cause of it. An element of higher emotion, however, generally enters in this case. Again, the intensity of pain or pleasure depends largely upon its contrast with a preceding state. After an unusual trip to the country, the painful toil of city life is all the harder to bear; so, after feasting the eyes upon a dish of luscious fruit, the beggar's plate of herbs is all the more unpalatable. So, also, the associations involved often convert pleasure into pain, and the contrary. A little clever deceit will make us enjoy a dish which before we found unpleasant.

Resulting Conception of Bodily Pleasure and Pain.—From the foregoing brief description of the conditions under which sensuous tone arises, we may put all such feelings under two larger physical categories. A careful examination of these conditions will show that all pleasures and pains involve either a state of change in the organic tissue, in the way of *integration* or *disintegration*, or a change in the relation of the organism to its environment, in the way of *adjustment* or *misadjustment*. These two aspects of the case may be considered separately. This brings us to the conclusion, when we reflect upon organic development, that in the life-process we have the *raison d'être* of pleasure and pain; but by life-process we must be careful to include life-development as well as simple life. The simple present life of an organism as constant function is more than covered by the facts as we have observed them; pleasure and pain have a prospective future reference as well—reference to a fuller development and potential growth. Accordingly, bodily pleasure may be defined as *the conscious effect of that which makes for the continuance of the bodily life or its advancement*; and pain, the *conscious effect of that which makes for the decline of the bodily life or its limitation.*

Intellectual Pleasures and Pains.—The further question concerning the higher pleasures of our ideal life of thought and emotion is equally important. Certain conditions of this higher tone may be mentioned also.

1. *Some degree of ideal change.* As physical pain arises from physical function, so higher pain comes with apperception considered as mental function; and in general, the degree of function, measured in terms of the emotional excitement to which it gives rise, indicates also the degree of pleasure or pain. Ideal change, the rearrangement of elements in the apperceptive content of consciousness, is accordingly the general condition of particular ideal tone. We may, accordingly, at once make use of the conception of bodily tone already arrived at, substituting for the physical the apperceptive function, and for the adjustment of end organs that of attention; and expect to find an adequate conception of ideal pleasure and pain. Accordingly, we reach a second condition.

2. *The degree, duration, and relative adjustment of attention*: determining ideal tone as pleasure or as pain. Excessive concentration of the attention is painful; yet the pain is directly merged in the pain involved in the adjustment of the bodily organ. Prolonged attention becomes painful by the law of fatigue. On the other hand, moderate concentration and duration of attention are pleasurable. The conditions which involve distraction, or drawing apart, or doing violence to the attention, are painful; those giving feelings of ease, flow, variety, measured concentration, etc., are pleasurable. It is probable that the most pleasurable adjustment is that of finest and most exact discrimination. Ward formulates this and the preceding condition as follows: there is pleasure "in proportion as the maximum of attention is effectively exercised."

The determinations already reached have evident application to those states of feeling which arise around acts of the attention regardless of the nature of the object to which the attention is directed. There are other emotional states, however, which are pronounced in their contribution to the tone of consciousness. The great expressive emotions (fear, love, anger), the sympathetic, the ethical, and æsthetic are all at times controlling agents of pleasure or pain. The question at once arises: Is it possible to bring them under the formulas already enunciated? This question awaits an answer from the consideration of the genetic conditions under which objects come to be pleasure or pain giving.

1. *Objects of perception and memory excite pleasure or pain only as they have or have had some relation to our physical well or ill being.* PERCEPTION (*q. v.*) is a summing up of sensations in the form of synthesis. Now an object perceived gives us certain sensations only; but it suggests others which belong to the synthesis, and we are thus able to anticipate them. The sight of falling rain prophesies to me the unpleasantness of being wet; the sight of a lion, the pain of being eaten. The tone of perception, therefore, as far as it refers to the object, is intrinsically the prophecy of the tone of the sensations it includes and suggests. To illustrate: A child first sees a fire (yellow light sensation), grasps it (touch sensation), feels pain (sensuous tone, due to damage to the life-process). Again he sees the fire (perception, carrying in it touch and pain memories) and has fear, which is of painful tone. The point advanced is that this latter tone, of fear, also has reference to the life-process. It is nature's way of utilizing simpler pain experiences, just as perception is her way of utilizing sensational experiences. This covers the whole field of emotions which accompany reproduction—memory, passive imagination, illusions, etc. The emotions which such representations excite have qualitative coloring (expectations, dread, etc.), but their tone is again due, as the tone of perception is, to the anticipation of advantage or damage from the pictured object.

2. *The tone of the emotions which accompany conception and thought has reference both* (1) *to physical and* (2) *to intellectual well or ill being.* The reference of conception and thought to physical pleasure and pain is clear in some cases. My conception of the work of dentists, for example, has a painful tone which is as clearly a warning of physical damage as the perception of my particular dentist is. So, also, the science of dentistry, the logical framework of the art, considered merely as a branch of instruction, can not be rid of its physical suggestiveness. The medical student grows faint when he hears his first lecture on blood-letting. Consequently, a positive part of the tone of higher æsthetic, ethical, and logical emotion illustrates the law of physical well-being. In the case of æsthetic emotion, the element contributed by association is largely of this sensational character. Apart from the beauty of the purely sensuous in music, its associations are largely sensuous. A face often becomes handsome from association at the table, the theater, on the promenade, and the pleasure we take in it is a reverberation of these associated pleasures of sense.

We may ask: Does this reference to physical well-being exhaust the range of ideal pleasure and pain? Further consideration convinces us that it does not. There are emotions whose tone seems to violate the law of physical well-being. We would expect, indeed, if consciousness is a synthetic

thing, and if its synthesis becomes explicit in what we call apperception or thought, that such a new thing in nature would have its own principle of development; and we would expect, further, that its development would be a matter of conscious adaptation to its conditions of thinking and willing. The most natural view of ideal pleasure and pain therefore is to consider it an index of healthy or unhealthy *mental* function. As physical pleasures, at first ministering blindly to the welfare of the organism, grow to attach to objects in relation to the organism, so ideal pleasures, while attaching still to attention as a function, yet come to attach to its objects as well. On this view, the tone of many emotions reflects the state of the mental functions primarily. This view is supported by abundant evidence. The pleasures of intellectual pursuit lead their devotees to neglect the body and even to continue this course in the face of acute physical pain. Æsthetic delight is so independent of selfish motives that admiration is often called out by what is destructive and terrifying. Ethical emotion, with the happiness it always brings, may triumph over physical impulse, when they come into conflict. Consequently, we may hold that there is an element of hedonic coloring arising with the changes which occur in the content of consciousness; and we are led to define intellectual pleasure as the conscious effect of that which makes for the continuance of the apperceptive life or its advancement; and pain, the conscious effect of that which makes for the decline of the apperceptive life or its limitation. Summing up all that has been said of pleasure and pain, both bodily and ideal, we may conclude that *pleasure and pain are the affective coloring, respectively, which consciousness takes on in conditions of present or prospective well or ill being.*

Complexity of Hedonic States.—It is now clear that the hedonic coloring of consciousness, at any time, is not a simple thing. Pleasure or pain is reported from the body and from the mind, from many organs of the body at once, and from many mental factors at once. Hope and fear may be struggling within, the will may be painfully paralyzed, attention distracted, and with it all a beating sun may annoy, an aching tooth distress, and all go to make up a complex condition of tone. So mental and physical conditions may combine to produce pleasure; and all possible combinations may, and do, arise in kaleidoscopic order. The elements, however, of this complex effect may be generally distinguished in consciousness. They do not coalesce except in their general tendency to produce emotional excitement, which has its own tone. If the two hands be held under two streams of water, very hot and pleasantly cool, respectively, the two hedonic effects may be clearly distinguished from each other. So the pain of suspense arises from the excitement of alternating hope and dread, and persists apart from the pleasure and pain of those emotions themselves as they struggle in consciousness.

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J. Mark Baldwin.

Paine, Elijah: legal writer: b. at Williamstown, Vt., Apr. 10, 1796; a son of Judge Elijah Paine; graduated at Harvard in 1814; studied law at Litchfield, Conn.; assisted in preparing Wheaton's *Reports*; was a judge of the New York superior court 1850–53; author of *Paine's Reports* (U. S. circuit court, second circuit, 1810–40: 1st vol. pub. 1827, 2d vol. 1856), and a joint author of Paine and Duer's *Practice in Civil Actions and Proceedings in the State of New York* (2 vols., 1830). D. in New York, Oct. 6, 1853.

Paine, John Knowles: composer and professor of music; b. at Portland, Me., Jan. 9, 1839; after studying at home and acquiring considerable skill as an organist, in 1858 he went to Berlin for three years, studying under Haupt, Wieprecht, and Teschner. In 1861 he returned home and gave a number of concerts. In 1862 he was appointed instructor of music in Harvard College, and in 1876 made full professor. His compositions are numerous and important. They include a grand mass in D, an oratorio, *St. Peter*; *The Song of Promise*, a cantata for the Cincinnati festival; *Œdipus Tyrannus*, for male voices, for the Harvard students' performance of the play; *Centennial Hymn*, words by Whittier (1876); *Columbian March and Chorus*, for the opening of the Chicago World's Fair Exhibition, Oct. 21, 1892; several cantatas, three symphonies, symphonic poems, and other orchestral pieces, songs, motets, piano solos, chamber music, and others. D. E. Hervey.

Paine, Martyn, M. D., LL. D.: physician; son of Judge Elijah Paine (1757–1842); b. at Williamstown, Vt., July 8, 1794; graduated at Harvard in 1813; studied medicine under Dr. John Warren, of Boston, Mass., and took his medical degree there 1816; practiced his profession at Montreal 1816–22; removed to New York city, where he became one of the leaders of the medical profession; was one of the founders of the University Medical College 1841, in which he subsequently held important professorships. Author of *The Cholera Asphyxia of New York* (1832); *Medical and Physiological Commentaries* (3 vols., 1840–44); treatises on *Materia Medica* (1842, 1848); a very valuable standard treatise on the *Institutes of Medicine* (1847); *The Soul and Instinct* (1849), and other works. D. in New York, Nov. 10, 1877.

Paine, Robert, D. D.: bishop; b. in Person co., N. C., Nov. 12, 1799; while in childhood removed to Tennessee; in 1818 joined the Tennessee conference of the M. E. Church, and did pastoral work till 1830; became president of La Grange College, Alabama, till 1846, when he became bishop; was a member of every general conference from 1824 to 1846; chairman of the committee of nine which reported the plan of separation on the basis of which the M. E. Church was divided; was a prominent member of the Louisville convention in 1845. He had great pulpit ability and great executive ability. His *Life and Times of Bishop McKendree* (2 vols., 1859) is highly esteemed. D. at Aberdeen, Miss., Oct. 20, 1882. Revised by A. Osborn.

Paine, Robert Treat: jurist; b. in Boston, Mass., Mar. 11, 1731; graduated at Harvard College 1749; studied theology and acted as chaplain in the Northern army; subsequently studied law and was admitted to the bar 1759, settling at Taunton; in 1770 was prosecuting officer (in the attorney-general's absence) of Preston and his men for the massacre at Boston; elected to the Legislature 1773; delegate to Continental Congress 1774–78, meanwhile filling various important positions in Massachusetts; was one of the signers of the Declaration of Independence, attorney-general of Massachusetts 1780–90, and judge of the Supreme Court of Massachusetts 1790–1804. With others he founded the American Academy of Massachusetts (1780). D. May 11, 1814.

Paine, Robert Treat: See the Appendix.

Paine, Thomas: radical and deistical writer; b. at Thetford, England, Jan. 29, 1737; son of a Quaker stay-maker; received an indifferent education at the Thetford grammar school, but acquired a considerable range of knowledge by private study while working at his trade as a stay-maker at London, Dover, and Sandwich; served a short time on board a privateer 1756; married in 1759 the daughter of an exciseman, but was left a widower the next year; obtained a post in the revenue service 1762, was discharged for irregular conduct 1765, but restored the next year; had to wait for a vacancy and meanwhile taught school and preached; was exciseman at Lewes 1768; married the daughter of a deceased tobacconist there 1771, whose business he continued; cultivated literature; acquired so clear and forcible a style as to be chosen by the excisemen as their representative in advocating their interests, in which capacity he published a pamphlet, *The Case of the Officers of the Excise* (1772), which probably led to his introduction to Dr. Franklin, and to his dismissal from the service a second time on a trumped-up charge 1774; separated from his wife the same year for an unknown cause. Influenced by the advice of Franklin, he proceeded to America; arrived at Philadelphia Nov., 1774; obtained immediate employment as editor of the *Pennsylvania Magazine*; published in Bradford's *Pennsylvania Journal* in Mar., 1775, an article entitled *African Slavery in America*, which probably hastened the formation of the first American anti-slavery society (Apr. 14, 1775); published, Jan. 10, 1776, his celebrated and widely circulated pamphlet *Common Sense* (120,000 copies were sold in the first three months), which struck the keynote of the situation by advocating independence and a republican government; published in the *Pennsylvania Journal* of Dec. 19, 1776, the first number of *The Crisis*, which appeared at irregular intervals all during the war, and had great influence in maintaining the spirit of the army and the people; was chosen in 1777 secretary to the committee of foreign affairs, from which

post he was dismissed and censured by Congress in 1779 for revealing diplomatic secrets in a controversy with Silas Deane; was soon afterward elected clerk to the General Assembly of Pennsylvania; rendered good service in 1780 in promoting a subscription for relieving the distress of the army; received that year a degree from the University of Pennsylvania; went to France with Col. Laurens, whom he aided in negotiating a loan 1781; received from Congress a grant of $3,000 (1785), from the State of New York an estate at New Rochelle, and from Pennsylvania £500 as rewards for his services; went again to France 1787; set up the following year at Rotherham, Yorkshire, the model of the iron bridge which he had invented some years previously; published in London in 1791–92, in reply to Burke, his *Rights of Man*, a vindication of the French Revolution, which gave him immense popularity in France and led to a bestowal of citizenship and his election to the French National Convention as deputy for Calais 1792; took his seat in that body; usually acted with the Girondists; heroically opposed the execution of the king, advocating his banishment to America; was imprisoned by the faction of Robespierre in the Luxembourg, from Dec. 28, 1793, to Nov. 4, 1794. Immediately prior to his arrest he wrote part of his *Age of Reason*, and during his imprisonment finished it and published it after his release (1795); narrowly escaped the guillotine; again took his seat in the Convention; resided nearly two years in the family of James Monroe, then minister to France; wrote several political letters and pamphlets of minor importance; returned to the U. S. in 1802, making the voyage in a U. S. sloop of war; was cordially received at Washington, Philadelphia, and New York, and by Jefferson at Monticello, but insulted by the Federalists at Trenton and elsewhere; and deprecated by the religious public on account of his deism, he passed his closing years in comparative obscurity at New York and on his estate at New Rochelle. D. at New York, June 8, 1809. He was buried on his estate at New Rochelle, where a monument was erected by his admirers in 1839, though his remains were carried to England in 1819 by William Cobbett. Biographies of Paine have been written by Chalmers, Cobbett, Cheatham, Rickman, Sherwin, and G. Vale, but these are all of little value, and are superseded by that by Moncure D. Conway (2 vols., New York, 1892), who has also brought out the only complete and authoritative edition of his writings (4 vols., New York, 1894–95). Revised by S. M. Jackson.

Paine, William H.: civil engineer; b. in Chester, N. H., May 17, 1828; was engaged in surveying in the western part of the U. S. until 1861, when he entered the Fourth Wisconsin Regiment and served through the civil war with distinction, being appointed captain of engineers. He was connected with the Brooklyn suspension bridge as engineer in charge, and as consulting engineer from its inauguration until 1889. Later he was engaged in construction of cable-railways. D. Dec. 31, 1890.

Painesville: village; capital of Lake co., O. (for location, see map of Ohio, ref. 1–I); on the Grand river, and the Lake Shore and Mich. S., the N. Y., Chi. and St. L., and the Pitts. and West. railways; 3 miles S. of Lake Erie, 29 miles E. N. E. of Cleveland. It is in an agricultural and fruit-growing region, and contains several foundries and machine-shops, flour-mill, tanneries, factories, Lake Erie Female Seminary (non-sectarian, chartered in 1856), 2 libraries, a national bank with capital of $200,000, and 2 daily and 3 weekly newspapers. Pop. (1890) 4,755; (1900) 5,024.

Paint [from Fr. *peint*, deriv. of *peindre* < Lat. *pin'gere*, decorate, paint]: a name which is generally limited to mixtures of insoluble colors or pigments with certain materials which prepare them for application to surfaces of wood, iron, stone, plaster, canvas, etc., by the aid of a brush. When the colors are soluble the preparation is more properly a stain or a dye. Paints are used not only for purposes of decoration, but to protect surfaces from moisture and decay, which they accomplish by closing the pores and excluding the agents of destruction. All paints consist essentially of two parts: (1) the pigment; (2) the vehicle. *The pigments* are very varied in character; the whites are generally white lead, more or less adulterated with barytes, oxide of zinc, prepared chalk, etc.; the yellows are ochers, chromate of lead, etc.; the reds are red oxide of lead, ochers, oxides of iron, red oxide of copper, vermilion, dichromate of lead, carmine, carmine, madder, and other lakes, etc.; the blues are Prussian blue, ultramarine, smalt, Thénard's blue, verditer, etc.; the greens are verdigris, Paris green, verditer, borate of copper, chromate of copper, oxide of chromium, cobalt green, and green lakes, the most common being, however, a mixture of chrome yellow and Prussian blue; the browns are umber, bole, terra di Sienna, bistre, sepia, etc.; the blacks are lampblack, bone-black, anthracite, graphite, etc. (See Lakes.) *The vehicles* determine the character of the paint: we have oil-paints and water-colors.

Oil-paints.—The most common vehicle is linseed oil, which is especially valuable on account of the property it possesses of oxidizing to a resinous body, which holds the paint in a firm water-proof varnish. By boiling this oil with litharge and sulphate of zinc it acquires the property of drying very rapidly, though the color is darkened by the operation. For some purposes other oils, as nut and poppy oils, are substituted for linseed oil; the latter, being colorless, is preferred for very delicate colors, but it dries very slowly. In the preparation of oil-paints the pigment is mixed with a small quantity of raw linseed oil and ground in a mill to make the mixture homogeneous. This is put up in convenient packages for the painter, who mixes it for use with a further quantity of raw and boiled linseed oil, and colors it to any desired shade with colored pigments, which are also furnished ground in oil. As pigment and oil alone would be too thick, a third class of agents is employed in preparing paints, the *thinners*. These are either spirits (oil) of turpentine or benzine—both of which mix freely with the oil-paint and thin it to any desired degree. As it is desirable that the paint, after it has been applied to a surface, should dry speedily before it is contaminated by dust or rubbed off by accident, it is necessary to do something more than boil the linseed oil; a fourth class of substances is used, the *driers* or *siccatives*. Driers are sugar (acetate) of lead, sulphate of zinc, verdigris, binoxide of manganese, red lead, japanner's gold size, etc. By far the most powerful siccative is the borate of manganese, one one-thousandth being sufficient to hasten greatly the drying of linseed oil. This agent is supplied to the painter ground in oil in a convenient form for mixing with the paint. It is always necessary to mix the above-mentioned materials, pigment, oil, thinner, and drier, just before the paint is to be used, as, if the mixture is allowed to stand for any length of time, the pigment settles to the bottom, the thinner evaporates, and the oil absorbs oxygen, becomes thick and ropy, and a hard skin forms over it, which can not be dissolved again. To meet this difficulty a new system of mixing paint has been introduced, by which paints of any color can be made and mixed on a large scale at the factory, and put up in convenient packages which are always ready for use. Any portion which may be left over after painting any work can be returned to the package for future use. The principle involved in the preparation of these ready-mixed paints is the formation of an emulsion which holds the pigment in suspension and prevents its settling.

Water-colors.—For many purposes paints are prepared with the aid of water as a vehicle, glue or gum being added to make the pigments adhere after the evaporation of the water. Such paints can only be used for interior work, walls, and ceilings, for coloring pictures, maps, etc. They must be mixed as they are used, as a solution of glue or gum would mould or putrefy and dry up if kept for any time. The most common paint of this kind is called "kalsomine," and is a mixture of prepared chalk with a solution of glue, to which ultramarine is added to neutralize a faint yellow tint for white, and ochers, etc., for other colors. The solid cakes of water-color are made by mixing the pigments with gum and water to a thick paste, pressing in moulds, and drying in warm air. By rubbing them in water or applying a wet brush to them the color is liquefied for use. Silicate of sodium, soluble glass, has been suggested as a vehicle for pigments, and as specially adapted for application to walls and ceilings, as it produces a very hard and durable surface. Sometimes the silicate of sodium paint is applied to the ceiling, and a thin solution of the clear silicate is afterward sprayed over the entire surface. Naphthas and tars, both coal and wood, are used as vehicles for cheap paints or for paints for special purposes, as for protecting iron, ships' bottoms, etc. Poisonous pigments are also used to prevent the adhesion of barnacles and other marine animals and seaweeds to ships' bottoms, specially copper compounds, the red oxide, etc. Artists' colors are composed of very carefully prepared pigments ground in a small quantity of very fine oil, and put up in metallic tubes.

Luminous paint is made by mixing with the ordinary articles some phosphorescent powder which emits light in

the dark. Powders useful for this purpose are (1) *Canton's phosphorus*, made by calcining a mixture of oyster-shells and sulphur; (2) *Osann's phosphorus*, made by calcining oyster-shells and sulphide of antimony. The subject of phosphorescent powders is fully discussed in Gmelin's *Handbook of Chemistry* (vol. i., p. 193). C. F. CHANDLER.

Painter's Cream: a mixture of mastic, lead acetate, nut oil, and water, applied by artists to unfinished oil-paintings to prevent drying during the interruptions of the work. It is applied with a brush and washed off with water.

Painting: the laying of paint upon a surface; especially of paint in the strict sense—i. e. insoluble color mixed with some liquid or semi-liquid medium. It follows from this that painting is generally considered to be covering with thick and opaque pigment, and that the putting on of thin and nearly liquid color is called *staining*, because it is assumed to soak into the surface, or simply *coloring*. *A painting* means generally a work of fine art in color, and a painted work in light and shade only is spoken of as a "painting in monochrome," or as an "oil monochrome," or the like. PASTEL (*q. v.*) is included in the general art of painting, but a single work is called simply *a pastel* rather than a painting in pastel. For painting as a trade and as a preservative of wood, iron, etc., see PAINT; for decorative painting and the painting of ancient sculpture and architecture, see POLYCHROMY.

The fine art of painting includes DRAWING (*q. v.*). Painter artists must necessarily draw a great deal, both in the production of paintings and in study, and most of them draw in many different ways, some of their drawing passing imperceptibly into painting, or forming an inseparable part of it. FRESCO (*q. v.*) is painting done on damp plaster, the colors being mixed with powdered lime and water. In this case the drawing has been done previously upon sheets of paper, the figures, etc., being of the full size of the intended painting and somewhat elaborately finished, and then transferred to the plaster, as explained under FRESCO. Painting on plaster or stucco which has grown hard is unlike fresco in this, that the artist can draw directly on the plaster, as with charcoal or black chalk. The plaster is usually sprinkled with water, that the color may not dry too rapidly; then the color is applied either as ENCAUSTIC PAINTING (*q. v.*) or distemper or tempera, which is merely painting with colors mixed with some glutinous and adhesive matter, such as white and yolk of egg, i. e. together, yolk of egg alone, either of these with vinegar or some liquid glue. Distemper colors are diluted with water, however, and the modern *calcimine* or *kalsomine* process (see PAINT) is only a variety of this. Ancient paintings on walls, from the time of the early Egyptian tombs to the sixteenth century, were generally upon plaster or stucco of some kind, and these paintings, when not done in fresco, are generally found protected by some varnish or glaze which enters more or less into the substance of the work. It is therefore very difficult to ascertain just how ancient paintings were executed, and great differences of opinion exist as to this. During the later Middle Ages and the early Renaissance movable pictures were painted on wood, generally in *distemper*. Frequently the frame was an elaborate semi-architectural composition of gilded wood, and this and the *panel* upon which the picture was painted were made together as one piece of joiner's work. Altar-pieces and the like were often made up of many separate paintings united by a common system of frames of rich design.

Oil-painting came into use in the fifteenth century. Its power of giving depth of color and richness of effect quickly made it popular. It was not much used, however, upon plaster surfaces. Perhaps this was because oil-painting on plaster grows dark very rapidly, or perhaps it was because plaster is not nearly so agreeable a surface to work on as the prepared canvas. At all events the greater part of the large-scale painting of European peoples has been done in oil-painting upon *canvas*, and less commonly upon *panel* or specially prepared millboard, since its general adoption about 1520. Even the largest pictures of the Venetian school, such as the *Paradise* and the *Crucifixion* by Tintoretto, the *Presentation of the Virgin* by Titian, and the *Supper at Emmaus* and *Christ in the House of Simon* by Paul Veronese, are painted on canvas. Modern decorative painters too, in large paintings intended expressly for special walls which it is desired to adorn permanently, have used canvas, as in the great works of Puvis de Chavannes in the Panthéon in Paris. Indeed, most modern attempts to paint on plaster in fresco or other recently invented processes, such as *water-glass* and *spirit-fresco*, have failed to give the good results expected, and artists have generally returned to oil-painting on canvas. This canvas may be glued fast to the wall or may be stretched on wooden frames with an air-space behind it.

The *fine art of painting* is the most elaborate and complex of all the arts that appeal to the eye. It is therefore the most difficult to understand and appreciate. At the same time, as painting much more than sculpture deals with scenes, incidents, historical events, the illustration of poems and fiction, landscape, and the representation of common objects of all sorts, so it is painting that persons not specially instructed in art are the most apt to care for. The result is that there is no fine art in which the aim of the artist in producing and the feeling of the public in admiring are so widely separated. It is very often true that the painter was hardly conscious as he worked on his picture of that which most of the admirers in the exhibition most admire and enjoy. In a picture of military subject, for instance, the incident, as of rescuing a banner, fighting for a field-piece, or the like, is what attracts most persons, and it is looked at and judged by the greater number of visitors to the gallery somewhat as a dramatic performance is judged, or the poetical narrative of an event. The painter may indeed have taken some care to arrange his figures so as to tell the story intelligibly, or even to tell it with vigor and spirit; but this will not have been his greatest care. His interest is not in the incident, but in the harmony of colors, in the light and shade, in the general composition of graceful lines and of harmonious masses. In other words, to the painter the parallelogram within his frame is a surface which he has filled with a beautiful design, while to most of the spectators it is a piece of story-telling. Painter and spectator find, indeed, one seeming point of agreement, namely, in the truth to nature of the artist's work. But this is rather seeming than real, for the truth to nature which the artist cares about is really inappreciable to most of his public. The painter has at some time noted the beauty of sunlight on certain textures and certain colors, and thinks he has there the possibility of a new artistic effect. This, when he tries to put it into his military picture, will be unsuspected by nine-tenths of those who look at the picture, though it may be the most important part of it to its author. The truth to nature which he thinks his picture contains, and of which he is proud, is generally of this sort, and it is not even suspected by the majority of the spectators. This has always been the case. The comments by ancient writers upon the pictures of their times show an interest in the incidents related and the personages portrayed, and express admiration for supposed skill in copying nature, but no appreciation of any more artistic aim in the artist. Those pictures have perished, but the sculptures of antiquity remain to show us by a sure analogy that the artists 400 years B. C. worked in as purely artistical a way as those of 1500 or of 1890 A. D. That is to say, they cared for nature chiefly because of its suggestions to them as artists; and they cared for incident, for tradition, for the great Tale of Troy or that of the Seven against Thebes, for the Niobe tragedy or the fight with the Centaurs, chiefly as affording scope and room for their own artistic conceptions. It has been thought surprising that the great painters of the Italian Renaissance and the sixteenth century were as ready to paint Madonnas as Venuses and Venuses as Madonnas. The reason for this is merely that Venus and the Madonna alike were to the painter types of feminine grace, and figures upon which he could use his skill as draughtsman and as colorist. To a painter the great thing must always be to paint; to paint as well as possible and to produce as beautiful pictures as possible; little does he care in comparison for the story which he is ordered to tell, or the conventional type which he is bade reproduce. And it is not until the student of pictures seizes this truth and begins to approach good pictures somewhat in the spirit in which they have been conceived and carried out, that much enjoyment from the study of painting is possible. This is true of the other branches of fine art. It is true indeed of the finer handicrafts that a technical and esoteric standard of excellence exists for the workman, almost unsuspected by the spectator. It is especially true of artistic painting because, as has been said above, this is the most elaborate and complex of the fine arts. One can more easily seize the sculptor's secret, or some part of it, than the manifold thing, made up of reminiscences and dreams, of light and dark, of color intermingled with light and dark and putting

on their semblance, of pure form expressible only by means of light and dark and hardly expressible at the same time with color, and of expression of face and gesture and the individuality of persons. Landscape thought is in some ways more unseizable even than figure-painting; probably no such thing as adequate written criticism on landscape-painting exists or can exist; but the student who tries to find in the picture what the painter tried to put there may have an immense delight in tracing it, and may go far toward getting a full share of the artist's delight in his work. Thus it often appears in a landscape-painting that the expression of important natural truth is mingled with artistic merit so as to be indistinguishable from it. The rocky frame of a hill is traceable under its clothing of forest or of heather and bog; this has been seen and felt by the artist, perhaps half unconsciously, and it reappears in his picture.

The painting of antiquity which is known to us is almost wholly decorative. The important works of the celebrated Greek painters have perished, and no certain idea of them can be formed. It can not be too much insisted on that the statements concerning them which we have in the works of ancient writers are of no critical value whatever. The wall decorations of Pompeii and of a few newly discovered ancient houses in Rome help us only to form an idea of the classical style of composition. Painting in the time of the decline of the Roman empire and of the Byzantine empire is chiefly known to us in ILLUMINATED MANUSCRIPTS (*q. v.*). In the Middle Ages painting on walls of churches, etc., was mainly decorative in character. In the fifteenth century in Italy there was a great increase in the power of execution among a small body of painters in Siena, Florence, and other towns; the names most important to us are those of Duccio di Buoninsegna (about 1260–1330) and Guido of Siena, his contemporary Cimabue (1240–1302), and Giotto (1266–1336). Of these, Giotto is the one who came the nearest to the skill and facility of later times, and who established many of the types of legend and of the Bible story as told in painting. His most powerful and original follower was Andrea di Cione, called Orcagna, whose important work is of the middle of the fourteenth century. Florence at that time came to possess the most important school of painting. Of the Florentines, Masaccio (1402–28) seems to have made the most surprising advance in naturalistic power, both in drawing and in conception and composition; but the work of Masolino da Panicale, perhaps his teacher, is hard to distinguish from his. Meantime the purely ecclesiastical and decorative style was maintained by Fra Angelico da Fiesole (1387–1455). Ghirlandajo (1449–94) Filippo and Filippino Lippi (1412–69 and 1457–1504), able men and delightful artists, are, in the sense of mere trained skill and executive power, somewhere between the two standards. Their work seems far more realistic and vigorous than Fra Angelico's, and yet archaic beside Masaccio's. Sandro Botticelli (1474–1515) occupies a place apart, and is one of the original designers of any period. Luca Signorelli (1441–1523) painted chiefly at Orvieto and at Cortona and near Siena; important and well-preserved frescoes exist in the Orvieto cathedral. Andrea del Sarto (1487–1531) seems to close the list of the great men of the Florentine school, except that the long life and the immense achievements of Michelangelo (1475–1564) prolong the celebrity of Florence in other cities and under very different influences. Michelangelo spent only a part of his life in painting, but his achievements in fresco put him among the few greatest masters.

Perugino (1446–1523) and his successor, Raphael (1483–1520), made the Umbrian school famous; but Raphael in early life removed to Rome, and what is called the Roman school consists mainly of him and his pupils. Mantegna (1431–1506) was a powerful and original artist, and yet his work shows the immediate influence of classic relief sculpture and also of Venetian painting. He stands almost alone as the great painter of his time in Padua and Mantua. Leonardo da Vinci (1452–1519), coming from the north and soon returning there, is connected with both the Florentine and the Milanese schools, of which latter school he is the great master.

Meantime the Venetian school took shape in the hands of the two Bellini (Giovanni, 1428–1516, and Gentile, 1421–1507). Its purely artistic value is of the very highest; color was its especial point of superiority; and in the hands of Giorgione (about 1477–1511), Titian (1477–1576), Tintoretto (1512–94), and Paolo Veronese (1528–88), it attained a splendor never reached by any other school. Only individual painters here and there, such as Velasquez and Michelangelo, can be ranked with the great Venetians. Tiepolo (1693–1770) was the latest master of the Venetian school, and the last of those Italians who kept the ancient traditions. The Bolognese school must be mentioned, because of the great admiration which less critical ages than the present have felt for its mannered and artificial work. Ludovico Caracci (1555–1619), Annibale Caracci (1560–1609), and Domenichino (1581–1641), are the most famous names of this the so-called eclectic school. Correggio (1494–1534) is hard to class with any Italian school.

Spanish painting is of far less importance in the history of art; its greatest names are those of Francisco Zurbaran (1598–1662), Velasquez (1599–1660), one of the half-dozen giants of art, and Murillo (1613–82).

German painting has had a curiously uneven history—some great men, such as Albert Dürer (1471–1528) and Holbein (1497–1543), and long lapses of time during which little was achieved.

Dutch and Flemish painting is of the greatest importance after that of Italy. John Van Eyck (1370–about 1440) and his brother Hubert (1366–1426) are wonderful painters, excelling the Italians of their time in many respects. Memling (about 1430–95), Roger Van der Weyden (1400–64), and Quentin Matsys (1450–1529) are strictly mediæval painters, but their great ability distinguishes them from other artists of the pre-Renaissance style. It must not be forgotten that the art movement of the Renaissance was much later in the north than in Italy. Rubens (1577–1640) and Vandyke (1599–1641) are of the next succeeding epoch, and close the history of Flemish art, properly so called. Then the Dutchmen took up landscape art as their special study, and Cuyp (1605–91), Hobbema (1638–1709), and Ruysdael (1630–82), founded that great landscape school which is the peculiar glory of modern art. Two men of singular genius devoted themselves to portraiture and the human figure, Frans Hals (1584–1666) and Rembrandt (1607–69). In executive power each of them belongs to the small list of unsurpassable masters.

French painting was late in its development out of mediæval decoration, and was not of supreme importance, even in the seventeenth and eighteenth centuries; but Nicholas Poussin (1594–1665), Claude Lorrain (1600–82), and Watteau (1684–1721) are of high rank as artists, and a good school of portraiture existed under Louis XV. and Louis XVI.

English painting is also recent in its development. Its greatest names are Reynolds (1723–92), Gainsborough (1727–88), and Hogarth (1697–1764).

Painting in the nineteenth century is curiously affected by the freedom of intercourse among different nations, and also by the thronging of large numbers of persons into the professional life of the painter. The aggregate amount of talent, and even of unmistakable genius, to be found in modern painting is enormously great, but it makes less impression upon the public, because of the great size of modern communities and the large comparative number of persons interested in art. The French school, centered in Paris, is much the most important of modern times. Among those who have been some time dead, Ingres (1780–1867) is the greatest master. With him may be named Gérieault (1791–1824), Delacroix (1799–1863), Rousseau (1812–67), Couture (1815–79), Corot (1796–1875), and J. F. Millet (1814–75). In Great Britain the first half of the nineteenth century saw a great school of landscape art, of which J. M. W. Turner (1775–1851) was much the greatest master, but Constable (1776–1837) the one most widely known during his life, on the Continent as well as in Great Britain. The much-discussed pre-Raphaelite school produced one great and original artist, Dante Gabriel Rossetti (1828–82). Many painters have been popular and admired because of their large and showy pictures of patriotic and other historical subjects, such as Paul Delaroche (1797–1856) in France, Maclise (1806–70) in England, Cornelius (1783–1867) and Wilhelm von Kaulbach (1805–74) in Germany.

A general history of painting in ancient times and down to the close of the Renaissance has been written in German by Alfred Woltmann and Karl Woerman, and translated, with some changes, by Sidney Colvin. Kugler's *History of Art* and Mrs. Heaton's *Concise History of Painting* are much used. The French *Bibliothèque de l'Enseignement des Beaux Arts* contains volumes on French, Italian, Dutch, and other schools, and these volumes are being published in English translation. A very large and elaborate work is Charles Blanc's *Histoire des Peintres de Toutes les Ecoles*, com-

pleted in 1876. Bryan's *Dictionary of Painters and Engravers* (new ed. 1886) is good, and Seubert's *Künstler Lexicon* easy to use for persons with even a slight knowledge of German. The fullest biographical dictionary is Nagler's *Allgemeines Kunst-Lexicon*, but it is out of print and needs revision, and a revised edition which has been undertaken has not been carried very far. For the pictures of Christian religious subjects, Mrs. Jameson's *Sacred and Legendary Art*, *Legends of the Madonna*, and *Legends of the Monastic Orders* should be studied; also Lady Eastlake's continuation of Mrs. Jameson's *History of our Lord*; also Lord Lindsay's *Christian Art*. For Italian painting, the different books by Crowe and Cavalcaselle and by Morelli should be studied. For other schools, Crowe and Cavalcaselle, *Early Flemish Painters*; Stirling-Maxwell, *Annals of the Artists of Spain*; Redgrave, *Dictionary of Artists of the English School*, and *A Century of Painters of the English School*. All of the works of Ernest Chesnau are valuable for criticism, and those of Hamerton for their familiar and popular treatment of the art of painting.

RUSSELL STURGIS.

Paisley; town; in the county of Renfrew, Scotland; on the White Cart, 3 miles from its junction with the Clyde (see map of Scotland, ref. 12–F). It consists of an old town situated on the western bank of the river, and a new town on the opposite bank, paved and well built. The abbey (originally founded in 1203) is historically interesting, and among the modern buildings are the town-hall (1879–82) in the Italian style, the county buildings (1891) with a fine council-hall, and the Coats free library and museum (1871) with an observatory and picture-gallery. The Coats Memorial Baptist church (1891) is said to be the finest ecclesiastical structure erected in Scotland since the Reformation. Of its manufactures cotton thread occupies the first place, the two principal firms employing between them 10,000 hands. There are also works for dyeing, bleaching, distilling, and brewing, and the manufacture of woolen shawls, printed-cottons, handkerchiefs, carpets, soap, and starch: and there are ship-building yards on the Cart, which has been deepened to 18 feet since 1890. Paisley returns one member to Parliament. Pop. (1891) 64,379; (1901) 79,355.

R. A. ROBERTS.

Paiute Indians: See SHOSHONEAN INDIANS.

Paixhans, Fr. pron. pāk'saăn', HENRI JOSEPH: soldier; b. at Metz, Jan. 22, 1783; was educated in the Polytechnic School at Paris; entered the army; served in Napoleon's campaigns, but left active service after the Restoration; was employed in the war ministry and on the committee on the artillery. In 1824 experiments were made at Brest, at Col. Paixhans's suggestion, upon cannon for horizontal shell-firing. The idea was taken up by the British admiralty, and the Paixhans guns were the result. He published *Considérations sur l'Artillerie* (1815); *Nouvelle Force maritime* (1822); and *Force et Faiblesse de la France* (1830). D. near Metz, Aug. 19, 1854.

Paixhans Guns: See ARTILLERY and COLUMBIAD.

Pak'enham, Sir EDWARD MICHAEL, G. C. B.: soldier; a brother of the Earl of Longford; b. in Ireland in 1779; entered the light dragoons in early life, and served with brilliant reputation under Wellington (whose quartermaster-general he became), and also in the West Indies. In 1812 became major-general; in 1814 commanded the expedition against New Orleans; was killed in the battle of New Orleans Jan. 8, 1815, an action in which he displayed great gallantry.

Paktong: the correct name of the Chinese alloy resembling German silver in appearance, which is commercially known as *packfong*, *fong* being an original error for the Chinese *tong*, or *tung*, copper. The name means "white copper," and is pronounced peh-tūng in the mandarin dialect. Paktong is composed of arsenic and copper fused at a low temperature, two parts of arsenic to five of copper. It was once extensively exported to Europe and employed in making philosophical instruments and a great variety of other goods. It can not be fused, for the copper alone will remain after melting. Of late the cheaper nickel alloys have driven this substance out of the European market, but it is still extensively employed by the Chinese. It is probable that the Chinese often manufactured paktong directly from arsenical copper ores. See NICKEL.

Palacio, pāă-laa'sĕĕ-ō, RAIMUNDO ANDUEZA: politician; b. in Venezuela about 1840. He took an active part in politics; was Minister of State under Rojas Paul 1888–90, and at the close of his term was elected president, assuming office Mar. 19, 1890. In 1892 the elections were postponed; a rebellion, headed by Gen. Crespo, broke out; Palacio's forces were defeated near Caracas, and he was forced to resign and leave the country (June, 1892). H. H. S.

Paladilhe, pāă'lăă'dĕĕl', ÉMILE: composer; b. at Montpellier, Hérault, France, June 3, 1844; entered the Paris Conservatory when nine years of age; won first prize in 1857 and Prix de Rome in 1860. He has since won considerable fame as a composer of operas, the most important of which is his grand opera *Patrie*, text from Sardou's drama, produced at the Opera, Paris, Dec. 20, 1886. He has also composed a symphony, masses, and much music for vocal and instrumental solos. D. E. H.

Palæ'mon, QUINTUS REMMIUS: a Roman grammarian of the first century A. D., from Vicenza, whose *Ars* was largely appropriated by later grammarians. See K. Marschall, *De Remmii Palæmonis libris grammaticis* (Leipzig, 1887).

Palæog'raphy [Gr. παλαιός, ancient + γραφή, a writing, deriv. of γράφειν, write]: the science of ancient handwriting. Palæography has to do with manuscripts, as epigraphy with inscriptions; it teaches how to decipher them and to judge of the time and place of their writing. It includes in its scope all handwritings, alphabetic and non-alphabetic, Oriental and Occidental: but its chief concern has been with manuscripts written in the Greek or in the Latin alphabet.

Of the two, Latin palæography is the older. For some time after the invention of printing, as both compositor and scholar were familiar with the mediæval script, no need of palæographic study was felt; but, as the the old contractions disappeared from printed books and the new Italian hand crowded out the crabbed monastic writing, the manuscripts grew unintelligible. At the same time the exposure of such forgeries as the Constantinian Donation and the Pseudo-Isidorian decretals threw doubt on the genuineness of all ancient documents. In their eagerness to save the true at the cost of the false Catholic scholars went almost further than Protestants in their skepticism, and in 1675 the learned Jesuit Papebroch, editor of the Bollandist *Acta Sanctorum*, made a sweeping assault on all charters claiming early Frankish origin. These charters were almost wholly in the hands of the one ancient monastic order of the West, the Benedictines, and the ablest of its scholars, Mabillon, came to the rescue of the questioned documents by the publication in 1681 of his *De re diplomatica*. It created at one stroke a new science. With the sure hand of a master he laid down the criteria and rules for the determination of the age of MSS., illustrating and proving from the ample materials at his hand. Even his Jesuit opponent was convinced, and Mabillon's book remains the foremost in the literature of its subject. The voluminous *Nouveau traité de diplomatique* of his fellow Benedictines Toustain and Tassin, a half-century later (1750–65), only expands and illustrates the work of Mabillon. Thus far the new science aimed at both the decipherment of handwriting and the determination of the genuineness and worth of documents; but, when with the French Revolution the legal value of old charters was swept away, they no longer interested any but historians, while the other manuscript treasures of convent and castle, scattered now to the libraries of Europe, became the heritage of all scholars. Palæography, the science of handwriting, separated itself from diplomatics, the science of documents; and while archivists are now trained in the latter by two or three national schools, like the École Nationale des Chartes at Paris and that founded by Sickel at Vienna, the former has found a place in the curricula of most institutions for the higher learning. Facsimiles, multiplying with the growing ease and cheapness of pictorial reproduction, make the study possible and fruitful anywhere.

The oldest Latin MSS. extant belong to the first centuries of the Christian era. They show already in use two clearly marked hands—a formal book-hand in majuscule (capital) letters closely resembling those of the inscriptions, and a cursive (running) hand clearly derived from the other, but differing nearly as much as the small letters from the capitals of the modern alphabet. The whole story of palæography is the story of the reciprocal influence of these two hands—the majuscule growing more careless under the influence of the cursive, and the cursive more legible under the influence of the majuscule. Thus from the book-hand were developed in times still Roman the easier *uncials*, characterized especially by the rounded forms of *a*, *d*, *e*, *h*, *m*, and soon of *g*, *q*, *t*, *u*, all

taking on nearly their present minuscule shape. From a mixture of uncial and cursive grew, in the Germanized lands of the Continent, a group of national hands—Frankish, Lombard, Visigothic—while the Irish monks and their English disciples metamorphosed the uncial after their own fashion, but in much the same direction. Meanwhile the Roman cursive itself, stiffened into a charter-hand, had given birth to the grotesquely illegible script of the early Frankish diplomas. From the end of the eighth century, however, all these, one by one, gave way to the beautiful minuscule which had come into use at Rome, then the bookmart of the West, or, under the fostering care of Charles the Great and of Alcuin, had been evolved from the Frankish half-uncial in the convent schools of Neustria and Austrasia. Capitals were now banished to head-lines and initials, the script of letters and of charters became by degrees once more identical with that of books, and the Caroline hand was from the tenth century universal in Latin Christendom. After the twelfth century it fell indeed into that angularity which still survives in German book-type, as for long in Old English black letter; but happily the Italian scholars and printers of the Renaissance took as a model the purer Caroline forms of the old MSS. whence they drew the classical texts which were their delight. The chief difficulty of the later mediæval MSS. lies in the ever-multiplying abbreviations which had made writing almost a system of shorthand, and which even survived for a time the invention of printing.

The rise of Greek palæography followed close upon that of Latin. In 1708 the Benedictine Montfaucon published his *Palæographia Græca*, which, even longer than Mabillon's great work, remained the sole and sufficient authority in its field. Only in our own day has it been found necessary to revise his work in the light of ampler material, especially for the earlier periods. Since Montfaucon's time the field of study has been pushed centuries back by the discovery of Greek papyri at Herculaneum and in Egypt. Though we are perhaps but at the beginning of what we may hope from the latter source, we have already enough for a survey of the growth of Greek handwriting from the third century B. C. The development is strikingly parallel to that of Latin. From the first we have side by side two hands: the book-hand of literature and the running hand of ordinary use. In Greek, too, the angular capitals, in the early centuries of our era, took on the rounded forms which bear the name (borrowed from their Latin counterparts) of uncials. This remained the usual book-hand till in the ninth century there was shaped from the cursive a minuscule which thenceforward became the literary hand. Greek palæography has drawn a peculiar interest from its bearing on the transmission of the Christian Scriptures.

For the study of the non-alphabetic handwritings the best book is Wuttke's *Die Entstehung der Schrift*; for the history of the alphabet, Taylor's *The Alphabet* and Kirchhoff's *Studien zur Geschichte des griechischen Alphabets*; for the general history of handwriting, Astle's old but excellent *Origin and Progress of Writing*, Humphrey's *Origin and Progress of the Art of Writing*, Berger's *Histoire de l'Écriture dans l'Antiquité*. For Greek and Latin palæography we have at last an excellent manual in English: Thompson's *Handbook of Greek and Latin Palæography*. Of other modern introductions to palæography, the best for Greek are the German ones of Wattenbach, Gardthausen, and Blass; for Latin, the unwieldy Wailly, and the later textbooks of Wattenbach, Prou, and Paoli, while the convenient little manuals of Chassant and Leist have still a use. These must be supplemented of course by collections of facsimiles. The most comprehensive are still the *Paléographie universelle* of Silvestre, and the vast series of the Palæographical Society; but ample for the student's use are the *Schrifttafeln* of Arndt, the *Album patéographique* of the French National Library, or the *Recueil de fac-similés* of the École Nationale des Chartes. The best dictionary of abbreviations is still the old *Lexicon diplomaticum* of Walther, but the little one of Chassant and that appended to Prou's *Manuel* serve an excellent purpose, and Martin's *Record Interpreter* is of value for English documents. See MANUSCRIPTS. G. L. BURR.

Palæol'ogus: the name of a Byzantine family which gave rulers to the BYZANTINE EMPIRE (*q. v.*) from 1261 to 1453. It produced many able men. One branch held the principality of Montferrat, Northern Italy (1305–1533); another ruled in the Peloponnesus (1380–1462). Sophia, only child of Thomas, chief of the latter branch, married (1472) Ivan III. the Great, Grand Duke of Russia, who in consequence assumed the double-headed Byzantine eagle of Constantinople as the Russian arms. Theodore Palæologus, the last descendant of the Palæologi, died Jan. 21, 1656, and is buried in the Church of Landulph, Cornwall. See CONSTANTINE XIII. E. A. GROSVENOR.

Palæontology: same as PALEONTOLOGY (*q. v.*).

Palæphatus (in Gr. Παλαίφατος): Greek mythographer of uncertain period. The language seems to point to a time not earlier than the second century B. C. To this Palæphatus, for there were several of the name, is usually ascribed a treatise Περὶ ἀπίστων [ἱστοριῶν], *On Incredible Tales*, which was once a favorite school-book. In the extant compilation fifty of the Greek legends are explained historically and allegorically, much after the fashion of EUHEMERUS (*q. v.*), and on the general subject. The treatise has been edited by Fischer (Leipzig, 1789), and by Westermann in his *Mythographi Græci* (Brunswick, 1843). See Grote's *History of Greece* (vol. i., p. 45 foll., Am. ed.) and Wipprecht, *Questiones Palæphateæ* (1892). B. L. GILDERSLEEVE.

Palaihnihan Indians, also called **Palaiks** and **Pit River Indians** [from the Klamath word *p'laikni*, signifying mountaineers, uplanders]: a family of North American Indians, having as their habitat the territory drained by Pit river and its tributaries from Goose Lake to the mouth of Squaw creek, in Modoc, Lassen, Shasta, and Siskiyou Counties, Northern California. The following tribal divisions are recognized: Achomawi, Atuamih, Chumawa, Estakewach, Hantewa, Humawhi, Ilmawi, Pakamalli (?).

The physical appearance of the tribes of Pit river varies greatly. The Humawhi and Estakewach have been described as "most miserable, squalid, peaked-faced, mendicant, and mendacious wretches," the result chiefly of the inroads of the Modok and Mukalnk (who carried into bondage their comeliest maidens and bravest youths whenever opportunity offered) and partly of warfare in former years with white settlers. The Atuamih were much superior in physique. The women of all the tribes are degraded and their positions are servile. Marriage is by purchase, and polygamy prevails. All these tribes were very indifferent hunters. They formerly trapped game in pitfalls covered with brush, grass, and earth. These pits were particularly numerous along the river, hence Pit river, after which the tribes were also named. Cremation is generally practiced in cases where the person died of an unknown disease; all others are buried in a sitting posture. The Ilmawi, however, never burn their dead. Very few of the Palaihnihan Indians survive. Some of them were removed to the Round Valley reservation, California, and these, with some natives from Potter Valley, numbered thirty-four in 1889. See INDIANS OF NORTH AMERICA; also Stephen Powers, *Tribes of California* (*Cont. N. A. Ethnology*, iii.), 267–274 (Washington, 1877). F. W. HODGE.

Palaik Indians: See PALAIHNIHAN INDIANS.

Palamede'idæ [Mod. Lat., named from *Palame'dea*, the first described genus, from Gr. Παλαμήδης, a Trojan hero]: a family of birds most closely related to the ducks (*Anatidæ*), but resembling also the rails (*Rallidæ*), and remarkable for their large feet. In general aspect they resemble the rails more than the ducks. The neck is comparatively short; the head small and decorated with a slender horn-like appendage, from 2 to 3 inches long, rising from the forehead; bill short, compressed; the wings are large and armed at the shoulder with two strong spurs; the tail rather small; legs enlarged, covered with numerous oblong and somewhat hexagonal scales, which extend on the tibiæ as well as tarsi, and with larger oblong scales in transverse rows on the upper surface of the toes; the toes long, the anterior connected by slight scaly webs. In the osteology the species essentially resemble the ducks, and have been combined with them by Huxley under the name *Chenomorphæ* as typical desmognathous birds. The family is composed of but two genera: (1) *Palamedea*, Linn., with one species, *P. cornuta*, and (2) *Chauna*, Illig., with two species. All are inhabitants of South America, and frequent marshy grounds and borders of lakes and rivers. They generally associate together in pairs, but sometimes in troops of many individuals. Their gait when undisturbed is slow, their flight easy and rapid; they soar to great heights; they rest in high trees, and in these they make their nests, wherein the female generally lays two eggs. F. A. LUCAS.

Palanquin'[viâ Fr. and Portng. from Javanese *palangki*, viâ Prakrit. from Sanskr. *paryañka*, bed, couch, liter., a sit-

ting with bent legs on the hams; *pari*, around + *aṅka*, hook, bend, groin]: a portable litter for conveying travelers. Palanquins are employed extensively in India, China, and other Asiatic countries. The Japanese *norimono* and *kago* are but forms of the palanquin. The Indian palanquin has a water-proof cover, with Venetian shutters at the sides. The traveler is carried in a recumbent posture. The palanquin is borne by four men, who are relieved at regular intervals by others. Quite a train of attendants accompany the palanquin on foot, and the bearers while on duty keep up a monotonous chant. The journey is often continued for long distances by day and night.

Palaprat, pȧȧ'lȧȧ'praa', Jean, Seigneur de Bigot: dramatist; b. at Toulouse, France, in 1650. In 1675 he was capitulary of his city; he afterward traveled, lived for a time in Rome, and again in France as secretary of the Duke of Vendôme. D. Oct. 14, 1721. He is known chiefly as the associate of David August de Brueys (1640–1723) in the production of comedies. Their best-known work is the adaptation of the old farce *L'Avocat Patelin*; of their original works, *Le Sot toujours sot*, *Les Quiproquo*, *L'Important*, *Le Muet*, *Le Grondeur*, the last is called the best comedy between Molière and Regnard. A. G. Canfield.

Palatal Bones: a pair of bones in the vertebrate skull, which develop from the anterior part of the cartilage of the upper half of the anterior visceral arch ("palato-pterygo-quadrate arcade"). In the sharks (in which, however, no bone exists) the corresponding cartilage serves to bear teeth, and in the lower *bony* vertebrates (fishes and Batrachia) the bones may be teeth-bearing. In the higher forms, however, these teeth are lost, and the bones here merely form part of the skeleton of the roof of the mouth. In man and other mammals they are irregular in shape, and form part of the floor of the nasal cavity and wall of the orbit as well.

J. S. Kingsley.

Palatalization, or **Palatization** (Germ. *mouillierung*, *palatalisierung*): the modification of a sound toward a palatal articulation. The term is specially applied in historical grammar to the palatal modification either of guttural or of dental consonants under the influence of *e*- or *i*-sounds. Thus in Indo-Iranian the Indo-Europ. velar gutturals *q*, *g*, *gh* became palatalized before the vowels *e*, *i*, so as to become, e. g., in Sanskrit *c*, *j*, *jh*, instead of *k*, *g*, *gh*; cf. Lat. *quod* : *quid* :: Sanskr. *kas*, who? : *cid*. The Indo-Europ. perfect of root *qer*-, "make," is *qeqora* > Sanskr. *cakāra*; of root *gem*, "come," is *gegoma* > Sanskr. *jagāma*. Very similar is the treatment in the Romanic languages of Lat. *c* (=*k*) in *ce* and *ci* in distinction from that in *ca*, *co*, *cu*; thus contrast on the one hand Lat. *centum* > Ital. *cento* (pron. *tšento*) : Fr. *cent* (pron. *sōt*), and on the other Lat. *causa* > Ital. *cosa* (pron. *koza*) : Fr. *chose*, or Lat. *cursus* > Ital. *corso* : Fr. *cours*. The palatalization of a dental may be illustrated by the change of *ni̯* (*ny*) to *ñ* in the Romanic languages, as Lat. *seniorem* > Ital. *signor* : Span. *señor*. Entirely similar are such changes as Gr. *pʰaniō* > *pʰañō* > *φαίνω*. Changes such as *ti̯* to *ts* or *tš*, *di̯* to *dz* or *dž*, which occur in various languages and play often an important part in the development of their phonology, are commonly classed as palatalizations, because the direction of the change is palatal. Cf. Eng. *ort-yard* > *orchard*, pronounced *ortšard*; Gr. *taki̯ō* > *τάσσω*; Lat. *diurnus* > Ital. *giorno* (pronounced *džorno*) : Fr. *jour*; Eng. **verdi̯ure* > *verdure* (pronounced *vəədžur*); Gr. **di̯eus* > *Ζεύς*.

Benj. Ide Wheeler.

Palatals: the sounds formed between the body of the tongue and the hard palate. They are to be distinguished from the velars or gutturals proper, which are formed between the back of the tongue and the soft palate. (See Gutturals.) Palatal explosives are *k* (as in *kiss*, not as in *cot*) and *g* (as in *get*, not as in *got*). Palatal spirants are *ch* or *χ* (as in Germ. *ich*), and ʒ, the voiced variety of the same (as in Mod. Gr. *Αἴγινα*, or in Germ. *lege*, *folge*, *regnen*). The palatal semi-vowel *y* (*i̯*), in Eng. *yet*, *young*, *onion*, *use* (*i̯ūz*), approaches near to the character of a voiced palatal spirant, and is more accurately classified as such. The palatal vowels are the various forms of *e* (as in *ten*, *bat*, *bait*) and of *i* (as *it*, *bit*, *beet*). See Phonetics. Benj. Ide Wheeler.

Palate [from Lat. *pala'tum*, roof of the mouth, palate]: the arch or roof of the mouth. It is made up of two parts, called the hard palate and soft palate, or *velum pendulum palati*. The hard palate, which is situated anteriorly, is bounded in front and at the sides by the gums and alveolar arches, being continuous behind with the soft palate. It consists of a bony structure, formed by the union of the two palate-bones and the palatal portion of the superior maxillary bone. These palate-bones are wedged in between the superior maxillary and pterygoid process of the sphenoid. In form each palate-bone resembles the letter L, and is divided into a superior or vertical plate and an inferior or horizontal plate. The inferior surface of the horizontal plate forms the back part of the hard palate. The anterior border of each palate-bone articulates with the palate process of the superior maxillary bone. The bony structure of the hard palate is covered by periosteum, to which the mucous membrane is firmly attached. A linear ridge or raphe extends along the middle line, terminating anteriorly in a small papilla. The mucous membrane in front of and upon either side of the raphe is pale, thick, and corrugated; behind, it is smooth and deeper in color. A number of small glands are situated in the mucous membrane, the surface of which is covered with squamous epithelium. The *soft palate* is composed of muscular fibers covered by mucous membrane with gland structures embedded in its substance. From the middle of its lower border hangs a conical-shaped process, the *uvula*, and upon either side of the uvula, arching downward and outward from its base, are the pillars of the soft palate. The mucous membrane is thin, covered by squamous epithelium on both surfaces, except near the orifice of the Eustachian tube, where it is columnar and ciliated. The muscles of the soft palate are five in number on either side, viz., the levator palati, tensor palati, palato-glossus, palato-pharyngeus, and azygos uvulæ. Upon either side of the fauces, between the anterior and posterior pillars of the soft palate, are two glandular organs, the tonsils. During the first part of deglutition the food is carried back by the tongue, pressing against the hard palate; at the same time the base of the tongue is retracted and the larynx raised with the pharynx, and carried forward under it. Then the epiglottis closes the entrance to the larynx, and over this the food glides, the palato-glossi muscles contracting at the same time that the levator and tensor palate, with the palato-pharyngei, prevent the passage of the food into the upper part of the pharynx or posterior nares. Thus the palate serves an important part in the act of swallowing or deglutition. When its muscles are paralyzed, as occurs not infrequently after diphtheria, the posterior nares are not closed during deglutition, and food, especially liquids, regurgitates at the mouth. Revised by William Pepper.

Palat'inate, The (in Germ. *Pfalz*): formerly a political division and independent state of Germany, consisted of two separate territories, respectively called the Upper Palatinate, now forming the northern part of the kingdom of Bavaria, and the Lower Palatinate, situated on both sides of the Rhine, and now forming the southern part of Rhenish Prussia, the northern part of the grand duchy of Baden, and the province of Bavaria, called Rhenish Bavaria. From the eleventh century these two territories belonged together and formed an hereditary monarchy, their ruler being one of the electors of the German empire; but in 1648, by the treaty of Westphalia, they were separated, the Upper Palatinate falling to Bavaria while the Lower Palatinate continued a possession of the original dynasty. In 1777 the male line of Bavaria having become extinct, the two Palatinates were reunited, but at the Peace of Lunéville, in 1801, the Lower Palatinate ceased to exist as an independent state, its territory being divided between Hesse-Darmstadt, Baden, France, Leiningen-Dachsburg, and Nassau, and the only alteration which the Congress of Vienna made in this arrangement consisted in transferring to Germany that part of the Palatinate which France had occupied, Bavaria receiving the larger part and Hesse-Darmstadt and Prussia obtaining the rest. Many of its people emigrated to Pennsylvania.

Palatine [from Mediæv. Lat. *palatinus*, palatine, orig. one having an office in a palace, spec. use of Lat. *palati'nus*, belonging to a palace or to the Palatine Hill, deriv. of *Palatium*, the Palatine Hill, the imperial residence, situated on the Palatine Hill]: a term originally applied to persons holding office in a royal palace, later to certain high administrative or judicial officers. Under the Merovingians the counts palatine were attached to the court and palace of the sovereign, and aided him in his judicial duties, but from the time of Charlemagne this title was given to powerful feudal lords who were placed in charge of remote or turbulent provinces, where they maintained a court and

palace in the sovereign's name. This was the origin of the counties palatine. In England the chief counties palatine were Chester, Durham, and Lancaster; the last to lose the distinction was Lancaster (1873). King John divided Ireland into twelve counties palatine. Scotland had anciently a county palatine of Strathearn.

Palatine Hill (*Mons Palatinus*): one of the most important of the seven hills of ancient Rome. It was the site of *Roma Quadrata*, the original city. It is S. of the Capitoline Hill and S. W. of the Forum. It was the official abode of the emperors, and in mediæval times of the highest dignitaries, but has since then fallen into decay. Extensive excavations are being made, bringing to light many valuable remains of the imperial period.

Palatka: city; capital of Putnam co., Fla. (for location, see map of Florida, ref. 3–J); on the St. John's river, and the Fla. S., the Ga. S. and Fla., the Jackson., St. Aug. and Indian River, and the Jackson., Tampa and Key West railways; 30 miles S. W. of St. Augustine, 60 miles S. of Jacksonville. It is in an agricultural region, has a daily steamboat line to Jacksonville, and ships large quantities of cotton, sugar, oranges, pineapples, vegetables, and other products. It contains several hotels, a national bank with capital of $50,000, a savings and trust company with capital of $20,000, and a daily and a weekly newspaper. Pop. (1880) 1,616; (1890) 3,039; (1900) 3,301.

Palazzo del Campidoglio: See CAMPIDOGLIO, PALAZZO DEL.

Paleario, AONIO: b. at Veroli, in the Papal States, 1500; studied in Rome 1520–27; settled at Siena as teacher in 1530; and became one of the most prominent humanists of his age. His *De immortalitate animarum* (a large didactic poem published in 1536) is his principal work, but in 1542 he published *Della pienezza, sufficienza e satisfactione della passione di Christo*, and immediately he was summoned before the Inquisition. He defended himself, however, so brilliantly that he was acquitted, and after that time he became very cautious. He declined an advantageous professorship in Lucca because the Roman curia was too powerful in that place. His *Actio in pontifices Romanos et eorum Asseclas* he kept carefully concealed (it was not published until 1606, at Leipzig). In 1555 he removed to Milan. He was a second time accused of heresy and summoned before the Inquisition, and, having been sent to Rome, was condemned to death Oct. 15, 1569, and burned at the stake July 3, 1570.

Palefits: See LAKE-DWELLINGS.

Pale, Irish: See ENGLISH PALE.

Palembang': a Dutch residency on the east coast of Sumatra. Area, 61,911 sq. miles. Pop. 637,500, including Malays, Chinese, Hindus, Arabs, and Europeans. The coastland is low, marshy, overgrown with jungle, and extremely hot, but it is not unhealthful, except in the immediate neighborhood of the swamps. The interior is higher, and covered with rice-fields and plantations of sugar, cotton, pepper, and tobacco, and with immense forests of gum and cocoanut trees. Coal and oil-springs are found, and gold dust, iron ore, sulphur, and arsenic. The capital is Palembang, where the Dutch governor resides. It is the largest town and the chief trade center in Sumatra, and is built on both sides of the Moesi, a broad and deep river, which admits the largest vessels and forms a fine harbor. The city has about 50,000 inhabitants, and carries on a very active trade both with the interior and with Java, China, and Siam. Revised by C. C. ADAMS.

Palencia, pă-len'thĕc-ăă (anc. *Pallantia*): a province of Spain, consisting of parts of Old Castile; area, 3,126 sq. miles. Pop. (1887) 188,954. With exception of the northern part, which is mountainous, the province is an extensive table-land, cold and treeless, but fertile, well cultivated, and rich in salt, copper, saltpeter, chalk, and coal. Wheat, wine, vegetables, and fruit are produced. The capital, Palencia, has a Gothic cathedral (1321–1504). Pop. 15,028.

Palencia, DIEGO FERNANDEZ, de: See FERNANDEZ DE PALENCIA.

Palenque: See CENTRAL AMERICAN ANTIQUITIES.

Paleontology: the science which treats of the ancient life of the globe. The name is of French origin, though, indirectly, from the Greek, παλαιός, ancient, ὄντα, being, and λόγος, discourse; and in its broadest sense covers the fields of palæozoölogy and paleobotany.

As a branch of science distinct from zoölogy and botany, paleontology owes its origin to the recognition of fossils as the remains of extinct organisms. Cuvier is generally credited with the honor of having first clearly announced the scientific opinion that organisms specifically distinct from the present inhabitants have lived upon the earth. This was done in 1796, in a paper on *The Living and Fossil Species of Elephants*, read before the French Institute of Sciences and Arts, and was founded upon the study of the bones of the Siberian mammoth and of the *Elephas americanus*, which were shown to be specifically different from those of the living Asiatic elephant.

At first the result of the study of fossil organisms was to add new species to the known genera of modern zoölogy and botany; but it was not long before it was found necessary to arrange in the classification for distinct fossil genera, and, as the science has developed, new families and orders have been defined, entirely distinct from any living groups, for the reception of the organisms whose fossil remains have been found in the rocks. Paleontology has not only enlarged the number of species and genera, etc., of animals and plants, but it has enlarged the conception of organisms. So long as these were supposed to be only such organisms as now live, the classifications had to deal with only the differences marking the present inhabitants of the globe, and the organic species was conceivable as a group of individuals having a common parentage. When, however, the idea of extinct forms, unlike anything now living, was introduced into science, the question naturally arose, how did these different kinds of organisms arise? and what relation do they bear to those now living? Paleontology primarily considers organisms as having a history, while zoölogy and botany are primarily concerned with the structure and classification of organisms; thus the former science finds its legitimate field of investigation to be the *history of organisms*. The records of this history are found chiefly in the rocks in the form of fossils, which are either the remains of the hard structures elaborated during the growth of the animal or plant, or tracks left on, or in the sands or muds during its life; but they include as well the skeletons or hard parts of recent animals to be examined after its death, or even while still living. The study of the history involves also the comparison of ancient with more recent types, and the examination of the more minute and perishable structures of living organisms, in order to explain the function or import of the hard parts alone preserved in the rocks.

The mere description of the fossil remains of organisms and their systematic classification is, properly speaking, a part of zoölogy and botany, technically described as palæozoölogy and paleobotany, while paleontology proper is wider in its scope, and is that branch of biology treating of the history of organisms, both vegetable and animal. As botany and zoölogy treat of the characters expressed in the life of the individuals, so paleontology treats of the life of the races, the former discussing the modification of the organs and tissues as adapted to the various life-functions of the individual, the latter the modification of the individual as a part of a fauna or a flora in adaptation to its environment, or as related to its ancestors or successors in the evolution of the race. Paleontology is therefore based upon the sciences of zoölogy and botany on the one hand, the nomenclature and systematic classifications of which are essential to the clear understanding of the historical relations of the organisms, and upon stratigraphical geology on the other hand, in which the records are preserved, and by which the time-relations of the fossils are determined.

The materials studied and described by the paleontologist are of two kinds, fossils and stratified rocks.

Fossils are the buried traces of organisms that have once lived, buried and preserved by natural means; the stratified rocks are the, generally, hardened layers or beds of sediments into which the original organic remains fell and were buried, and in which they have been preserved. A fossil may be an impression, footprint, or trail of the tail, or worm-boring made upon the sediments before they were hardened by the living animal itself; or it may be a bone, a tooth, or shell, or some other hard part of the animal or plant covered and preserved in its original condition; or it may be the petrified remains of some more perishable parts, which by infiltration, or chemical alteration or replacement, have become mineralized, or by pressure, heat, or other means have become metamorphosed into some stable chemical compound. In some cases fossils are the hollow cavities from which the mineral part of the fossil has been removed

by solution, and in other cases such cavities have been filled by mud or sand, or by mineral substances brought in by waters in solution and deposited in the cavities by crystallization. In all these various methods of fossilization the essential part of the fossil is not the material, either chemical or mineral, of which it is composed, but the form it holds; and there may be clear evidences that this, too, has been changed by the distortion of the rocks on which the record is made. Still it matters not of what the fossil is made; from the form it assumes is interpreted the character of the organism which made it. In this particular paleontology is but the science of ancient organisms—paleozoölogy or paleobotany. Fossils reveal the form, in almost every case, of only the hard parts of the organism, such as internal or external skeleton, organs of defense or offense, as scales, scutes, spines, and teeth, or crusts or deposits formed for protection and shelter, as shells, corals, etc. Animals composed entirely of soft tissues would therefore leave little or no record of their existence, and even of the others the preserved remains which are subject to study must be a very small proportion of the actual inhabitants of the earth.

When we consider also the mode of fossilization, the imperfection of the record becomes still more apparent.

Death comes to most animals and to some plants, not by the natural living out of the functions of the body, but by violent means, the killing by more powerful animals. In the process of taking the life and using the organism for food, not only the soft tissues but in many cases the skeletal parts are crushed and partially destroyed. Second, in the formation of sediments for deposition there is always more or less attrition, due to the grinding together of the pebbles and sand as they are tossed by the waves or borne along by the currents of rivers or seas; and thirdly, the organic tissues are unstable chemical compounds, and therefore, so long as they are left within reach of the oxygen of the air, they are liable to decomposition.

For these various reasons, although the substance of the hard parts may be preserved, it must be assumed that in the rocks the forms of only a very small percentage of the organisms that have lived can be recorded, and that those which are preserved are in great part of animals which developed durable hard parts, such as shells, skeletons, and corals; and of these, finally, the fossils must represent mainly inhabitants of the ocean, at the borders of which the great proportion of the sedimentary rocks were formed, or the inhabitants of fresh-water lakes and surrounding land, for the lakes produce deposits similar to those at the edges of the continents.

Paleontology is therefore limited to certain groups of organisms. Not all of them have left their history, and for some groups, such as the Mollusca, Corals, Crinoids, and Crustacea, the history is preserved with a considerable degree of fullness, compared with our knowledge of the living forms.

Imperfections in the stratigraphical series of rocks is another source of difficulty in reading from fossils the full history of organisms. Strata have been formed mainly within 100 miles of the edges of continents or in shallow mediterranean seas. The surface of continents in relation to the mean tide level of the oceans has been, geologically speaking, constantly changing; in one region sinking, at another emerging from the sea. The result to the strata has been that they were not formed continuously in one place, but the locality of the maximum accumulation of sediments has been constantly shifting. Hence any section now made through the strata is of limited extent, and exposes only a small part of the geological formations. The accumulation of evidence therefore requires the comparison of sections made through the strata of separate regions. The fact that at the present time the faunas of the seas at separate regions along the same coast differ in species, and at different depths out from the same point show marked differences in species, makes it evident that mere difference of species of fossils can not be taken as a certain criterion of distinct epoch for the strata containing them; but in making up the geological series of strata different sections must be combined on the basis of correlations of the strata by the contained fossils. In a general way by this means the strata of one country can be correlated with those of another, the strata containing like species being classified as belonging to the same system or formation, however widely separated geographically. The fact of geographical distribution of living species leads to the presumption that the finding of identically the same species at widely separated points on the earth may indicate, not contemporaneousness, but succession in time sufficient to allow of the migration of the species from one region to the other.

The theory of the evolution of species, from earlier species morphologically differing from them, has led to the hypothesis that under differing conditions the evolution of a race may progress more or less rapidly, so that on one side of the globe, for instance, species may appear earlier than in another region on the opposite side, though both were evolved from a common stock. Some paleontologists therefore prefer to interpret the evidence of likeness of fossils in strata of widely separate regions as indicating "homotaxial" rather than "contemporaneous" position of the strata. Undoubtedly the correlation of strata can not be made with minute accuracy when they are widely separated geographically, but so great is the parallelism in the general progress of life for all the known world that even in the present state of science the grander divisions of the geological series can be correlated by the fossils from whatever part of the globe they come.

The geological time-scale is composed of a series of stratified rocks making up the outer crust of the earth. The separate sheets or strata were originally laid down under water, the greater portion of them under marine water, as sediments washed by water from the land. They constitute, therefore, a succession of layers one upon the other, the lower being the older and their relative stratigraphical position expressing relative order of formation.

The strata are composed of various kinds of material, broken fragments of rocks, as sand, mud, pebbles; or of shells or corals, as limestones; or of plant stems or tissues, as coal; or of volcanic ash, tufa, or schalstein; or they may be of chemical origin, in whole or in part, as are some calcareous, siliceous, and ferruginous beds; but in order to constitute geological time-records they must have been accumulated successively, one layer upon another, indicating by their superposition their chronological succession.

Subsequent disturbance of these strata has resulted at some places all along the way in folding, upturning, and breaking them; in pushing those already formed above the surface of the water, thus stopping the process of their formation and subjecting them to erosion and partial or total destruction. In other places the formation may be continuous. By similar disturbances the strata which have been above the surface may be depressed, and upon their uneven edges again receive deposits of newer strata.

The breaks thus formed in the series of strata represent intervals in the time-scale that must needs be filled out by strata in which there was no break for the particular period of time so represented.

Examination of the edges of the strata now above water and making the land of the continents has enabled the geologist to make out a continuous series of strata of a maximum of not less than 100,000 feet in thickness.

In a general sense the thickness of the strata represents duration of time, and on the basis of the estimated rate of the formation of the strata the total length of time represented by this geological time-scale is believed to be at least 50,000,000 years.

Fossils are found imbedded in these strata from the base to the top. Hence the fossils of the strata in a particular part of the series are interpreted to be the remains of organisms which lived during the period of time corresponding to their position in the geological time-scale.

Systems.—The stratigraphical series of rocks has been divided into ten divisions of greater or less thickness called systems, the relative order of which is established with certainty. Their names and order from above downward are as follows:

	Time-ratios, after Dana.	
10. Quaternary and Recent.	1	Cenozoic time.
9. Tertiary.		
8. Cretaceous.	1	Mesozoic time.
7. Jurassic.	1½	
6. Triassic.	1	
5. Carboniferous.	2	Paleozoic time.
4. Devonian.	2	
3. Silurian.	1½	
2. Ordovician.	6 [5]	
Potsdam	1	
1. Cambrian.	[5]	

Below the Cambrian are rocks which originally may have been formed in the same manner, but, so far as at present known, contain no recognizable traces of organisms.

The period of time represented by the several systems is not known in terms of human or solar chronology, but some approximation to the time-ratio expressed is determinable

by a comparison of the thickness and kinds of rocks composing each.

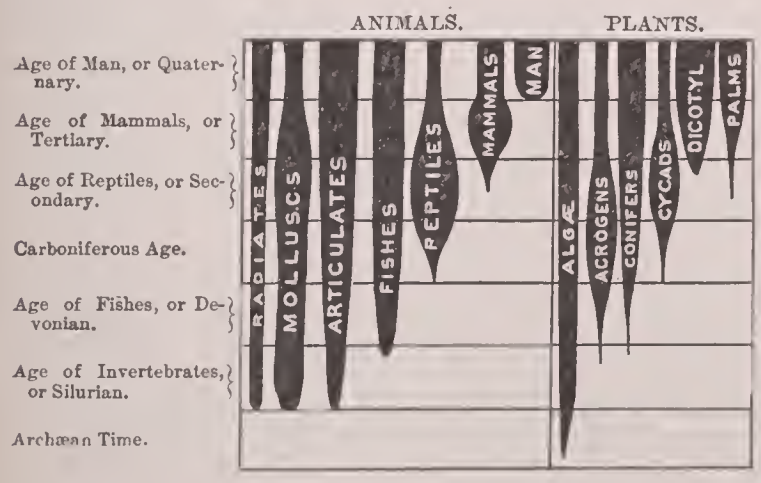
In his *Manual of Geology* Dana has estimated the time-ratios for the several systems to be approximately that of the figures opposite them in the above table, but the lower two may probably now be expressed more accurately by 5 and 5 as expressed in brackets. Grouping the systems, as is commonly done, into three great groups marked conspicuously by the dominant characteristics of the life of the time, there are formed (1) the *Paleozoic*, five times as long as the (2) *Mesozoic*, and fifteen times as long as the (3) *Cenozoic*.

In this grouping of the systems expression is given to one of the fundamental facts observed in the geological history of the globe, viz., the progressive change with the passage of time in the total life of the globe. In the Cenozoic, or more recently formed rocks, are found species the same as those now living, and only this part of the geological series holds fossils which generically are mainly of recent types.

In the Mesozoic time the life holds an intermediate character, mingling ancient with modern generic types. In Paleozoic time the organisms represented are almost entirely of extinct genera. This may be illustrated by the range of the gasteropods (coiled, shell-bearing mollusks, like the snail on land and the whelk in the sea). Of the 59 known families, reported in Zittel's *Paleontology* (1885), only 17 families are known to have had Paleozoic representatives. Taking as a further example one of these families, the *Trochidæ*, out of 75 genera enumerated only a single genus of the Paleozoic is represented by living species; 22 Paleozoic genera are now extinct, and 20 of these became extinct at the close of the Paleozoic. Of the 31 Cenozoic genera about two-thirds began in the Mesozoic. The above is a selected example of the general principles—(1) that the organisms of Paleozoic time were of ancient and now extinct types in a very large majority of cases; (2) that the life of the Mesozoic is specifically almost completely extinct, and a majority of its genera were different from the prevailing forms now living; and (3) the further back we go the greater is the contrast between forms then living and the present life of the globe.

If we select the dominant life reported from each of the successive geological systems, we find another law expressed, viz., that there has been a continuous advance in the rank of the dominant life for each geological age. If we divide geological time on the basis of dominant life on the globe as indicated by the fossils preserved in the rocks, we have, first, the age of Invertebrates, which continued from the Cambrian practically to the base of the Devonian, for although fish, the lower division of the Vertebrates, lived in the Silurian period, and, as Walcott has shown, in the Ordovician (as fossils from Trenton rocks in Colorado have shown), the fishes were not in size, strength, or numbers the rulers of the seas till about the Devonian age. The second age is the age of Fishes, as recorded in the Devonian system of rocks; the third age is the age of Amphibians of the Carboniferous system; the fourth, or age of Reptiles, included the whole of Mesozoic time, in which gigantic reptiles were the rulers of land and air, as well as of the seas, if we may judge from their size, strength, and armor, both offensive and defensive. Mammals, of weak and low types (marsupials), appeared in the Mesozoic, but true mammals became dominant with the opening of Cenozoic time.

This series of facts is illustrated in the following figure from Dana's *Manual*, which shows the kinds of animals and plants which began and were dominant in each age:



It is for zoölogy and botany to classify and determine the genetic relationship of the various known animals and plants, and that part of paleontology which deals with the description and naming of fossils alone is unsatisfactory, unless it is based upon a thorough knowledge of the structure and systematic classification of living organisms.

The study of living forms, however, does not reveal their history, and in order to fully understand the relations of living forms to each other those which have gone before them in geological time must be known; this is the particular province of paleontology.

Embryology reveals the various steps and stages through which the individual passes in attaining the adult form from the primitive ovum; and these steps of development have been found very helpful in suggesting genetic relationships not recognized in adult forms, and thus their study has served to perfect the systematic classification. Paleontology, as the science of the history of organisms and of the races of organisms, throws independent light on their systematic classification by revealing the actual order of succession of adult forms. While it may be reasonably assumed that the embryonic stages of development of the ancestors of any living organism corresponded to its own embryological development, it is not, *a priori*, necessary that the adult forms of the ancestors should have taken on characters expressed in the embryonic stages of their progeny now living. The science of paleontology, while needing light from every possible source in order to interpret its very limited and imperfect facts, has in itself the evidence of the true succession of organic forms in past geologic time, which is its chief function to elaborate and explain.

In attempting to exhibit the more conspicuous facts of paleontology a few words regarding the methods of classification may be appropriate.

Organisms are distinguished, primarily, from inorganic things by performing vital activities or functions, and, secondarily, by the organic structure or tissues which have been seen associated with or performing such functions. Dead organisms, or parts of dead organisms, are known to be such by their morphological likeness to parts or wholes of living organisms. Organisms are classified as of two kingdoms, vegetable and animal. When two or more individual organisms are compared, as, for instance, a dog and a hen, they are found to possess points of likeness and points of difference. By their like characters they are classified together, by their differences they are separated into different groups. The dog and hen both breathe, have blood, bones, and limbs, and they are both classed as Vertebrates. The one has hair, four feet, walks and nurses its young, and is called a mammal; the other has feathers, wings, and lays eggs, and is called a bird. To distinguish the subdivision of the birds other different birds must be compared with this one, and so subdivisions of various rank are established in classifying organisms, and names are given to the several divisions indicative of their rank. The chief of these are, first, the two kingdoms of animals and plants. In each of these there are sub-kingdoms, as branches or types; in each branch are different classes. The subdivisions of classes are orders, under them are families; the families are subdivided into genera; each genus includes one or more species, and species are made up of individuals. These various groupings are artificial, and receive technical scientific names, as in the illustration: *Canis* is the generic name of the dog; *familiaris* its specific name. The wolf belongs to the same genus, but it is a different species—*Canis lupus*. The dogs (*Canis*) and the foxes (*Vulpes*) are generically different, but both belong in the family *Canidæ*. The *Canidæ* and the *Felidæ* (cats, lions, etc.), two distinct families, are both *Carnivora*, which is an order.

The order *Carnivora* and the order *Cheiroptera* (bats) are in the class *Mammalia*, and the birds and reptiles and mammals are several classes of the branch *Vertebrata*.

It is evident therefore that any individual dog is not merely a species, but that it exhibits in its structure and functions all the characteristics—1, of an organism; 2, of an animal; 3, of a vertebrate; 4, of a mammal: 5, of a *Carnivora*; 6, of a *Canidæ*; 7, of a *Canis*; and 8, of the species *Canis familiaris*.

Each organism thus possesses numerous characters which are relatively of greatly varying degrees of importance from the point of view of affinity with other organisms. The particular color of its hair is less important than the number and shape of its teeth, and this, again, is of less importance than the number of its legs; or, in general, we

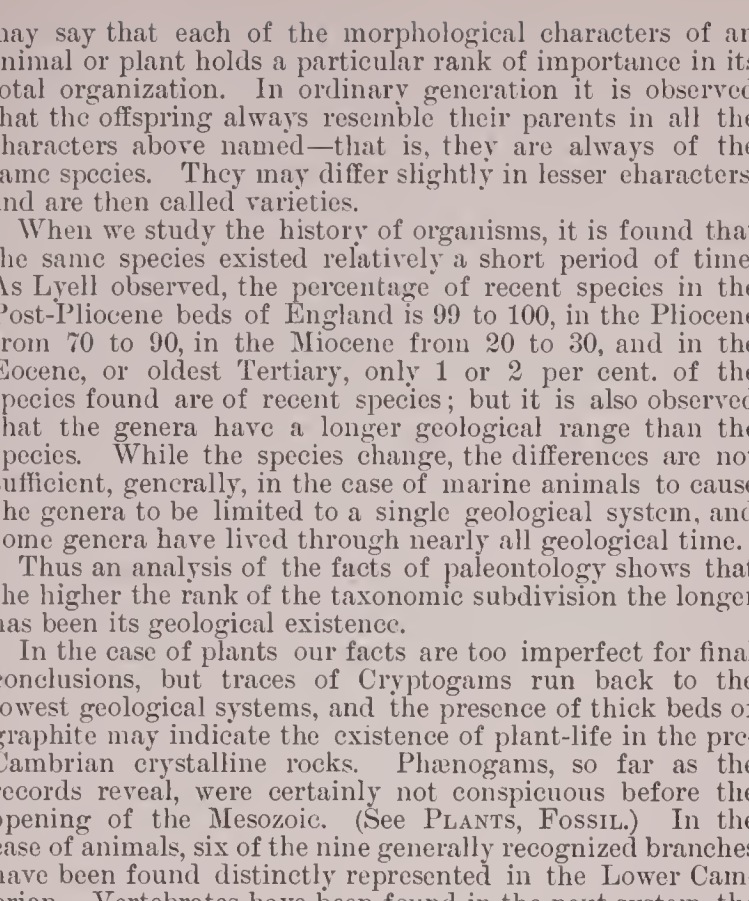
may say that each of the morphological characters of an animal or plant holds a particular rank of importance in its total organization. In ordinary generation it is observed that the offspring always resemble their parents in all the characters above named—that is, they are always of the same species. They may differ slightly in lesser characters, and are then called varieties.

When we study the history of organisms, it is found that the same species existed relatively a short period of time. As Lyell observed, the percentage of recent species in the Post-Pliocene beds of England is 99 to 100, in the Pliocene from 70 to 90, in the Miocene from 20 to 30, and in the Eocene, or oldest Tertiary, only 1 or 2 per cent. of the species found are of recent species; but it is also observed that the genera have a longer geological range than the species. While the species change, the differences are not sufficient, generally, in the case of marine animals to cause the genera to be limited to a single geological system, and some genera have lived through nearly all geological time.

Thus an analysis of the facts of paleontology shows that the higher the rank of the taxonomic subdivision the longer has been its geological existence.

In the case of plants our facts are too imperfect for final conclusions, but traces of Cryptogams run back to the lowest geological systems, and the presence of thick beds of graphite may indicate the existence of plant-life in the pre-Cambrian crystalline rocks. Phænogams, so far as the records reveal, were certainly not conspicuous before the opening of the Mesozoic. (See Plants, Fossil.) In the case of animals, six of the nine generally recognized branches have been found distinctly represented in the Lower Cambrian. Vertebrates have been found in the next system, the Ordovician. It is evident, therefore, that the main divisions of the animal kingdom, and probably of the plants also, date back to the time of the very earliest records at present known; and whatever may have brought about the differentiations of form, the scheme of classification based upon recent forms is applicable in its grander features to all known traces of life on the globe.

The classification and the known range of each branch are given in the following table, in which the vertical spaces indicate the geological systems in their relative order from below upward, from left to right, and the heavy horizontal lines express the range of each of the branches of the animal and vegetable kingdoms named in the list on the left:



From the above table it is evident that no laws of history are expressible in terms of the branches (alone) of the animal kingdom. It is not improbable that each of the branches may have had representatives in the time of the Cambrian system, and has continued ever since.

In regard to plants the same may be said, but it is more probable that the higher forms of land vegetation did not appear till the close of the Paleozoic or the beginning of the Mesozoic. A glance at the diagram of range of plants shows very distinctly the relative succession of appearance of the three great groups—(1) vascular Cryptogams, (2) Gymnosperms, (3) Angiosperms—to coincide exactly with the general rank of complexity and elaboration of organization exhibited in each; the lowest types were evidently first to be conspicuous, and the highest flowering plants were of relatively modern origin. Although nearly 10,000 species of extinct plants have been described, the results from the study of fossil plants are too meager to permit of profitable discussion of them in the present article. The above table expresses the general facts. The ferns, equisetums, and lycopods constituted the bulk of the luxuriant flora of the Carboniferous age. The cycads and pines were as conspicuous in the Mesozoic, and the Cretaceous and Eocene floras were the first to be conspicuously constituted of angiosperms. See Plants, Fossil.

A more minute analysis of the history of animals will reveal some facts illustrating the grander laws of paleontology.

Protozoa.—The Protozoa are for the most part minute, and even microscopic in size. Functionally they have no permanently specialized organs, but in many cases secrete calcareous or siliceous shells of particular form, or of particular mode of aggregation, furnishing means for their morphological classification. Of the three classes (Gregarinida, Rhizopoda, and Infusoria) into which the recent Protozoa are divisible, undoubted remains of only Rhizopoda are found fossil. The Rhizopoda include the orders *Foraminifera*, *Radiolaria*, and *Heliozoa*. The fossil species are chiefly the *Foraminifera*, of which some are of considerable size, i. e. not microscopic, the Fusulina of the Carboniferous reaching a length of half an inch; Nummulites, a thin discoid or coin-shaped fossil, from half an inch to an inch in diameter, which was extremely abundant in the Middle Eocene, forming great deposits, now the nummulitic limestone, reaching a thickness of several thousand feet in Southern Europe and Asia and Northern Africa.

Eighty genera of *Foraminifera* are enumerated in Zittel's list of 1880; of these only one is described from lower than Carboniferous strata, and only twelve genera are Paleozoic, fifty-eight are Mesozoic, and a large majority of the latter genera are known among living forms. This expansion in the historical appearance of the genera is probably due rather to lack of record than to real first appearance of the greater part of the *Foraminifera* in the latter half of geological time. The minute size and the ease of destruction or obliteration of form accounts for the absence of these simplest of animals from the early geological formations. This statement is supported by the fact that of the six families into which the fossil *Foraminifera* are classified, all but one of them is represented among the twelve known genera of the Paleozoic, showing an expansion of all but generic characters almost as great in the Paleozoic as now, and Carpenter concluded, from his study of the order, that there was no evidence of any fundamental modification or advance of the foraminiferous type from the Paleozoic period to the present time.

Cœlenterata.—The Cœlenterates may be divided for our purpose into four classes, viz.: 1, Sponges; 2, Anthozoa (polyps or corals); 3, Hydrozoa (including jellyfish); and 4, Ctenophora.

Of these we may know of fossil remains of sponges, in the form of siliceous and calcareous spicules or composite masses of structure; of the Anthozoa by the calcareous corals they deposit; but the latter two classes, because they develop no solid test or skeletal parts, must be regarded as beyond the possibility of making a record except of very doubtful value. However, undoubted traces of medusa (jellyfish) are found in Cambrian rocks.

Fossil sponges have been detected in the lowest, the Cambrian, and in each of the successive geological systems. Although in the case of sponges the evidence must be very incomplete, their great antiquity is shown by the fact that of the seven orders into which the known sponges are classified by Zittel, six of them are already known from the Carboniferous system, viz.: the *Ceraospongiæ*, the *Monactinellidæ*, the *Tetractinellidæ*, the *Lithistidæ*, the *Hexactinellidæ*, and the *Calcispongiæ*.

The Anthozoa are better represented than any of the animals heretofore mentioned, and in the fossil corals which

they constructed during life we have the record of the evolution of the type in sufficient elaboration to give a somewhat definite idea of the nature of the changes that have taken place.

Opposite each family in the following table is given the number of genera of the various families of Anthozoa recorded (at the time of the publication of Zittel's *Handbuch*) for each geological system:

Genera of the various families of Anthozoa (corals) arranged according to their geological range.	Cambrian.	Ordovician.	Silurian.	Devonian.	Carboniferous.	Triassic.	Jurassic.	Cretaceous.	Tertiary.	Quaternary and Recent.
Zoantheria.										
Tetracoralla:										
Fam. 1. Inexpleta	..	..	7	6	4	..	..	..	..	..
" 2. Expleta	..	..	38	25	27	..	..	..	..	..
Hexacoralla:										
Fam. 1. Poritidæ	..	1	8	6	5	1	2	4	11	7
" 2. Madreporidæ	..	..	..	..	..	..	..	..	1	2
" 3. Pocilloporidæ	..	..	..	2	1	..	..	..	1	1
" 4. Eupsamminidæ	..	..	1	..	..	..	2	2	7	12
" 5. Fungidæ	..	..	..	..	..	5	11	9	15	22
" 6. Astræidæ	..	..	..	..	..	11	58	76	62	52
" 7. Stylophoridæ	..	..	..	..	..	..	2	..	2	2
" 8. Oculinidæ	..	..	..	..	..	..	6	4	4	5
" 9. Dasmidæ	..	..	..	..	..	..	..	1	1	1
" 10. Turbinolidæ	..	..	..	..	..	..	3	15	22	27
Totals	..	1	54	39	37	17	84	111	126	131

From this table it will be seen that of the two great divisions of the older (viz., Tetracoralla and Hexacoralla), the first division is characteristic of the Paleozoic, and the latter, although it is represented by a few genera in the Paleozoic, is as dominantly characteristic of the later half of geological time.

The imperfection of record has nothing to do with the general law here illustrated. There were the Tetracoralla with two well-characterized families, which were abundant in genera (which means that there was evolved wide difference in structure and form), and expressed by a great many species and abundance of individuals in the Paleozoic, and this whole group then became extinct (or nearly so, for there are numerous living forms which have been recently studied and are shown to be closely allied to these ancient types).

Again, the Hexacoralla represented by a few forms in the Paleozoic rapidly expanded in variety of form, number of genera, and necessarily in abundance of species and individuals, and, as we may infer, took the place in the oceans of the extinct forms that were evidently so abundant in earlier time.

To use an illustration, the genus *Zaphrentis*, one of the expleta corals, is as characteristically an ancient genus as *Fungia*, one of the Fungida, is characteristically a modern genus.

An important geological group of the Cœlenterata is the Graptolites. They developed delicate stem-like rows of cells in which the polyp lived, and they are characteristic of the lower half of the Paleozoic.

Echinodermata.—The third branch, the Echinodermata, are classified by the zoölogist as follows: viz., Crinoidea (or sea-lilies), Asteroidea (starfish), Echinoidea (sea-urchin), and Holothurians (sea-slugs, trepangs, or sea-cucumbers. Each of the first three develop hard calcareous or chitinous shell, or granules, or spines, which are easily preserved after death, and hence of them a fair record is known. The Holothurians, secreting only a leathery kind of external coating, and fragile calcareous spicular in the inner coatings, are unsatisfactory as paleontological objects of study.

The paleontological history of the several types of Echinoderms may be expressed mathematically by noting the number of different generic forms of each order known in each of the successive geological systems.

As the conditions of preservation of the remains may be supposed to be comparatively alike in the several systems, although the records are very imperfect and the specimens rare, divergence of structural development as indicated by different genera may be safely interpreted as a measure of dominance, vigor of generation, and abundance of the forms expressed in fossil condition. While it is reasonable to suppose that the tables will be greatly modified by future discoveries as to the actual number of species and genera, these discoveries will not be likely materially to change the general relations of the grand divisions of organisms to paleontological history.

The following table expresses this law based upon the facts recorded by Zittel:

Differentiation of the genera of Echinoderms, expressed in the number of genera of each class and order for the various geological systems.	PALEOZOIC.					MESOZOIC.			CENOZOIC.	
	C.	O.	S.	D.	Carb.	T.	J.	K.	Tert.	Rec.
Echinodermata	1	48	101	65	78	9	69	101	98	100
Crinoidea	..	14	94	51	53	1	13	13	6	11
Tesselata	..	14	74	51	53	..	..	2	..	..
Articulata	..	..	..	..	..	1	12	11	6	11
Costata	..	..	..	..	..	..	1	..	..	..
Cystoidea	1	27	13	4	4	..	..	..	..	..
Blastoidea	..	..	2	3	4	..	..	..	..	..
Echinoidea	..	2	2	3	12	5	45	76	83	74
Palechinoidea	..	2	2	3	12	1	..	..	..	..
Euechinoidea	..	..	..	..	..	4	45	76	83	74
Asteroidea	..	5	12	4	5	3	11	11	9	15

Analysis of the table shows the general laws of evolution of the Echinoderms to be as follows:

The Crinoids are distinctly an ancient type, represented abundantly and in great variety of generic forms in the Paleozoic, and becoming almost extinct at its close. In the Mesozoic (the Jurassic showing the earliest dominance of the genera) a new subordinal group springs into prominence, the Articulata, and they continue on to the present time, when they are chiefly of deep-sea habitat. The Tesselata and the Articulata are closely related, but possess distinct and permanent characteristics.

The Cystoids were of an irregular form and apparently of lower rank of organization than the Crinoids, and had none or but imperfectly developed arms. As will be seen from the figures they are particularly an ancient type—the earliest to appear in the Cambrian, had their climax in the Lower Silurian or Ordovician, and became extinct at the close of the Paleozoic. Exception to this statement may be made on account of the recent discovery of forms classed with the Cystoids in the deep seas.

Extinct is used to express lack of evidence of the continuance of the race. Species, genera, and orders may still continue to live in the depths of the ocean where the conditions of life have remained remarkably uniform for geological ages, and only the deep-sea dredge can reveal the facts to us. Some remarkable finds have already been made, and it would not surprise paleontologists to hear of the discovery of many supposed extinct ancient types of life in the sea depths.

The Blastoids are a group of beautiful, symmetrical, bud-shaped Crinoids, of the later Paleozoic; they too had their beginning and dominance and finally became extinct.

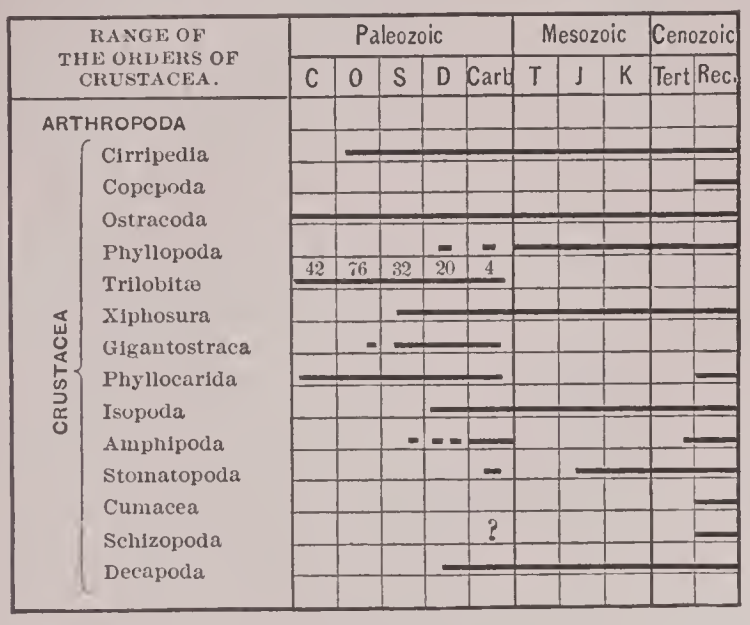
The Echinoids, or sea-urchins, are as characteristic of later geological time as the Crinoids and Cystids are of early time. The Palechinoids are represented in the later Paleozoic by a few characteristically inferior types of Echinoid structure. This is seen in the irregular number and the multiplication of the rows of plates making up the ambulacral and interambulacral series. The true Echinoids (*Euechinoidea*) in both orders (Regulares and Irregulares) began their evolution in the Triassic, rapidly expanded in the Jurassic and Cretaceous, and the largest number of recorded genera was not reached till Tertiary and recent times. The climax of evolution, as expressed by greatest diversity and number of generic forms and abundance of specific and individual forms, was attained for this class certainly not till the Tertiary time.

Vermes.—The fourth branch of the animal kingdom, the worms, has left traces in the earliest sedimentary formations in the form of borings or tracks. From the morphological structure of worms and its relation to that of other branches, it is altogether probable that worms were among the very earliest of animals to appear. On account of the failure to develop hard parts, except of the nature of minute jaws or teeth (Annelida), the history of worms can not be written.

Arthropoda.—The Arthropoda, producing chitinous shells or external skeletons, left valuable records of their history for the paleontologists, and from the study of the fossils we learn that this branch was probably the first to dominate among the inhabitants of the seas.

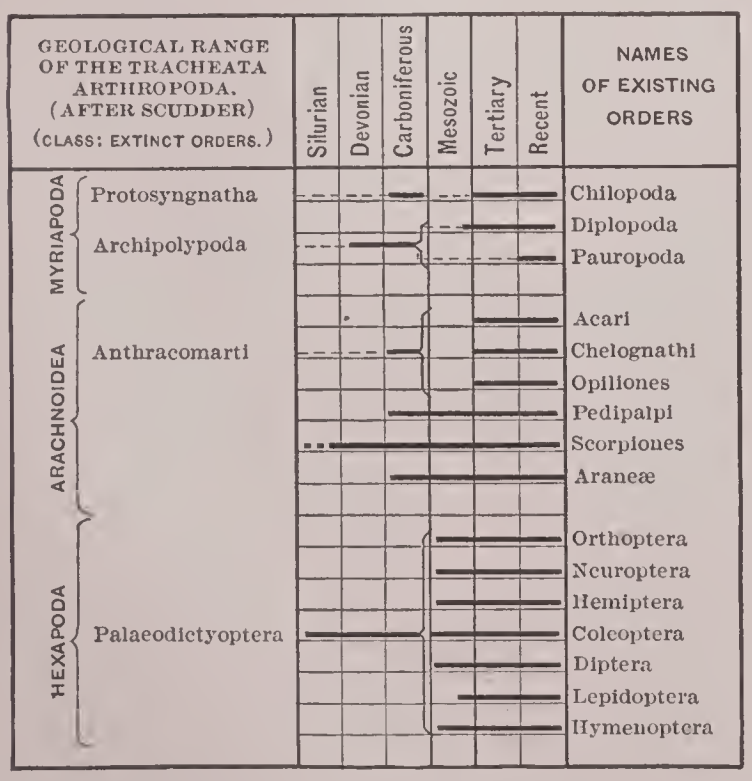
In the following table the geological range of the several orders of Crustacea (the first class of Arthopoda) is given; and opposite Trilobitæ the number of genera known in each system is given in the column corresponding to the Cambrian (C), the Ordovician (O), the Silurian (S), the Devonian

(D), and the Carboniferous (Carb.). It will be seen that the Trilobites were not only an ancient race, but that we already have knowledge of their remarkable expansion into separate genera—42 in the Cambrian, 76 in the Lower Silurian, or Ordovician time. Here, too, there were species of large size; several have been seen which attain 2 feet, or nearly that, in length. The Trilobites furnish the most abundant and characteristic fossils of the Cambrian system, and evidently were the highest and the dominant organisms of their time.



The Ostracoda, the Gigantostraca (the Eurypterus, the Pterygotus, etc.), and the Phyllocarida are ancient types. The Decapoda (including modern crabs and lobsters) is historically a later type, beginning at the close of the Paleozoic, rapidly expanding in the Mesozoic, and including many of the dominant representatives of Crustacea of the present time.

The other classes of Arthropoda are the Myriapoda (thousand-legged worms), the Arachnoidea (spiders, scorpions, etc.), and the insects. The following table, after Scudder, expresses the fundamental facts regarding their paleontological history so far as known:



It will be observed that the Scorpiones are of very early origin. The modern types of insects, spiders and Myriapods, are of more recent origin, although represented by ancient and more or less synthetic types in the Paleozoic.

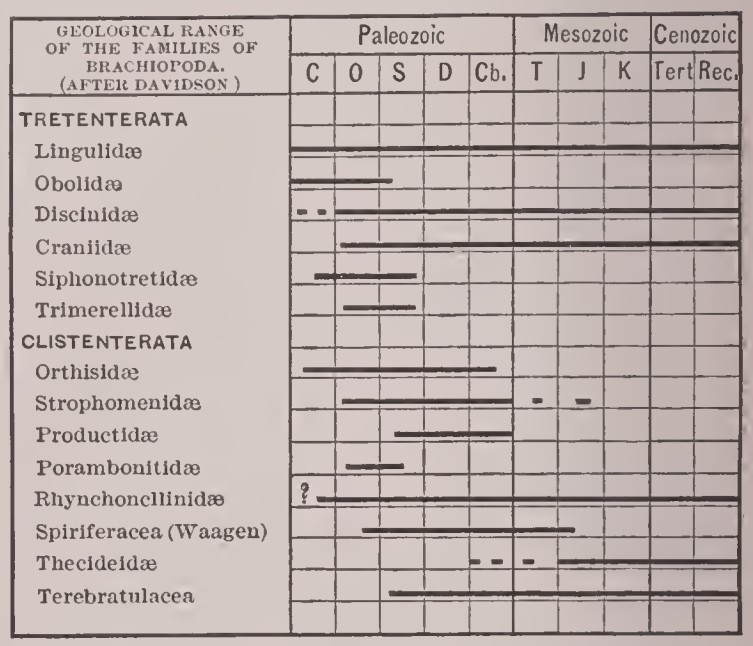
The oldest known insect is *Paleoblattina douvillei* Brongniart of the Middle Silurian. Although insects are so little apt to be preserved in the rocks, there are already described 2,600 fossil species.

Molluscoida.—This branch of the animal kingdom has furnished the most detailed evidence of paleontological history with which the paleontologist is familiar.

The branch includes the two classes Polyzoa (Bryozoa) and Brachiopods. The Polyzoa individually are minute animals, but construct chitinous or calcareous, moss-like colonies of cells, which are preserved abundantly in some of the ancient rocks, and representatives still live in the seas. The Brachiopods form bivalve shells, calcareous and chitinous, which have resisted remarkably the destructive agencies of time, and are among the most frequently appearing fossils in the rocks from the earliest to the latest geological periods. See MOLLUSCOIDEA.

In his description of the *Bryozoa of Illinois*, Ulrich enumerates 138 genera classified under 26 families, all Paleozoic forms. Although individually minute the expansion of the races into modified form and the abundance of individuals characterized the Lower Silurian (Ordovician), and the Polyzoa (Bryozoa) were abundant in the Mesozoic and are still represented by a large number of species and genera in modern times.

The importance of the Brachiopods, in the interpretation of the age of Paleozoic formations, particularly demands fuller discussion than can be given here. In the present state of our knowledge the grouping of the genera into families is not satisfactory, as is the case with the Trilobites, but in order to tabulate and express the more prominent facts in the evolution, the families, as classified by Davidson, will be tabulated in the following table and their range given, without attempting to group them according to relationship, further than to designate the two ordinal groups of hinged (Clistenterata) and unhinged (Tretenterata) forms:



This method of illustration, to be clear, requires the following explanation: In the cases of the Lingulidæ, Discinidæ, and Rhynchonellidæ, represented by living forms, the Lingulidæ are represented in the earlier Paleozoic by several genera which are confined to that part of the scale, and the persistent form is the single genus Lingula. The persistent forms in the other two families named are single genera in each; i. e. Discina and Rhynchonella; much the same fact is true of the Craniidæ. Hence it may be said of the Tretenterata that they are dominantly ancient types, confined mainly to the lower half of the Paleozoic, and are perpetuated by three genera which continued to be represented by species till the present time.

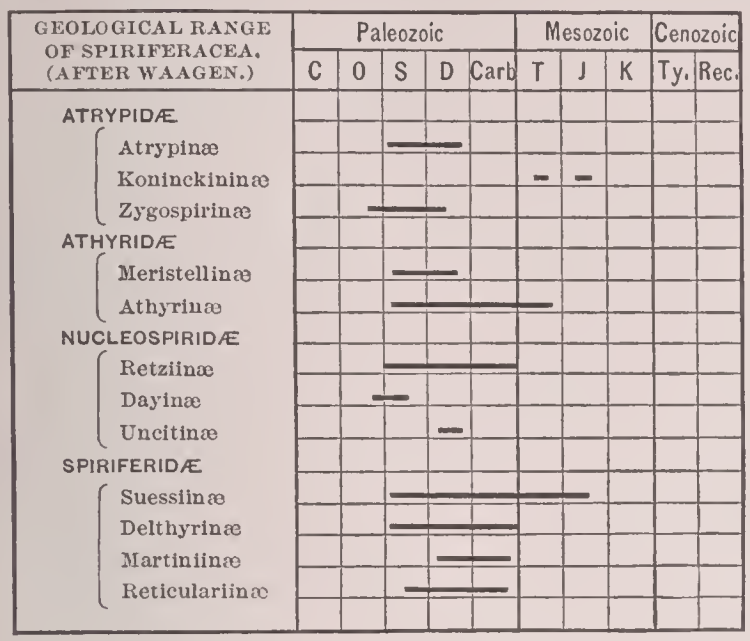
Of the Clistenterata, the Orthis, Strophomena, and Spirifer families are almost entirely Paleozoic, a few rare species appearing in the Mesozoic.

Productus is characteristically of Devonian and Carboniferous age, culminating in the Carboniferous. Some allied genera are known in the Silurian and in the earlier Mesozoic.

Terebratulidæ, a large and prominent group of genera, runs back with several genera into the Paleozoic, but its great expansion in genera and species is in the Mesozoic and later times. These are the most important groups of Brachiopods.

An analysis of the range of the smaller groups of forms, as given in the case of the Spiriferacea by Waagen, will illustrate admirably the very intimate relationship existing

between the morphological differences, as expressed in the classification, and the geological time in which the different forms lived.



From this table it will be seen that likeness of morphological organization, which is the basis of biological classification, is co-ordinate with sameness of time in the geological history of the races. Where a genus has a clearly marked beginning and ending, the different species of the genus are more or less abundantly and continuously represented during the period. Different species which are similar to each other, enough so to be ranked in the same genus, rarely are found in more than two or three adjoining systems, and as a rule the more closely animals are like each other the nearer together in geological time did they live, and in series of related forms the more extreme divergence is found between the earliest and the latest representatives of the race.

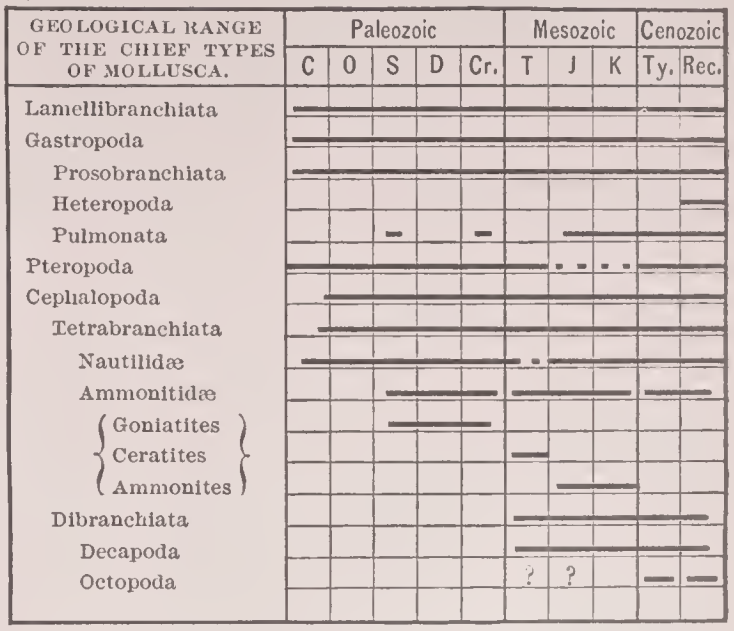
Minute comparison of the variations and specific differences observed in a series of forms of the same genus occurring in successive strata leaves little or no doubt of the existence of continuous races the successive members of which were genetically related, and, as races, with the passage of time they suffered gradual modification in a few or many of their characters, leading to the conviction that species which appear to breed close for a given epoch of time have descended from ancestors from which they differ morphologically enough to be ranked in different species or genera, or in some cases even in groups of higher taxonomic rank.

The slight differences observed in successive representatives of the same race of organisms are called *mutations*, and the differences expressed by the same species living at the same time, but geographically separated, or existing under differing conditions of environment, are called *varieties*.

In many cases, where the facts are sufficiently numerous to illustrate the point, it is observed that in a race of organisms great variability or plasticity of form is characteristic of the earlier stage of the history, while mutations are slow and gradual and in lines already marked out by the variability of the early types.

Mollusca.—The Mollusca are grouped into four classes: Lamellibranchiata, Gasteropoda, Pteropoda, and Cephalopoda. In each class calcareous shells of some kind are developed for most of the orders. In the Lamellibranchs, a bivalve shell like that of the clam; in Gasteropoda, a shell as in the snail. In the Pteropods a frail hyaline shell is developed by many of the recent forms; in the Cephalopods, shells like the pearly Nautilus, or internal shells like the cuttle-bone. These are types of the numerous kinds of shell produced. These hard parts are readily preserved when buried in the mud, and therefore they are prominently represented among fossil remains. In many cases their external form or contour (which, as in the Lamellibranchs, is all that is generally preserved) furnishes small evidence of the more important structural differences distinguishing species, genera, or categories of higher rank. Hence it is difficult to determine for the Paleozoic forms the finer points of their paleontological history.

Each of the classes is of early origin, beginning at least as early as the Ordovician, as will be seen in the following table.



The evidence is clear that for Lamellibranchs and Gasteropods the greater generic expansion was as late as Mesozoic, and probably did not reach its maximum till the Tertiary, as illustrated by the fact that the greatest number of recorded genera for any particular time, previous to recent, was in the Tertiary. This fact may, of course, be due in part to the better knowledge we have of Tertiary shells, but in general the earlier forms that are found belong to fewer genera and families in both of the great classes mentioned.

The Pteropods were more prominent, both in numbers of generic types and in species and individuals, in the lower systems of the Paleozoic. Four genera with fifteen species and two varieties have been described from the Lower Cambrian of North America (Walcott), which is nearly 10 per cent. of the total known American fauna of that formation, including the Trilobites.

The Cephalopods had their chief expansion, for the Nautiloid types, in the Paleozoic, including the straight, chambered Orthoceras, the Gomphoceras, the Gyroceras, Cystoceras, etc., and the earlier representatives of the genus Nautilus which has persisted to the present time in the case of the pearly Nautilus. The Ammonite type, represented by a large number of Goniatites in the Devonian and Carboniferous, found their great expansion and abundance of species and genera in the Mesozoic, and their shells constitute one of the most important and characteristic marks of the Jurassic and Cretaceous, after which they appear to have become suddenly extinct. The Dibranchiate order, represented by the modern octopus and squid, were of still later origin, and no traces of them have been seen lower than the Trias. The order of appearance in the case of the various types of Cephalopods is clearly that of the order of rank of elaboration and of organic structure. The well-known series of genera of Cephalopods—i. e. Nautilus, Goniatites, Ceratites, Ammonites—expresses the law of progressive evolution in its simplest form, in the elaboration of the edges of the chambers as seen in the suture lines of the shells.

The physical relation borne by the successive forms of suture lines in this case is such that it would be physically impossible for the Ammonites' septum and suture to be formed by development without passing through stages represented by those of the Nautilus, Goniatites, and Ceratites successively, thus furnishing almost mathematical proof of the genetic relationship of the later to the earlier types. See Mollusca.

Tunicata.—The few known forms referred to this branch of the animal kingdom develop no structures sufficiently durable to lead to the expectation that their fossil remains could be discovered, except under the most favorable circumstances. They may have lived in the earliest times, but at present undoubted traces of them are not known in the rocks. See Tunicata.

Vertebrata.—The paleontology of the Vertebrates is discussed in other articles of this cyclopædia, and here only the grander facts will be referred to. See Vertebrates, Fossil.

In the first table the geological range of the several classes is given.

GEOLOGICAL RANGE OF THE CLASSES OF VERTEBRATES.	Paleozoic					Mesozoic			Cenozoic	
	C	O	S	D	Car.	T	J	K	Ty.	Rec.
Leptocardii										—
Cyclostomi										—
Pisces		–	–	—	—	—	—	—	—	—
Amphibia					—	—	—	—	—	—
Sauropsida (Huxley)					–	—	—	—	—	—
Mammalia						–	– – –	– – –	—	—

Of the lower and rarer forms of Vertebrates, the Leptocardii and the Cyclostomi, only recent examples are known. The chief classes of Vertebrates made their first appearance, so far as known, and became dominant in the order of their zoölogical rank.

The fishes were the first to appear, in the types of Ganoids and heavily mailed Placoderms, and the ancient types of Cephalaspis and Pteraspis, and early types of Shark.

The earliest known remains of fish are from the Trenton rocks of Colorado. In the Devonian fish remains are abundant, and of the types above mentioned.

In the Carboniferous Amphibian remains appear, not those of the more modern Batrachian type of the toads and tailed salamanders, but of a separate order, Stegocephala; and the species were often of large size, and in some cases protected by scales or plates over part of the body.

The modern type of Amphibia are not known earlier than the Cretaceous.

The modern type of fish, the Teleosts, did not appear till the middle of the Mesozoic, and their chief expansion is in the Tertiary. Of the 45 recorded families of Teleostei, only 16 are reported from below the Tertiary, and only 2—the *Hoplopleuridæ* and the *Clupeidæ*—below the Cretaceous. Species of these two families appear in the Triassic.

The reptiles and birds (paleontological evidences requiring their association in one great class—the Sauropsida) formed their great expansion in the Mesozoic, which on that account has been called by Agassiz the age of Reptiles. A few true reptiles were seen in the Carboniferous, and though a few traces of true birds have appeared in Cretaceous rocks, the birds and the mammals were very insignificant among the faunas previous to the Tertiary.

In the following table the range of the grander divisions of the reptiles and birds is given:

	GEOLOGICAL RANGE OF THE ORDERS OF REPTILES AND BIRDS.	Paleozoic					Mesozoic			Cenozoic	
		C	O	S	D	Car.	T	J	K	Ty.	Rec.
REPTILES	Ichthyosauria						—	—	—		
	Sauropterygia						—	—	—		
	Testudinata (Turtles)						—	—	—	—	—
	Theromorpha					—	—				
	Rhynchocephalia						—	—	—	—	—
	Lepidosauria							—	—	—	—
	Lacertilia (Lizards)							—	—	—	—
	Pythonomorpha								—		
	Ophidia (Serpents)								–	—	—
	Crocodilia						—	—	—	—	—
	Dinosauria						—	—	—		
	Pterosauria						—	—	—		
BIRDS	Saururae							—			
	Ratitæ								—	—	—
	Carinatae								—	—	—

From the table it appears that the gigantic sea-lizards (Ichthyosauria, Sauropterygia) called Enaliosauria, and the sea-serpents, which were equally gigantic, of 70 feet or more in length (the Pythonomorpha), the peculiar type of Theromorpha, the gigantic and truly marvelous land reptiles, the Dinosauria, 25 to 30 feet long, and exceeding in bulk the elephants and rhinoceros of the present time, and the flying reptiles, with long teeth and bat-like wings—Pterosauria—were the dominant races of Mesozoic time, but have all become extinct. The modern reptiles are the turtles, the serpents, the rare Hatteria, and the lizards, all of size inferior to the mammals, and the Crocodilians which preserve somewhat of the importance of the ancient reptilian type.

The Saururæ, tailed, feathered, toothed, and winged animals, combine the characters of birds and reptiles, and have not been discovered later than the Jurassic. The Hesperornis of the Cretaceous, however, is a true bird (Ratitæ) with teeth in its beak, thus showing the intimate genetic relationship between these two great divisions of the animal kingdom, the reptiles and birds, suggesting to Huxley their inclusion in a single class, the Sauropsida.

The study of the fossil mammals reveals some of the most interesting facts of paleontology. See VERTEBRATES, FOSSIL.

With the exception of a few small representatives of the marsupials (Microlestes, Dromatherium, and other related forms from the Triassic and Jurassic), which are interpreted by Marsh as probably insectivorous, and allied with what are now marsupials, the mammals did not appear lower than the Eocene—the base of the Tertiary.

This is perhaps the most remarkable fact exhibited in the paleontological history of organisms—i. e. that the evolution of the highest, now by all means the dominant and most important class of the organisms on the globe, was evolved in all of its most characteristic differences of structure and organization since the beginning of the Eocene. The length of the life history of not only all the species but the genera, families, and orders of mammals is little longer (perhaps twice as long at the greatest) than the average length of life of the majority of the species of Invertebrates now living in the ocean.

The above review of the chief facts of paleontology will suffice to point out the nature of the problems which this comparatively new science reveals. To paleontology we must look for the demonstration of the laws of organic evolution.

HENRY S. WILLIAMS.

Paleozoic Era [Gr. παλαιός, ancient + ζῷον, animal]: one of the greater divisions of geologic time. It is preceded by the Proterozoic era and followed by the Mesozoic and Cenozoic, and it includes the Cambrian, Silurian, Devonian, and Carboniferous periods. See PALEONTOLOGY.

Paleozoic System: See PALEONTOLOGY.

Paler'mo [Ital. < Lat. *Panor'mus*, the ancient name = Gr. Πάνορμος, liter., always fit for landing; πᾶς, πάν, all + ὅρμος, harbor]: city of Sicily; situated on the north coast; in lat. 38° 6′ 44″ N., lon. 13° 20′ E. (see map of Italy, ref. 9–E). It lies on a bay formed by a deep and spacious inland sweep of the sea, between Cape Zafferano on the E. and Monte Pellegrino on the W. This bay has received the name of the *Conca d'Oro*, the Golden Shell, a name also applied to the city and to the plain which extends from the sea to the mountains in the rear—a region favored in its climate, soil, and landscape beauty. The city walls, 4½ miles in circumference, form a square, the four angles corresponding very nearly to the four cardinal points of the compass, and the town is entered by sixteen gates. The harbor lies to the N. of the town, and is sheltered by a huge mole. The Oreto, which, with its many small tributaries, waters the adjoining plain, flows into the sea near the east angle. Two fine streets, the Macqueda or Strada Nuova, and the Vittorio Emanuele, formerly Toledo, intersect each other at right angles near the center of the city, thus dividing it into four sections. Among the public squares are the Villena or Vigliena, decorated with fountains and statues in the Renaissance style, and the public garden on the left of the Porta Felice, abounding in almost tropic vegetation. The favorite promenade is the Marina, running along the shore on the line of the old fortifications.

Notable Buildings.—Palermo is an archbishopric, and has about 300 churches and chapels. The cathedral, built in the twelfth century by an Englishman, Archbishop Walter, contains curious mediæval monuments. San Domenico is the largest church in the city, and will hold 12,000 persons; the Olivella is the most gorgeous church. The royal palace is in part the work of the Arabs, for whom it served as a fortified castle, but it was transformed by the Normans. The chapel and the Sala di Ruggiero are richly incrusted with old mosaics. Of other buildings there is the university (founded in 1447) with (1891) 65 teachers and 1,253 students, the town library with 141,000 volumes and 2,640 MSS., and the national library with 110,000 volumes and 12,000 MSS. Some of the private edifices are remarkable for their antiquity, others for their architecture. The environs of Palermo abound in objects of interest—the great


Longitude 36 East from Greenwich
MEDITERRANEAN SEA
GREAT SEA
DAMASCUS
Esh Sham
Bahr-el-Mary (L. of the Meadow)
Abila
Abilene
SIDON
Saida
TYRE Sur
Jezzin
Mount Hermon
Hivites
Maachathites
Cesarea Philippi
Paneas
Geshurites
Geshur
Acre or Akka
Accho Ptolemais
BAY of ACRE
C. Carmel
Kedesh
Capernaum
Bethsaida
Safed
Tiberias
SEA of GALILEE
Hippos
Gadara
Pella
Jabesh gilead
Ramoth-gilead
Gerasa Jerush
ZEBULON
ISSACHAR
Nazareth
Megiddo
Jezreel
Bethshean
Shunem
Endor
Samaria
SHECHEM or SYCHAR
Neapolis Nabulus
Dor
Apollonia
Turris Stratonis
Cesarea
BASHAN
TRACHONITIS
AURANITIS
BATANEA
Ashteroth
Tell Ashtereh
Edrei Adra
Bozrah Bostra
Busrah
ITUREA
MANASSEH
GAD
Mt. Alsadamus
Kelb Hauran


PALESTINE
Note, The word Jebel is the modern Arabic for Mountain; Nahr for River, Wady for a Valley or Water-course. Where a Scriptural locality is shown, the Modern name is added with a line under it. The names enclosed in a parenthesis are Classical, all others refer to modern names of places Rivers &c.
Railroads
Scale of Miles
5
10
20
30
Longitude East from Washington
EPHRAIM
BENJAMIN
DAN
JUDEA
SIMEON
REUBEN
GILEAD
IDUMEA
EDOM
MOAB
MIDIANITES
Ammonites
JERUSALEM
el Kuds
Bethlehem
Hebron or Kirjath-arba
Beersheba
Bir es Seba
Gaza
Ascalon
Ashdod Azotus
Japho or Joppa
Jaffa Yafa
Jericho
Shiloh
Lydda
Ekron
Emmaus
Heshbon
Hesban
Kadesh Barnea
Desert of Paran
Raphia
Sodom
Zoar
Rabbath Moab
Kir Moab
Bozrah
Rabbah or Rabbath ammon Philadelphia)
Amman
Mt Nebo
Pisgah
Salt Mt
Wilderness of Ziph
AMALEK
Kenites
A
B
C
D
E
F
G
H
I
112
113
9
10
11
12
13
14
32
31

cathedral of Monreale (see MONREALE); the Castello della Zisa; the Castello della Cuba; and Monte Pellegrino, in which is the grotto of Santa Rosalia, the patroness of the city.

Trade and Industry.—These are active, though not growing. There are manufactures of gloves, essences, and machinery. The number of vessels annually entering the port is about 3,500, with a tonnage of 1,200,000; exports—fruits, wines, silks, gloves, etc.—in 1890 were valued at $6,383,044, of which the U. S. took more than one-half; the imports were valued at (1890) $4,019,604. There is also a coasting trade; imports over $15,000,000, exports about $5,000,000. Pop. (1892) 273,000.

History.—Palermo is probably of Phœnician origin, and is first known in history as a Carthaginian dependency. During the Punic wars it fell into the hands of the Romans and became a great naval station. In the fifth century A. D. it was taken by the Vandals, and was ceded by them to the Goths, who were driven out by Belisarius. In 830 it was conquered by the Saracens, who made it the capital of their Sicilian dominions. In 1071 the Normans, under Count Roger, took Palermo, and it continued the capital of the Sicilian kingdom through the Norman and Swabian dynasties. Charles of Anjou removed his court to Naples (1269), since which time Palermo has never been a permanent royal residence. (For further historical details, see SICILY and SICILIAN VESPERS.) From 1820 the revolutionary failures of Naples were repeated in Palermo until the landing of Garibaldi at Marsala (1860) caused an uprising here, which put to flight 30,000 Bourbon troops, backed by a strong fleet; and by an enthusiastic *plébiscite* the city became a part of the new kingdom of Italy. Revised by R. A. ROBERTS.

Pa'les: in Roman mythology, a divinity of flocks and shepherds, corresponding in some respects to the Greek Pan. This divinity was probably of early origin, but is seldom mentioned, and played in historical times only a subordinate part in the religion of the Romans. It was conceived of sometimes as male and sometimes as female, although the rites of the festival Palilia considered Pales only as female. This festival was celebrated on Apr. 21, and was considered the birthday of Rome. In this festival Pales was invoked to grant protection and increase to flocks and herds. The name Pales is thought to be connected with Palatium. Revised by G. L. HENDRICKSON.

Pal'estine [from Lat. *Palæsti'na* = Gr. Παλαιστίνη, by analogy of πάλαι, anciently, ancient from Heb. *Pᵉlesheth*, Philistia, liter., Land of Wandering, and *Pᵉlishthīm*, Philistines, derivs. of *pelesh*, wander]: a name designating originally only the country of the Philistines, but in the later Greek and Roman period applied, as we now apply it, to the whole country of the Israelites on both sides of the Jordan. Josephus uses the name in both of these senses. The oldest name was the Land of Canaan, or sometimes simply Canaan, lowland, by which was meant, however, only the country W. of the Jordan, which is all that was promised to Abraham. Other Scripture names are Judæa, the Land of Israel, the Land of Promise, and the Holy Land. The last name has for several centuries been more current than any other.

Boundaries and Extent.—The boundaries of Palestine can not be determined exactly. Approximately, they were as follows: On the W. the Mediterranean; on the N. a line beginning near the *Promontorium Album*, S. of Tyre, in lat. 33° 10′, trending northward till, near the southern base of Hermon, it strikes lat. 33° 16′, and then runs straight on to the desert; on the E. the Arabian desert; and on the S. the parallel of lat. 31°, a little S. of Beersheba (31° 15′), curving to take in Kadesh. Within these boundaries, as recently determined, there are, on the west side of the Jordan, about 6,600 square miles, and on the east side, including ancient Moab, S. of the Arnon, more than 5,000, perhaps nearly 6,000, square miles. The length of this territory is about 150 miles; its average breadth W. of the Jordan more than 40, and E. of the Jordan about 40 miles.

Physical Features.—The country is made up of four long parallel strips of territory, lowland and highland alternating. Along the Mediterranean coast is a strip of lowland, in the northern or Phœnician section of it, about 20 miles long and from 4 to 6 broad; in the middle, Sharon section of it, S. of Carmel, more than 30 miles long and about 10 miles broad; and in its southern, Philistine section, 40 miles long and from 10 to 20 broad. This strip of lowland is interrupted by the ridge of Carmel, which branches off from the mountains of Samaria, runs northwestward for 18 miles, rises at one point to the height of 1,810 feet, and thrusts out into the sea a promontory 556 feet high. On all this coast there is not one good harbor. Next comes the highland strip, some 25 or 30 miles broad, which springs from the roots of Lebanon, swells into the hills of Galilee, is interrupted by the plain of Esdraelon, as the lowland strip is interrupted by the ridge of Carmel, swells again into the hills of Samaria, reaches its greatest average height in Judæa, and then sinks away into the desert S. of Beersheba. This broad, high central strip of West Jordanic territory has been compared to a ship's longboat turned upside down. Among its highest points in Galilee are Safed (perhaps the "city set on a hill" of Matt. v. 14), 2,749 feet above the sea, and Jebel Jermûk, near by, nearly 4,000 feet above the sea. In Samaria the highest points are Ebal, 3,077, and Gerizim, 2,849, feet above the sea. In Judæa the highest point of Jerusalem is 2,593, Mount of Olives 2,693, Hebron 3,040, and Beersheba 788, feet above the sea. The Jordan valley, at some points quite narrow and at others from 5 to 10 or 12 miles broad, is one of the wonders of the world. The Jordan itself, in going from its Hasbeiya source to the Dead Sea (115 or 120 miles), plunges down a descent of more than 2,300 feet, from 1,080 feet above to 1,292 feet below the level of the Mediterranean. The fourth parallel strip, E. of the Jordan, is (most of it) high table-land, some of it 3,000 feet above the sea, sinking away eastward into the Arabian desert. As seen from the west side of the Jordan it looks like a purple wall.

Lakes, Rivers, and Springs.—Of the four lakes of Palestine, the northernmost is Phiala, 5 miles E. of Banias, nearly round, about a mile in diameter, and of unknown depth, occupying apparently the crater of an extinct volcano. It is some 3,300 feet above the sea, is not, as was anciently supposed, one of the sources of the Jordan, has neither inlet nor outlet, and abounds in frogs and leeches. Merom (now *Huleh*), 10 miles S. of Banias, in the midst of an extensive papyrus marsh, 7 feet above the sea, is a triangular lake, with its apex pointing southward, about 5 miles long, nearly 4 miles across its base, and 15 feet deep. Ten miles farther down is Gennesaret, 12¼ miles in length, 6¾ miles in its greatest breadth (at Magdala), 165 feet deep, and 682·5 feet below the level of the Mediterranean. The Dead Sea, which is situated at a distance of some 65 miles farther S., is 40 miles long, nearly 10 miles broad, more than 1,300 feet below the level of the Mediterranean, and 1,292 feet deep. No fish live in it. Of rivers, the most important is the Jordan, which has two tributaries emptying into it from the E. (the Yarmuk and the Zerka), and two from the W. (the Jalûd and the Fârah). Many of the so-called rivers of Palestine are merely winter torrents, which run dry in summer. Of the eight permanent rivers emptying into the Mediterranean Sea, the most important are the Belus (now *Nahr Na'man*, near Acre), celebrated for the accidental discovery of the art of making glass; the Kishon, "that ancient river" (now *Nahr el-Mukatta*, river of slaughter), which drains the plain of Esdraelon; the Zerka, just N. of Cæsarea; and the Aujeh (not mentioned in Scripture), a few miles N. of Jaffa, which drains the mountains of Samaria, and is, next to the Jordan, the longest permanent river in Palestine. Three permanent streams empty into the Dead Sea from the E. These are the Zerka Ma'in (not mentioned in Scripture), near which are the four hot springs of Callirrhoë; the Arnon (now *Mojib*), the northern boundary of the Moabites and the southern boundary of the Israelites, about half-way down the sea; and the Zered (now *el-Ahsy*), at the southeast corner of the sea. The springs of Palestine constitute one of its most characteristic features. First in importance are the three sources of the Jordan. Of these, that at Hasbeiya (not mentioned in the Bible) contributes one-seventh, that at Cæsarea Philippi (now *Banias*) two-sevenths, and that at Dan (now *Tell el-Kady*) four-sevenths, of the whole volume of the river. As an indication of the very great multitude of springs in Palestine, Robinson enumerates thirty in a circuit of 8 or 10 miles around Jerusalem.

Geology.—The backbone of the country, on both sides of the Jordan, is hard Jura limestone, full of grottoes and caverns, with sandstone, basalt, and other volcanic rocks also on both sides of the river, but these last more especially on the east side. There are many signs of violent volcanic action in the past, and earthquakes are still occasionally felt, the most severe in modern times being that which occurred in 1837, which partially destroyed both Safed and Tiberias.

Climate and Rainfall.—The climate, on the whole, is mild, inclining, however, toward the extreme of heat rather than toward the extreme of cold. There are only two seasons, summer and winter—the former, from April to Novem-

ber, rainless or nearly so; the latter, from November to April, rainy; but between the middle of December and the middle of February there is generally a kind of intermission, separating "the former and the latter rain." The rainfall at Jerusalem varies from 12 to 42 inches, both extremes being exceptional; 25 inches are considered necessary to insure good crops, and if less than 18 inches fall the harvest is poor and suffering ensues. During the rainy season of 1892–93 the rainfall was 38·4 inches. The average rainfall appears to be less than 25 inches, while on the Atlantic seaboard of the U. S. it is 45, and in California, whose climate is much like that of Palestine, it is only 20. Along the Mediterranean lowlands, and still more in the Jordan valley, the heat of summer is always great, and sometimes exceedingly oppressive, but not so on the higher levels, except during sirocco weather. At Jerusalem, from June, 1851, to Jan., 1855, according to Dr. Barclay's register, the mean temperature was 66·5°, the highest temperature 92°, and the lowest, on one occasion just before sunrise, 28°. In some years the mean is 62° and the highest 86°. Observations made by Dr. Chaplin, for the eight years preceding 1872, show a mean temperature of 62·8°. In May, and also in September, the temperature sometimes rises to 100°; on June 24, 1869, it reached 103·5°, and on Aug. 28 and 30, 1881, it remained for some hours at 112°. Mt. Hermon, nearly 10,000 feet high, and looking down upon the whole of Palestine, is never entirely clear of snow, though late in autumn only slender threads of it are left, as the Arabs say, "like the straggling silver locks on an old man's head." During the winter ice seldom forms, and the ground is seldom, if ever, frozen in any part of the country. With abundant rains, which may generally be counted upon, Palestine was once very fertile, and might be so again; but in order to this, trees must be planted, cisterns built and kept in repair, and the hills terraced, as of old. The products of the soil still range from peas, beans, wheat, and barley to grapes, figs, olives, apricots, lemons, oranges, and dates.

Botany.—The botany of Palestine, unlike that of Egypt, is richly varied. Upward of 3,000 species have been reported, chiefly by the labors and observations of Dr. George E. Post, of Beyrout. For mile on mile, in the proper season, the ground is fairly covered with flowers of all the colors of the rainbow. Everywhere one sees the scarlet anemone, which is thought by some to be our Lord's "lily of the field." The ranunculus and the pheasant's eye (*Adonis palestina*) are also very brilliant. The narcissus, the crocus, and the mallow are all candidates for the honor of being considered "the rose of Sharon." Of shrubs, the most abundant and most beautiful is the oleander. The whole country was once well timbered, and still there are groves, and even forests, of pine and oak beyond the Jordan. On the west side of the river, from Beersheba all the way up to Lebanon, there are very few trees, except on Tabor and Carmel. Since the time of the crusades the pine forest then standing between Jerusalem and Bethlehem has wholly disappeared. Repeated wars and conquests, and dreary centuries of bad government, have gradually reduced the country to its present naked, burnt, and desolate appearance. The tree now most common is the oak, of which Dr. Post enumerates eight different species, the most abundant being the prickly evergreen oak (*Quercus pseudo-coccifera*). The "oaks of Mamre" were not oaks, but terebinths, the most famous specimen of which is the so-called Abraham's Oak, near Hebron, 23 feet in circumference.

Animals and Birds.—The wild animals of the country are much the same as in ancient times, except that the lion has disappeared and the leopard is practically extinct. There are wolves, jackals, hyænas, wild boars, gazelles, the ibex or wild goat of the Bible, the lynx, otters, badgers, the coney, hares, ichneumons, hedgehogs, wild cats, chetahs. Bears are occasionally seen on Mt. Hermon. Of domesticated animals, the horse is less used than the ass, the mule, and the camel. The buffalo, introduced probably by the Persians, has in some sections taken the place of the ox, and the neat cattle of the country in general are neither so numerous nor so well cared for as in ancient times. Sheep and goats are abundant, but swine are scarcely ever seen. The dogs are nearly all of one breed (the shepherd), and are outcasts and scavengers, making night hideous, as the jackals do, by their howling. Of the 360 species of birds which have been observed may be mentioned, as most common, eagles, vultures, hawks, owls, storks, pelicans, ravens, doves, pigeons, partridges, quails, sparrows, and nightingales. Fish still abound, as of old, in the Lake of Galilee, but the natives employ rude methods in taking them: forty-three species of freshwater fishes have been recorded from Palestine, and of this number thirty belong exclusively to the Jordan system and its lakes. The "great fish" of Jonah i. 17, which swallowed the truant prophet, was not a "whale," as the κῆτος of Matt. xii. 40 is unwarrantably rendered in our version, but may have been a specimen of the great white shark (*Canis carcharias*), still found in the Mediterranean, and sometimes 25 or 30 feet long. There are many species of reptiles, upward of thirty species of snakes, and upward of forty species of lizards having been found. The crocodile still occurs occasionally in the marshes of the Zerka. Frogs (three species) are abundant, and two species of toads are known.

History.—The original, prehistoric occupants of Palestine appear to have been a Semitic population, including the Rephaim, Zuzim, Emim, and Horim, E. of the Jordan, and the Anakim and Avim, W. of the river; but the immediate predecessors of the Hebrews were descended from Canaan, the fourth son of Ham. The date of their migration can not be determined. In the original grant to Abraham (Gen. xv. 19–21) ten tribes are named, two of which (the Kenites and the Kenizzites) were probably S. of Palestine, toward Egypt, one of them (the Kadmonites) on the east side of the Jordan, and the remaining seven (the Hittites, Girgashites, Amorites, Canaanites, Perizzites, Hivites, and Jebusites) on the west side. In the time of Moses and Joshua the Ammon-Moab people were on the east side of the river, but had been crowded far south by the Amorites, who held the whole territory from Mt. Hermon to the Arnon. Reuben, Gad, and Half-Manasseh took this territory E. of the Jordan. The remaining nine and a half tribes crossed over and occupied the west side. The Hebrew commonwealth reached the summit of its prosperity and power under David and Solomon. Visible decay began (about 975 B. C.) with the secession of the ten tribes. Assyria crushed the northern kingdom of Israel about 720 B. C., and Babylon crushed the southern kingdom of Judah about 587 B. C. Since then Palestine has been under foreign domination, with hardly more than the shadow of independence at any time. Persians, Greeks, and Romans succeeded one another in the mastery. In the time of Christ, under the Romans, there were four provinces—Galilee, Samaria, and Judæa, on the west side of the river, and Peræa on the east side. Since 637, when Palestine was conquered by the Saracens, it has, with little interruption, been under Mohammedan power. The Seljukian Turks seized the country in 1073, and by their barbarous treatment of Christian pilgrims provoked the crusades. The Latin kingdom, with its nine successive sovereigns, established in 1099, held Jerusalem till 1187, and stayed in Acre till 1291. In 1517 the Ottomans came in, and made the country a part of the Turkish empire. It was snatched from the sultan by Mohammed Ali in 1832, but Europe intervened, and in 1841 it was given back again.

Population.—As no census is ever taken, the population of Palestine can not be exactly determined, but is supposed to be well on toward 400,000, which is less than a tenth of what it probably was in the time of Solomon. Of this number the Jews form a considerable portion, the most recent and reliable estimates placing them at 43,000. In round numbers 27,000 of these are in Jerusalem, 1,200 in Hebron, 6,000 in Safed, 3,000 in Tiberias, the rest being divided between Jaffa, Ramleh, Acre, Haifa, Nablus, and a few colonies. Attempts to colonize Palestine with Jews have not been very successful. The little remnant of the Samaritans at Nablus numbers only about 150. The bulk of the inhabitants are a mixed race, descendants of the ancient Syrians and their Arab conquerors.

Pilgrimages and Explorations.—Pilgrimages to the Holy Land began with Helena, the mother of Constantine, in 326, and have continued ever since. What was then known of the country may be found in the *Onomasticon* of Eusebius and Jerome. During the Middle Ages the principal topographers of Palestine were ignorant, superstitious, and careless monks, whose identifications of sacred places were largely of the legendary and childish sort. It is only within a comparatively recent period that the true critical method has been pursued. Seetzen was there from 1805 to 1807; Burckhardt in 1810; Irby and Mangles in 1817–18; but no one man has ever done so much for the geography of the Holy Land as Dr. Edward Robinson. He was the first to adopt and adhere persistently to the rule of looking for ancient Hebrew names under the disguise of modern Arabic names. Next in rank with respect to the amount and quality of service rendered is Dr. William M. Thomson, of Beyrout,

a native of the U. S., for more than forty years a missionary in Syria and the Holy Land, whose book appeared in 1858. In 1848 the lower Jordan and the Dead Sea were for the first time thoroughly explored and surveyed by Lieut. Lynch, of the U. S. navy. In 1859 Johann Gottfried Wetzstein, Prussian consul at Damascus, explored the northern section of the country E. of the Jordan. In 1866 the marsh and lake of Huleh and the upper Jordan were explored by John MacGregor, of Scotland, and in the same year the Lake of Galilee was accurately surveyed by Capt. Wilson, of the Royal Engineers. This last piece of work was done under the direction of the Palestine Exploration Fund, a society organized in 1865 for the purpose of making an exhaustive exploration and an exact survey of the Holy Land. From 1867 to 1870 Capt. Warren, under the direction of the same society, was making excavations in and around Jerusalem. In 1870 the American Palestine Exploration Society was organized to work on the east side of the Jordan. In the autumn of 1871 the triangulation of Western Palestine was begun by Capt. Stewart, whose health soon broke down, and was completed in 1877 by Lieut. Conder and Lieut. Kitchener. Of 622 biblical sites in Western Palestine they claim to have identified 172 out of the total of 434 which are now considered to have been identified with tolerable certainty. Their large map in twenty-six sheets, on the scale of an inch to the mile, was published in 1880. Seven quarto volumes accompany it—three of memoirs, one of name-lists, one of special papers, one on the Jerusalem work, and one on the flora and fauna of Palestine. The reduced map (on the scale of three-eighths of an inch to a mile) is in four forms—the Old Testament ancient, the New Testament ancient, the modern, and the water-basins. In 1873 the American society sent out its first expedition, under command of Lieut. Edgar Z. Steever, of the U. S. army, detailed for that service by the Secretary of War. A base-line was measured in the desert E. of the Jordan, over against Jericho; the work was carried on through the hottest months of the summer and more than 500 sq. miles were triangulated. Prof. John A. Paine, archæologist and botanist of the expedition, discovered several new species of plants, and examined with great care Mt. Nebo and the adjacent region. In 1875 a second expedition was sent out under command of Col. James C. Lane, who remained in the country but a short time, and the work was put in charge of the archæologist, Dr. Selah Merrill, who made several important expeditions to every part of that interesting country. A reconnoissance survey of the whole Trans-Jordanic region was made (the survey work being done chiefly by Rudolph Meyer), important sites, such as Ramoth-Gilead, Succoth, and others, were identified, and in all about 230 names appeared for the first time in Meyer's map (not published). Dr. Merrill reckons about 240 biblical names E. of the Jordan, besides fourteen mentioned in the Maccabees. Nearly 100 of these he thinks have been identified. At this point the work of triangulation was surrendered to the English society, which entered the field in 1881, surveyed about 500 sq. miles, and was then compelled by the disturbed condition of the country to withdraw. The American society published four *Statements* (1871, 1873, 1875, 1877), and holds in reserve Dr. Merrill's *Notes* upon the Meyer map. Dr. Merrill's finding of a section of the "second wall" outside of which our Lord was crucified was one of the most important discoveries of recent years. This was in 1885. Other discoveries are the finding of the church built by Eudocia (A. D. 460) on the site of the Martyrdom of St. Stephen, and near it the tomb in which she was buried; the finding in the year 1891 of the "monument of Herod," mentioned by Josephus (*Wars*, v., 12, 2); and the unearthing by F. J. Bliss in the ruins of Lachish of a cuneiform tablet belonging to 1400 B. C., when prehistoric Palestine was subject to Egypt.

The event, however, which has attracted most attention was the completion of the Jaffa and Jerusalem railway, the first to be opened in either Palestine or Syria. After two years' labor by a French company the railway was opened for traffic on Sept. 26, 1892, and since then trains have run regularly between these two ancient cities. The road is 54 miles long, and cost not far from $2,000,000.

LITERATURE.—The literature of the subject is of immense extent. Tobler, in his *Bibliotheca Geographica Palestinæ* (1867), enumerates more than 1,000 writers on this one topic. To mention only a few of the most important: The *Onomasticon* of Eusebius (c. 330), translated into Latin, with additions, by Jerome (388), edited by Larsow and Parthey (Berlin, 1862); *Descriptiones Terræ Sanctæ*, by writers of the eighth, ninth, twelfth, and fifteenth centuries, edited by Tobler (Leipzig, 1874); *Early Travels in Palestine*, edited by Wright (London, 1848); the *Historica Theologica, et Moralis Terræ Sanctæ Elucidatio* of Quaresmius (Antwerp, 1639), valuable for the traditions; Maundrell's *Journey from Aleppo to Jerusalem at Easter, 1697* (Oxford, 1703); Reland's *Palestina Illustrata* (Utrecht, 1714), a classic; Hasselquist's *Voyages and Travels in the Levant in the Years 1749, '50, '51, '52*, edited by Linnæus (London, 1766), valuable for the natural history; Burckhardt's *Travels in Syria and the Holy Land* (London, 1822); *Travels in Egypt and Nubia, Syria and Asia Minor, during the Years 1817 and 1818*, by Irby and Mangles, printed but not published (London, 1822); Robinson's *Biblical Researches* (3 vols., Boston, London, and Berlin, 1841); *Later Researches* (1856) and *Physical Geography of the Holy Land* (published posthumously, 1865); Williams's *Holy City* (1845; 2d ed. 1849), defending the traditional sites; Lynch's *Expedition to the Dead Sea and the Jordan* (1849); Stanley's *Sinai and Palestine* (1857), highly graphic; Barclay's *City of the Great King* (1858), valuable for the meteorology; Thomson's *The Land and the Book* (1859; 2d ed. 3 vols., 1880–85); Tobler's *Bethlehem* (1849), *Jerusalem* (1854), and *Nazareth* (1868); MacGregor's *The Rob Roy on the Jordan* (1870); Tristram's *Land of Israel* (1865; new ed. 1876), *Natural History of the Bible* (1867), and *Land of Moab* (1873); Nutt's *Samaritan Targum and History* (1874); Ritter's *Geography of Palestine*, translated by Gage (4 vols., 1866); Porter's *Damascus* (1855), *Giant Cities of Bashan* (1865), *Handbook of Syria and Palestine* (revised ed. 1875); the new edition of the *Handbook for Syria and Palestine* (1892), by Haskett Smith, is very unsatisfactory and faulty in many respects; Palmer's *The Desert of the Exodus* (1872); Conder's *Tent Work in Palestine* (1878); Merrill's *East of the Jordan* (1881; new ed. 1883) and *Galilee in the Time of Christ* (1881); Dawson, *Egypt and Syria* (1885) and *Modern Science in Bible Lands* (1888); also see the many publications of the Palestine Fund. The German Palestine Society has published a journal since 1878. The best maps are those of van de Velde (1866), of Kiepert (1875), and of the English Exploration Fund (1880–83). The best atlases are those of Menke (1868) and of Clark (1868). For further information see special articles, such as ESDRAELON, HAMATH, JERUSALEM, JEWS, and JORDAN.

Revised by SELAH MERRILL.

Palestine: city; capital of Anderson co., Tex. (for location, see map of Texas, ref. 3–J); on the International and Great Northern Railroad; 10 miles E. of Trinity river. It is in an agricultural, fruit-growing, iron ore, and timber region; contains the headquarters of the railway company, 3 banks, and a semi-weekly and 2 weekly newspapers; and has water and electric-light systems, and numerous manufactories. Pop. (1880) 2,997; (1890) 5,838; (1900) 8,297.

EDITOR OF "SEMI-WEEKLY TIMES."

Palestrina, pă̆a-les-tree'nă̆a (anc. *Præneste*): town; in the province of Rome, Italy; situated on a spur of the Apennines, about 1,600 feet above the sea; 18 miles N. E. of Albano, 22 miles E. S. E. of Rome (see map of Italy, ref. 6–E). It covers only a portion of old Præneste, whose strong citadel crowned the height now occupied by the mediæval castle San Pietro. The Church of Santa Rosalia is richly adorned with marbles and alabaster. The Palazzo Barberini, occupying a part of the site of the vast old Temple of Fortune, was erected in the fifteenth century, and with the garden contains many statues, bas-reliefs, mosaics, and inscriptions, etc., from the ancient city. Præneste was a member of the Latin League until in 499 B. C. it joined Rome; it took part, however, in the Latin war against Rome. In 82 B. C. Sulla inflicted upon it the most cruel punishment for harboring the younger Marius, by putting to death more than 12,000 of its citizens; but the town recovered itself, and under the emperors it was a favorite resort of the Roman aristocracy. On the fall of the Western empire it became a part of the papal dominions; but the Colonna family afterward claimed it as their fief, and held it for more than two centuries. In 1297 Boniface VIII. utterly destroyed the town, with the exception of the cathedral. From this time the Colonna never ceased to struggle with the popes for its possession until 1630, when it passed by sale to the Barberini. The modern town is in itself of no interest except as the seat of one of the six suburban bishopries. Pop. 5,855.

Palestrina, GIOVANNI PIER LUIGI, da: composer; b. in Italy about 1528; went to Rome about 1540 to study music

with Goudimel, a Flemish composer, then celebrated. Palestrina published his first works (five masses dedicated to Pope Julius III.) in 1554. This led to his appointment to the pontifical chapel, and for a number of years he filled the part of chapelmaster or conductor at the Lateran and also at Santa Maria Maggiore. The church music of that day had become degraded to an extent difficult for us now to understand. Secular and profane melodies, often of an utterly ribald nature, had been introduced into the service of the Mass, the actual improper text being frequently and unblushingly sung by many of the singers, excepting a relatively small number standing in front who sung the sacred text. So scandalous became this condition of things that the Council of Trent passed a unanimous resolution in favor of reform, which resolution nearly amounted to a decree silencing all music in the churches. In this juncture Pius IV. appointed a commission of eight cardinals (1563) to carry out the wishes of the council. This led to Palestrina's being engaged to write a mass which should serve as a model of what religious music should be, both from the standpoint of the council's strictures and also illustrating the best science of the day. Instead of one he wrote three, the first two winning ample praise, the third creating unbounded enthusiasm. The delighted pope (Pius IV.) declared—"some such music it must have been that St. John heard sung by the heavenly hosts in the vision of the New Jerusalem." From this time Palestrina's position was fixed and his name renowned. During the remaining years of his life both the quality and quantity of his works continued remarkable. D. in Rome, Feb. 2, 1594. His published compositions consist of thirteen books of masses, six books of motets, one book of lamentations, one of hymns, one of litanies, one of sacred madrigals, three of secular madrigals, and a *Stabat Mater*. In Palestrina the ancient musical system found its highest development, thus leading the world up to the logical necessity of a new revelation—viz., a new doctrine of tonality and the birth of harmony in our modern sense. D. B.

Paley, Frederick Apthorp: grandson of William Paley; classical scholar; b. at Easingwold, near York, England, in 1816; graduated at Cambridge 1838; became a Roman Catholic in 1840; Professor of Classical Literature at Kensington 1874. D. at Bournemouth, Dec. 11, 1888. Edited Æschylus, Euripides, Hesiod, Homer, and other classic authors; translated Æschylus (1864) and Pindar (1875) into English. Author of a *Manual of Gothic Mouldings* (1845) and a *Manual of Gothic Architecture* (1846).

Revised by A. Gudeman.

Paley, William, D. D.: theologian; b. at Peterborough, England, in July, 1743; graduated at Christ's College, Cambridge (1763), where he became fellow (1766), a tutor and lecturer upon moral philosophy and divinity (1768); took orders in the Church of England; rector of Musgrove 1775; vicar of Dalston 1776; prebendary of Carlisle 1780; archdeacon of Carlisle 1782; and chancellor 1785; prebendary of St. Paul's, London, 1793; sub-dean of Lincoln and rector of Bishop Wearmouth 1795. Published *Principles of Moral and Political Philosophy* (London, 1785); *Horæ Paulinæ* (1790); *View of the Evidence of Christianity* (1794); and *Natural Theology* (1802). These works have been repeatedly edited and republished, but are now superseded. Their merit was their simple style and lucid illustrations; their defects, their lack of spirituality and their utilitarian morals. D. at Bishop Wearmouth, May 25, 1805. See his *Life*, by W. Meadley, 1809, and in his complete works 1819; n. e. 1834; principal works 1877. Revised by S. M. Jackson.

Palfrey, John Gorham, D. D., LL. D.: author; b. in Boston, Mass., May 2, 1796; was educated at Phillips Exeter Academy and Harvard College 1815; studied theology; succeeded Edward Everett as minister of Brattle Square church in Boston 1818; succeeded Andrews Norton as Professor of Sacred Literature in the Cambridge Divinity School 1831; retired in 1839. From 1842–43 he was member of the House of Representatives, and 1844–47 was secretary of State in Massachusetts. In 1847 he represented the anti-slavery Whigs in Congress; was a leading Republican, one of the creators of the Republican party, a prominent writer and speaker on the anti-slavery side, an able ally of Sumner and Adams; lost his seat in Congress after a fiercely contested struggle against the "compromise" Whigs; ran for Governor of Massachusetts, but was defeated, in 1851; was postmaster of Boston 1861–67, and then retired from public life and devoted himself to literature. Dr. Palfrey was a diligent author. His books are *Evidences of Christianity* (Boston, 2 vols., 1843); *Jewish Scriptures and Antiquities* (4 vols., 1838–52); *History of New England* (Boston, 4 vols., 1858–75); *The Slave Power* (1 vol., 1847), etc. He was editor of *The North American Review* from 1835 to 1842, and in 1851 was one of the editors of *The Commonwealth Newspaper*. D. in Cambridge, Mass., Apr. 26, 1881.

Revised by S. M. Jackson.

Palgrave, William Gifford: traveler and author; son of Sir Francis Palgrave; b. at Westminster, England, Jan. 24, 1826. He graduated with honors at Oxford 1846; was an officer of the native infantry in Bombay 1847–53; subsequently studied theology at the Jesuit Seminary at Laval, France; entered the Roman Catholic priesthood, and was employed as a missionary in Southern India, Palestine, and Syria. In 1862, commissioned by Napoleon III., he made a daring journey through the Wahabite kingdoms of Central Arabia, disguised as a physician. His intimate acquaintance with the Arabic language and customs enabled him to carry out this exploration in safety. In 1864 he severed his connection with the Jesuit order, and in 1865 he was sent to Abyssinia by the British Government to negotiate with King Theodore for the release of English prisoners. Thereafter he held various British consular positions, and from 1884 was minister to Uruguay. His publications include *Central and Eastern Arabia* (2 vols., 1865); *Essays on Eastern Questions* (1872); *Dutch Guiana* (1876); and *Alkamah's Cave, a Story of Nejd* (1875). D. at Montevideo, Uruguay, Oct. 1, 1888. Herbert H. Smith.

Palikao, păă'lĕĕ'kăă'ō, Cousin-Montauban, Count de: soldier and statesman; b. in Paris, France, June 24, 1796; served in Spain, and for twenty years in Africa; rose to be general 1851. In the expedition to China (1860) he commanded the French troops, gaining the victory of Pa-li-k'iao (or Eight-mile Bridge), carried the forts of Taku, and marching to Peking enforced the conditions of peace submitted by the allied powers. He received for these services the cross of the Legion of Honor; was raised to the rank of senator with the title of count. In Aug., 1870, he succeeded M. Ollivier as premier of the French ministry, and acted as Minister of War. He published in 1871 an account of the events of his ministry. D. in Paris, Jan. 8, 1878.

Pāli (paa'lĕĕ) **Language**: the language in which the Buddhist scriptures are written. The word Pāli means text, as distinguished from commentary, and is used by Buddhists as the current name for Māgadhī, the dialect of Magadha, in which they think their sacred books are written. Magadha was the name of the district round Patna on the Ganges at the time when those scriptures were composed—from about 500–250 B. C. Some modern scholars think that the Buddhists are mistaken in identifying Pāli with Māgadhī. Ernst Kuhn would rather identify it with the dialect of Ujjen (*Beiträge zur Pali Grammatik*, p. 7), and Eduard Müller (*Pali Grammar*, p. iii.) with that of Kalinga. Whichever view should turn out to be correct, Pāli is one of the Prākrit dialects into which the old spoken Sanskrit, the Sanskrit of the Vedas, was gradually broken down during the centuries from 1000–600 B. C. while the Sanskrit-speaking Aryan tribes were gradually forcing their way from the Punjaub down into the Ganges valley. It is the only one of those spoken dialects of which we have full and such early records, and it bears about the same relation to Vedic Sanskrit that Italian does to Latin.

We have records of other Prākrit dialects from about the sixth century A. D., and the Jaina Prākrit, in which the sacred books of the Jains were composed still later, is closely allied to it; but the inscriptions of Asoka, the celebrated King of Magadha, in the middle of the third century B. C., come the nearest to Pāli of all the existing linguistic documents of ancient India.

Down to the fifth century A. D. the texts were handed down in Ceylon in Pāli, and the commentaries in Sinhalese, the local dialect of Ceylon. During that century the commentaries also were translated into Pāli, and now exist only in that language. The Pāli of these early commentators differs from that of the texts in the same way as the Latin of Augustine differs from the Latin of Vergil and Cicero.

From the twelfth century A. D. onward there have been a number of works composed from time to time in Ceylon, Burma, and Siam in a Pāli which differs from the two previous stages in much the same way as the Latin of the mediæval theologians and chroniclers differs from the Latin of Augustine and of Cicero. In this third and last stage of

Pāli a large number of words are introduced which are merely retranslations of Sanskrit, Burmese, Siamese, or Sinhalese expressions; and the idiomatic phraseology of the sentences is not seldom a reproduction of the idiom in which the author was accustomed to speak in everyday life.

Of these three stages the pure Pāli, or language of the texts, though considerably older in time than the majority of the books written in so-called classical Sanskrit, is considerably younger in form. The changes shown in it as compared with Sanskrit are allied to the changes which have produced the modern languages of Western Europe out of Latin, and may be summarized as follows:

1. Every word has to end either in a vowel or in a vowel followed by a nasalization (pronounced probably like the English *ng* in *sing*).

2. The groups of consonants which are so characteristic of Sanskrit are softened down by assimilation, elision, or crasis, or are avoided by the insertion of vowels.

3. The vowels *ri*, *rī*, *li*, and *lī* have completely disappeared, the diphthongs *ai* and *au* are replaced by the vowels *e* and *o*; and the three different sorts of *s*'s are all represented by the simple dental *s*.

4. The rules of Sandhi—that is, of the union of adjacent words—are much simplified, so that the words retain very much of their previous form, and Sandhi becomes in Pāli very little more than a set of rules for the elision of vowels in a simple, natural way.

5. The rules for the declension of nouns and the conjugation of verbs are much simplified, not only by the action of the foregoing principles, but also by the loss of the dual number, and by other and similar alterations.

In consequence of these new guiding factors Pāli, like Italian, has become a language at once flowing, melodious, and sonorous; and an examination of its grammar and vocabulary reveals all the distinctive characteristics of a vigorous, spoken, and growing vernacular, as distinguished from the formal hardness of a dead language. There are, as in Sanskrit, a few imported words, such as *chāṭī* and *chumbaṭa*, adopted from Dravidian or other native sources. With these few exceptions the whole of the word-forms in Pāli are derived directly, like the classical Sanskrit, from the older Sanskrit as spoken by the Aryan conquerors of India, before it became a dead language. In about a score of instances Pāli has preserved word-forms peculiar to the ancient Vedic and lost in the classical Sanskrit, and it has preserved the Vedic palatal *l*. In a few cases it has even distinct traces of the still older language of which Sanskrit and all other Aryan languages are the common children. A few instances will make its relation to Sanskrit more clear.

In giving these instances it should be borne in mind that the Pāli books are preserved, in the three countries where it is still studied and used, in the local alphabets—all of them, like the various alphabets in which Sanskrit is written, being derived from the old Pāli alphabet of the inscriptions, now fallen out of use. In transliterating Pāli words into English the vowels have the sound of Italian vowels; double consonants (as in Italian) are pronounced double; and the consonants have their English sounds. The *g* is always hard, as in *gate*, the *ñ* is pronounced as *ny*, and *ṃ* is *ng*, as in *sing*.

About two-fifths of the words in Pāli are identical with their Sanskrit equivalents, these latter being so little complicated in structure that they conform to the principles of Pāli simplicity. Such words as *nāga*, snake, elephant; *gochara*, realm; *āha*, he said; and *ayaṃ*, this, are examples of this sort of word.

There is another class, comprising two-fifths of the Pāli language, in which the change is so slight as to be easily recognizable. Thus *mukta*, free, becomes *mutta*; *kleśa*, sin, becomes *kilesa*; *sthāna*, place, becomes *ṭhāna*; *ambā*, mother, becomes *ammā*; *agni*, fire, becomes *aggi*; *aupamya*, metaphor, becomes *opamma*.

The third class, which looms largest in the works on Pāli philology, but is really very small in comparison with the other two, contains those words in which the change is not so evident—*milakkha*, foreigner, for *mleccha*, in Sanskrit; *upacikā*, ant, for *upādikā*; *dosina*, clear, for *jyautsna*; *samparanka*, friend, for *sampariyanka*; *gaddūhana*, small space, for *dadrūghna*; *vutta*, sown, for *upta*; *jantaggha*, for *yantragṛiha*, bathroom. Some words, certainly identical, are still more unlike in appearance even than these, and the reasons which have brought about changes so considerable are not as yet fully worked out. This unsolved department of Pāli, or rather of Indian linguistics (for it deals with the whole history of speech in India), is full of interest to the trained philologist.

Bibliography.—Childer's *Dictionary of the Pāli Language* (London, 1875; out of print); Eduard Müller, *Pāli Grammar* (London, 1884); Ernst Kuhn, *Beiträge zur Pali Grammatik* (Berlin, 1875); Vincent Fausböll, *Sutta Nipāta*, vol. ii. (Pāli Text Society, 1893, a root dictionary to the work so called); Richard Morris, *Notes and Queries on Pali Philology* (in the *Journals* of the Pāli Text Society, 1884–93); Émile Senart, *Kaccāyana's Pali Grammar* (Pāli text with translation and notes, Paris, 1871); V. Trenckner, *Pāli Miscellany* (London, 1879). T. W. Rhys Davids.

Pāli Literature: a literature consisting of the Buddhist sacred texts, and of other works by Buddhist authors—histories, poems, legends, commentaries, books on ethics, and controversial volumes on the rules of the Buddhist order. Its extent is constantly being increased, for the Pāli language has become the *lingua franca* of the Buddhists in Ceylon, Burma, and Siam, and is still used by authors who wish to be read not only in their native land, but by the Buddhists in all these countries.

The Pāli books containing the sacred texts are divided into three collections called the *Piṭakas* or Baskets—that is to say, the vessels in which the truth is handed on from teacher to scholar. The most important of these for the right understanding of the ethical and philosophical standpoint of Gotama himself and of the early Buddhists is a collection of dialogues in which usually the Buddha himself, but occasionally also one of his principal disciples, is represented as setting forth to an outsider or a disciple some fundamental point of his theory of life. These dialogues are arranged in two books containing respectively the longer and the shorter dialogues (called in Pāli the *Dīgha* and the *Majjhima Nikāyas*). They occupy in the history of Indian thought a position equivalent to that occupied in the history of Greek thought by the *Dialogues* of Plato. As compared with these, while by no means without a peculiar eloquence of their own, they are deficient in the graces of style; but the thought is more original, especially as being free from the ancient soul-theory. They are also much more systematized and worked out, and less charged with logomachies. The two collections were evidently put together at the same time—probably in the fifth century B. C.—and by the same hands; they form, in reality, but one book.

Next in historical importance to these *Dialogues of the Buddha* are the rules of the Buddhist order of mendicants. The whole of this body of canon law (in Pāli the *Vinaya*) was edited in Pāli, by Prof. Oldenberg, of Kiel, in 1879–83 (5 vols.), and an English translation by him and by the present writer of the most important parts of it has appeared under the title of *Vinaya Texts* in three volumes of the Sacred Books of the East (Oxford, 1881–85).

In the *Dialogues* the essential points of what we call Buddhism are all discussed; but each single dialogue deals for the most part with some particular point only, and allied points occur, perhaps, in other dialogues widely separated in the collection. The student has often to piece these various dialogues together before he can arrive at a full understanding of a particular question. This task was already done in a rather loose way by the early Buddhists. They brought together in one collection, called the *Samyutta Nikāya*, the various utterances ascribed to the Buddha, grouped according to particular subjects or particular persons addressed. Then again it is a distinctive characteristic of the Buddhist mode of thought that they arranged their ideas in groups consisting of one, two, three, four, and so on up to twenty or thirty detailed particulars. There is a collection, made by the early Buddhists and included in the Pitakas (called the *Anguttara Nikāya*), which takes each of these groups in order—Book I. dealing with the ones, Book II. with the pairs, Book III. with the triplets, and so on. Whether these two great collections add anything to the materials contained in the *Dialogues* of Gotama, or whether (as is at present generally supposed) they are only a rearrangement of the same matter, they are of the utmost value to the student.

A fifth collection (the *Khuddaka Nikāya*) consists of a number of shorter books of various dates and of various contents. They are: 1. The *Khuddaka Pāṭha*, selected short poems of great beauty. 2. The *Dhamma-pada*, a selection of 423 verses, most of them extracted from the earlier books of the Pitakas. 3. The *Udāna*, eighty short lyrics pur-

porting to be uttered by Gotama under circumstances of strong emotion which are explained in short prose introductions. Many of them are of great beauty and subtlety. 4. The *Iti Vuttaka*, 110 short lyrics of a similar character. A good many of the lyrics in both these tracts have been already traced elsewhere in the Pitakas. 5. The *Sutta Nipāta*, a very valuable collection of some of the most ancient lyrics produced by the early Buddhists. 6 and 7. *Vimāna* and *Peta Vatthu*, short poems on celestial mansions and on disembodied spirits. 8 and 9. The *Thera* and *Therī Gāthā*, poems by the members of the order, men and women respectively. Many of the verses in both collections are to be found in other parts of the Pitakas. 10. The *Jātaka* stories, the most ancient, the most complete, and the most valuable collection of folk-lore extant; edited by Prof. Fausböll, of Copenhagen (first 5 vols., London, 1877–91). A translation was undertaken by the writer (1st vol., *Buddhist Birth Stories*, London, 1881), but is being continued by a syndicate of English scholars under the editorship of Prof. Cowell (1st vol., by Robert Chalmers, Cambridge, 1894). 11. *Niddesa*, a work ascribed to Sāriputta, one of the personal disciples of Gotama, and containing accounts of the principal leaders, whether men or women, in the Buddhist reformation. 12. *Patisambhidā*, a longish treatise on the various mental powers resulting from the Buddhist system of self-culture. 13. The *Apadāna*, stories about Buddhist saints. 14. *Buddha Vansa*, short lines in verse, altogether 1,068 stanzas, of the twenty-five Buddhas. 15. The *Cariyā Piṭaka*, short poetical versions of 334 of the Jātaka stories.

All of the above fifteen books deal in one way or another with the life of ethical and intellectual self-culture which was the *summum bonum* of the early Buddhists. This was necessarily based on a view of psychology, one of the most interesting contributions of the Buddhists to human thought, which is constantly referred to and frequently discussed in scattered passages of these books. These passages have been collected and systematized in a series of works which form the third and last of the three great divisions of the *Pitakas*—the division called *Abhidhamma*. This word has been usually rendered by the misleading translation "metaphysics," but, as the soul theory of life is ignored by the Buddhists, they had of course nothing corresponding to what we understand by metaphysics. Looking at the contents of the *Abhidhamma*, the best translation of the word is psychology. There are seven books dealing with this subject, which is as full of difficulty and obscurity as of interest and value. These are as follows:

1. The *Dhamma Saṅgaṇi* (Concatenation of Qualities), which treats of the way in which a particular state of mind involves or connotes the coexistence of other states. It consists for the most part of long lists with constant repetition, and it is difficult to find the clue which binds these lists together. It presupposes in the reader (or rather in the user, for it was never intended to be read) a knowledge of the general system of Buddhist psychology—very little understood at present in the West. 2. *Vibhaṅga*, of which the contents are unknown. 3. The *Kathā Vatthu*, a discussion, by an author of the time of Asoka, of 219 points then at issue between different schools of Buddhists. The writer has published a full analysis of this treatise, so very valuable for historical purposes, in the *Journal* of the Royal Asiatic Society for 1892. 4. The *Puggala Paññatti*, a short tract on different sorts of individuals from the ethical point of view. 5. The *Dhātu Kathā*, a shorter work than, but similar in character to, the *Dhamma Saṅgaṇi*. 6 and 7. *Yamaka* and *Paṭṭhānn*, The Pairs and The Book of Origins, of which the contents are unknown.

Most of the above works have been edited for the Pāli Text Society of London, and some translations have appeared either for that society or in the Sacred Books of the East. Of works outside the Pitakas, the society has published a Pāli treatise called the *Gandha Vansa* (Account of the Books), giving a very short account of all the Pāli books written down to the fifteenth century. Of these there are accessible to Western students at present only the *Mahā Vansa*, a history of Ceylon; the *Dīpa Vansa*, another history of Ceylon; the *Milinda*, published by Dr. Trenckner (London, 1880); and a number of smaller works, mostly poetry, issued from time to time in the *Journal* of the Pāli Text Society. The *Milinda*, in many respects one of the most interesting of Eastern works known to the West, is a series of controversial conversations between Menander, the Greek King of Baktria, and Nāga sena, a member of the Buddhist order. It has been translated in full, with introductions, by the present writer for the Sacred Books of the East (Oxford, 1890 and 1894). Mention should also be made here of the very complete analysis, published in the Pali Text Society's *Journal* for 1893, of the *Visuddhi Magga* (Path of Purity), a systematic handbook of Buddhism drawn up by the distinguished scholar Buddhaghosa in the fifth century A. D. See PĀLI LANGUAGE. T. W. RHYS DAVIDS.

Pal'impsest [from Lat. *palimpses'tum* = Gr. παλίμψηστον, liter., neutr. of παλίμψηστος, scraped or rubbed out again; πάλιν, again + ψάειν, ψῆν, rub, rub away]: a term used either absolutely, or as an adjective with the word manuscript, to indicate an ancient writing of which the original ink has been washed or scraped away to enable a scribe to use the material again. Both the Greeks and the Latins were familiar with the process. Thus the phrases ὥσπερ παλίμψηστα and ὥσπερ βιβλίον παλίμψηστον occur in Plutarch, and both Catullus and Cicero speak of *palimpsesta*. Ulpian calls this second-hand writing material *charta deleticia*. It was probably used for little else than memoranda and rough drafts, and it is likely that only writings of an ephemeral and trivial nature were allowed to pass under the scraping-knife of the vellum-seller; but, with the decline of the commerce of the Mediterranean and the dwindling of the supply of papyrus, parchment or vellum—always dear, and by no means universally plentiful—soon became enhanced in value; and the large styles of uncial and capital writing then in vogue assisted this dearness by reason of the large amount of writing surface required. Hence naturally, in the last centuries of Rome and in the early Middle Ages, the use of the palimpsest was considerably extended. A Greek synod of 691 found it necessary to forbid the destruction in this way of copies of the Bible and of the Church Fathers; and when, in the West, the condensed and legible minuscule which we still use took the place of the cumbrous uncial and national scripts, the temptation must have been great to mutilate the old quartos with their growingly unfamiliar characters, their lavish pages, and their easily erasable ink. Nearly all our valuable Latin palimpsests come from this period between the seventh century and the ninth. Palæographers no longer credit, however, the charge that the monkish scribes indulged in wholesale destruction of earlier books. As Tischendorf has pointed out, no complete work has yet been found in a palimpsest, and it is improbable that any but worn or damaged books were often sacrificed.

Time brings back to the erased ink something of its color, and at length the manuscripts which had been subjected to the process of obliteration fell under the notice of modern scholars. At first the imperfect knowledge of a means of restoring the faded inks rendered the results unsatisfactory; but in the eighteenth century Knittel, a German theologian, carefully went through the palimpsests at Wolfenbüttel, and was so fortunate as to identify fragments of the Gothic Bible. P. J. Bruns discovered several palimpsests at Rome in the library ceded by Christina of Sweden to the Vatican, among them Cicero's *pro Roscio*, over which had been written a Latin version of the Scriptures. Niebuhr discovered in the same manuscript another oration of Cicero, that *pro M. Fonteio*, and was able to recover the *Institutes* of Gaius almost entire from a palimpsest at Verona. Angelo Mai made himself celebrated in deciphering texts of palimpsests, discovering Cicero's *de Republica* under Augustine's commentary on the Psalms and the *Letters* of Fronto under the acts of the Council of Chalcedon. Many curious morsels of antiquity have since been thus patiently rescued from oblivion, among them some of the most ancient manuscripts of the Christian Scriptures. Double palimpsests—those whose writing has twice been erased—are found. In the restoration of the earlier writing various chemical reagents have been used—an infusion of nutgalls, Gioberti's tincture, the hydrosulphuret of ammonia; but, unfortunately, all with great risk to the manuscript. So high an authority as Wattenbach declares that "more precious manuscripts, in proportion to the existing supply, have been destroyed by the learned experiments of our own time than by the much-abused old monks." One great palæographer (Sickel) points out how much may be gained by simply laying the manuscript in clear water, from which it takes no harm if it be afterward thoroughly dried.

The leading monograph on palimpsests is Mone's *De libris palimpsestis* (Carlsruhe, 1855), but the best discussion of the subject is that of Wattenbach, in his *Schriftwesen im Mittelalter*. For other authorities see MANUSCRIPT and PALÆOGRAPHY. W. D. BIRCH. Revised by GEORGE L. BURR.

Palinu'rus (now *Capo Palinuro*): a promontory on the coast of Lucania, in the Tyrrhenian Sea, between Velia and Buxentum. It received its name from Palinurus, the pilot of Æneas, who, according to tradition, was buried here. Some remains of old buildings still bear the name of the tomb of Palinurus. The place was twice the scene of great disasters, two large Roman fleets being wrecked on the rocky shores, one in 253 B. C., the other in 36 B. C.

Palisades: See FORTIFICATION.

Palisades: a line of cliffs bordering the lower portion of the Hudson, opposite New York city. They have a length of about 20 miles, and a general height of 300 feet. They are formed by the outcrop of an inclined sheet of trap-rock (diabase) which dips westward and was intruded in a molten condition between layers of sandstone and shale belonging to the Newark system, a division of the Jura-Trias. The same trap-sheet forms Bergen Hill to the S. and the Hook Mountains to the N. of the Palisades, and has been left in relief owing to the removal by erosion of the softer beds inclosing it. The trap is columnar, and at the Palisades breaks off so as to form vertical cliffs. The cutting away of the base of the cliffs by the Hudson is now progressing but slowly owing to the protection afforded by talus slopes. See also WATCHUNG MOUNTAINS. ISRAEL C. RUSSELL.

Palissot de Montenoy, pă'lĕe'sō'de-mŏń'te-nwă', CHARLES: author; b. at Nancy, France, Jan. 3, 1730. A precocious student, he entered the congregation of the Oratory, but soon left the order and tried literature. After some unsuccessful tragedies and comedies he found notoriety by bitter attacks on the philosophers. *Le Cercle* (comedy, 1755) satirized Rousseau, and *Petites lettres contre des grands philosophes* (1756) Diderot. His best-known work is the comedy *Les Philosophes* (1760), written with the same purpose. His *Œuvres* were published in 6 volumes (Paris, 1809). D. June 15, 1814. A. G. CANFIELD.

Palissy (Fr. pron. pă'lĕe'see'), BERNARD: potter and author; b. at Capelle Biron, in the department of Lot-et-Garonne, France, about 1510; was apprenticed to a potter, and afterward, on account of his knowledge of geometry, engaged for some time as a land-surveyor, but pursued also the arts of pottery, enameling, glass-painting, etc. He married about 1538 and settled at Saintes, but in 1564 removed to Paris. He was a Protestant, and although exempted from the massacre of St. Bartholomew by special order from the queen, in whose service he stood, he was twice imprisoned as a heretic—in 1557, when he was liberated by the intercession of the constable of Montmorency, and in 1588, when he was thrown into the Bastile and kept there to his death in 1589. The most remarkable of his glass-paintings is a representation of the *Myth of Psyche*, after Rafaello. Of his pottery, vases, ewers, jugs, salvers, etc., generally small in size but highly finished, collections are formed in several of the Paris museums; and these articles are much valued on account of the unique character of their design. His best-known pieces are those decorated with lizards, snakes, etc., in high relief, probably moulded from the actual creatures, and colored in close imitation of nature. None of his work can be compared for beauty with the finest Italian pottery. His writings, containing many new and true observations on the formation of springs, on the fertilizing power of marl, on the best means of purifying water, etc., and on the true origin and nature of fossil remains, were published in 1777 by Faujas de Saint-Fond and Gobet, and in 1844 by A. Cap. As an artist Palissy was well appreciated during his lifetime, but it was not until the time of Buffon and Réaumur that the truth of Palissy's scientific views was understood and recognized. The slighting remarks of Voltaire are simply the result of ignorance. Palissy's writings, published 1557–80, were edited by M. France and republished at Paris in 1880. His *Life* was written by H. Morley (2 vols., London, 1852), and in French by J. Salles (Nîmes, 1855), Audiat (1868), and Berty (1886). See Delange, *Monographie de l'œuvre de B. Palissy* (1862).

Palladio, pă'al-laa'dĕe-ō, ANDREA: architect; b. at Vicenza, Italy, in 1518. Little is known of his family or of his early years. A wealthy patron of Vicenza enabled the youth to travel over Italy and in France wherever Roman remains existed. Vitruvius and Leon Battista Alberti were the authors he studied, and it would seem that Giovanni Fontana, the architect of the castle of Udine, was for a time his master. In 1541 he modernized the palace of Trissino at Cricoli. He competed in 1546 with Giovanni Fontana, and again in 1549 with Giulio Romano, for the renovation of the Sala della Ragione (Palace of Reason) at Vicenza, an ancient monument of Gothic architecture, and won the competition, after which he went to Rome, where he made the façade of the palace of the Grand Duke of Tuscany. His genius was henceforth recognized, and his great learning and culture attracted the friendship and consideration of all the great men of his day. He settled at Vicenza, which, together with the neighboring country, is full of palaces and monuments designed by him. In 1556 he began the restoration of the Palace of Reason in his native city, a labor which lasted all his life. About the year 1560 Sansovino, being then eighty, recommended the Venetian republic to accept Palladio as his successor. His first work in Venice was the monastery Della Carità. Other important works here included the churches of San Giorgio Maggiore and Il Santissimo Redemptore, the façade of San Francesco della Vigna, and some palaces.

When Henry III. of France passed through Venice, the republic, wishing to astonish him by the splendor of the city, commissioned Palladio to decorate it. War prevented him from carrying out his engagement to renovate the cathedral at Brescia, which he had intended to transform into a masterpiece of his art. He commentated on and illustrated with drawings Polybius, and also the *Commentaries* of Cæsar, in a manner which showed careful study of the military tactics of the ancient Romans. His knowledge of hydraulics was also considerable. At Bassano he built a wooden bridge, in which he combined solidity with elegance of design, and this resisted the inundations of the river Brenta till the end of the seventeenth century, when its restoration by Ferracina spoiled its original beauty. Palladio took part in the competition of the greatest architects of his time for the design of a stone bridge to replace the wooden Rialto bridge at Venice, and his project was preferred to all, although Antonio da Ponte's was finally chosen as more within the means the republic had to dispose of. He planned the royal park in Piedmont for Duke Emmanuel Philibert of Savoy, to whom he dedicated his *Treatise on Architecture*, published in Venice in 1570, which has since been reprinted and translated in all languages. Palladio died at Vicenza in 1580. W. J. STILLMAN.

Palladium: a silver-white to steel-gray metal of the platinum group, discovered by Wollaston in 1803 in the mixture of platinum metals (polyxene) from South America. It has nearly the hardness of platinum, but is less ductile; specific gravity, 11·3 to 11·8; when hammered, 12. It does not fuse in ordinary furnaces, but melts in the oxyhydrogen flame and volatilizes. It can be welded like iron or platinum. It does not oxidize readily, but dissolves in hot nitric acid and in aqua regia, and may be combined with sulphur by heat and can be alloyed with various metals, particularly platinum, gold, silver, and copper. Four parts of copper and one of palladium form a white ductile alloy, so, also, with gold. The *oro pudre* or impure gold from Porpez, South America, contains 9·85 per cent. of palladium and 4·17 per cent. of silver. Similarly the *oro preto* (black gold) from Minas Geraes, Brazil, contains from 7·7 to 11·1 per cent. of palladium, according to assays made at the Rio de Janeiro mint. Six parts of gold and one of palladium formed the alloy used at the suggestion of Dr. Wollaston for the graduated part of the mural circle at Greenwich Observatory. Being very white and inalterable in the air, and not tarnishing like silver in sulphurous gases, it has been much used for such purposes. Some of its alloys have been used for the points of pencils, lancets, and as a substitute for gold in dental work. Palladium has the property of occluding hydrogen to an extraordinary degree. This was discovered by Graham, and he regarded hydrogenized palladium as a true alloy containing the hydrogen in the form of the metal hydrogenium, the compound corresponding to the formula Pd_4H_2. This property of the metal was well illustrated at Paris in 1878 by a disk of palladium 100 mm. in diameter and 2 mm. thick, in which nearly 1,000 times its bulk of hydrogen had been occluded. By the absorption of the gas its diameter was increased to 102·5 mm. and its thickness to 2·2 mm. It increased in weight, and became concave.

Brazil appears to be the chief source of this metal; it not only occurs in alloy with gold, as above shown, but separately in mixture with gold and platinum in alluvial sands. A small quantity occurs at Port Orford, on the coast of California, with platinum and iridium. It is reported to

have been found upon the south coast of the Black Sea, in the vicinity of Batum, in auriferous sands, and is associated with platinum in the Ural Mountains. WILLIAM P. BLAKE.

Palladium [= Lat. = Gr. Παλλάδιον, statue of Pallas, liter., dimin. of Παλλάς, Παλλάδος, Pallas]: a wooden image (ξόανον) of Pallas let fall from heaven by Zeus in answer to the prayer of Ilus, in token of his approval of the founding of Ilium. There are other stories of its origin. It was 3 cubits high, with legs stiff and closely pressed together, an uplifted spear in the right hand, and a distaff and spindle or a spear in the left hand. The image represented the protecting goddess, who would not allow the city to be taken as long as the image remained inside its walls. Odysseus and Diomedes crept into Troy by night and stole it. According to one story, Demophoon captured it from Diomedes as he was landing in Attica and placed it on the Athenian Acropolis. but according to another story Diomedes brought it to Argos. According to still another story, the Trojans, fearing that it might be stolen, made an imitation Palladium, which was the one stolen by Odysseus and Diomedes, and concealed the genuine one, which was carried by Æneas to Italy, and for centuries was preserved in the temple of Vesta in Rome, until Heliogabalus placed it in in his temple of the Sun. The theft of the Palladium by Odysseus and Diomedes was a favorite motive with the ancient artists. See the article *Palladium* in Baumeister's *Denkmäler*. J. R. S. STERRETT.

Palla'dius: the name of several distinguished men. (1) RUTILIUS TAURUS ÆMILIANUS. a Roman author, probably from the fourth century; wrote a work on agriculture, *De re Rustica*, in fourteen books, which was much used during the Middle Ages. Edited by J. G. Schneider in his *Scriptores Rei Rusticæ Veteres Latini* (Leipzig, 1795); translated into English by Thomas Owen (London, 1803). Book xiv., a poem in elegiacs on grafting (*De Incitione*) has been separately edited by J. C. Schmidt (Münnerstadt, 1877), and book i., by the same editor (Würzburg, 1876).—(2) A Christian Father; b. in Galatia in 367 A. D.; Bishop of Helenopolis in Bithynia in 400, and of Aspona in Galatia in 420; d. in 430. He wrote the *Historia Lausiaca*, a collection of biographies of hermits, dedicated to Lausus, governor of Cappadocia, published by Meursius (Leyden, 1616) and by Fronto Ducæus in his *Auctarium* (Paris, 1624).—(3) A Greek author on medicine; lived probably in Alexandria in the seventh century, and wrote commentaries on the works of Hippocrates, and a book on fevers, edited by Bernard (Leyden, 1745). M. WARREN.

Pallah [from the native (South African) name]: the *Æpyceros melampus*, a fine dark-red antelope of South Africa (called in Dutch *roode bok*, red antelope). It has a white belly, a black mark upon the croup, and black tufts on the back part of each foot. It has long, handsome horns, somewhat lyrate and ringed. Its flesh is good, though dry. It is very swift, but when surprised has the habit of trying to steal away undiscovered. It is found in considerable herds in bushy places.

Pal'las (in Gr. ἡ Παλλάς and ὁ Πάλλας): 1. A daughter of Triton and a youthful companion of Athene. Once when they were engaged in warlike sport they became angry, and Zeus, seeing that Pallas was about to strike Athene, interposed his ægis, and Pallas fell at the feet of Athene, who made an image in her honor and placed upon its breast the death-dealing ægis. This statue was the Palladium cast down from heaven by Zeus in answer to the prayer of Ilus for a sign of heaven's approval. 2. A Titan. 3. Father of Selene. 4. A giant. 5. The grandfather of Evander, after whom the city built by Evander on the Palatine Hill was named. 6. Son of Pandion, of Athens. 7. Freedman of Antonia, mother of Claudius; he played a prominent *rôle* under Claudius, and was put to death by Nero for the sake of his money. J. R. S. STERRETT.

Pallas, PETER SIMON: traveler and naturalist; b. in Berlin, Germany, Sept. 22, 1741; studied medicine and natural science; visited England and Holland; published in 1766 his *Elenchus Zoophytorum* and *Miscellanea Zoologica*, still of value; was invited by Catherine II. in 1768 to Russia as Professor of Natural Science at the Academy of St. Petersburg; made from 1768 to 1774 a journey of exploration through Southern Siberia to the frontier of China; resided for many years in the Crimea, where the empress gave him extensive estates, and partook with great activity in all scientific undertakings in Russia, but returned at last to Berlin, where he died Sept. 8, 1811. Those of his numerous works best known and still of interest are *Travels through the Southern Provinces of the Russian Empire* (Leipzig, 1799–1801; Eng. trans. 1812); *Flora Rossica* (2 vols., 1784–88, not completed); and *Sammlungen historischer Nachrichten über die mongolischen Völkerschaften* (2 vols., St. Petersburg, 1776–1802).

Pallas Athene (in Gr. Παλλὰς Ἀθήνη, Ἀθηναίη, Ἀθηνᾶ): See ATHENA.

Pallavicino, SFORZA, Cardinal: theologian and scholar; b. in Rome, Italy, Nov. 28, 1607. After studying jurisprudence there he turned to theology, receiving his baccalaureate in 1628. In 1630 he determined to become an ecclesiastic, and was at once given important charges by Pope Urban VIII. In 1637 he became a Jesuit, and for the rest of his life he was one of the most important members of the Society of Jesus, having in charge particularly the direction of its educational policy and work. In 1659 he was made cardinal by Alexander VII., who had long been his intimate friend. He is chiefly famous for his theological works, of which the most important is his *Istoria del Concilio di Trento*, etc. (Rome, 1656–57), written to combat the similar history by the Venetian Paolo Sarpi. In the preparation of this he had access to documents closed to all others; but the violence of his partisanship prevented him from giving scientific exactness to his treatment. To the same field belong (besides his Latin treatises, *Vindicationes Soc. Jesus, Assertionum theologicarum libri*, etc.) his *Arte della perfezione cristiana* (Rome, 1665) and his admirable *Della vita di Alessandro VII. libri cinque* (Prato, 1839–40). Besides being a theologian, Pallavicino was a scholar and poet. He belonged to the Roman academy called Gli Umoristi, and later to the Florentine della Crusca. He wrote a tragedy, *Ermenegildo* (1644); *Del Bene* (dialogues, 1644); *Considerazioni sopra l'arte dello stile del dialogo* (1646); *Avvertimenti grammaticali a chi scrive in italiano* (1661); and a sacred poem, *Fasti sacri*, of which only fragments are preserved. D. in Rome, June 5, 1667. For his life and works, see *Opere edite ed inedite di Sforza Pallavicino* (5 vols., Rome, 1844–48). A. R. MARSH.

Palliser, Sir WILLIAM, C. B.: soldier and inventor; b. in Dublin, Ireland, June 18, 1830; was educated at Rugby, Trinity College, Dublin, Trinity Hall, Cambridge, and Sandhurst College; became ensign in the Rifle Brigade 1855, and joined the Eighteenth Hussars in 1858; became captain 1859, major, unattached, 1864, and retired from the service in 1871. He was the inventor of the Palliser projectiles, designed for piercing armor-plated ships; he also invented an improved method of rifling iron wrought cannon for use both in ships and on fortifications, and of converting smooth-bore cast-iron ordnance into rifled guns. He was knighted by Queen Victoria Jan. 21, 1873. D. Feb. 4, 1882.

Pal'lium [= Lat., liter., cloak, mantle, pall]: in the Roman Catholic Church, a band of white lamb's wool, embroidered with purple crosses, worn upon the neck by the pope and all ecclesiastics of archiepiscopal rank, including metropolitans and patriarchs. It was once made of linen, embroidered with purple, and was worn by all bishops. The pallium has two pendants, one hanging down the back and one down the breast of the wearer. It is the chief badge of the archbishop's authority, is granted by the pope in person, and is worn only upon very solemn occasions. The pope, however, wears it continually. It is always buried with the wearer, and can never be transferred to another person.

Palm: See PALM FAMILY, PALM OIL, and PALM WINE.

Palm, JOHANN PHILIPP: bookseller; b. at Schorndorf, Bavaria, in 1768; succeeded his father-in-law, Stein, as publisher in Nuremberg, where, in 1806, his firm issued a pamphlet entitled *Deutschland in seiner tiefen Erniedrigung* (Germany in her Deep Humiliation), which censured Napoleon and condemned the occupation of Bavaria by the French troops. The book fell into the hands of the French officials and the matter was brought to the notice of Napoleon, who, it is said, gave orders for the arrest, conviction, and speedy execution of the offender, that his death might serve as a warning to others. Palm was seized, hurried before an extraordinary military commission at Braunau, and, though he professed ignorance of the contents of the pamphlet, was condemned to death Aug. 25, 1806. He was shot at Braunau on the following day. Like the execution of the Duc d'Enghien, this act caused general indignation throughout

Europe, and in Germany the hatred of Napoleon was intensified. Some writers have tried to lay the blame of this judicial murder upon Marshal Berthier instead of Napoleon. A bronze statue of Palm was erected at Braunau in 1766. See Schultheiss, *Johann Philipp Palm* (Nuremberg, 1860).

Pal'ma: town of Spain; capital of the province of Baleares, on the southwestern coast of the island of Majorca (see map of Spain, ref. 16–L). It is surrounded with walls and fortified with thirteen bastions, and has a fine harbor with a mole 500 yards long, and lined on both sides with dockyards, in which ship-building is carried on. The city is well built, and contains many elegant buildings, both private and public, among which the most remarkable are the cathedral (1232–1601) in the Gothic style, the Church of St. Francis, containing the tomb of LULL (*q. v.*), the exchange, dating from the fifteenth century, and the governor's palace. It has many good educational institutions and manufactures of silks and woolens, jewelry, soap, brandy, and glass. Pop. (1887) 60,514.

Palma: one of the CANARY ISLANDS (*q. v.*). Area, 330 sq. miles, with 39,622 inhabitants. It contains the interesting, now extinct, volcanoes Caldera and Barraneo, often referred to as exceptionally well-preserved types of volcanic forms. The island produces good timber, and has two fine towns, St. Cruz and Los Llanos.

Palma, JACOPO, called IL VECCHIO (the elder), or PALMA VECCHIO: painter; b. at Serina, near Bergamo, about 1480; d. in Venice in 1528. He went to Venice while still very young and followed Giorgione's method of coloring. His altar picture at San Cassiano is one of his early works, and one of his finest is *Santa Barbara* at Santa Maria Formosa. He soon received orders for altar pieces for the churches in Venice, the surrounding country, and for Serinalta. His picture of *The Epiphany*, now in the Brera at Milan, shows that he had originality. He painted in competition with Gian Bellini and Mansueti in the school of St. Mark the story of the ship bringing St. Mark's body to Venice in a terrible storm. Vasari bestows the highest praise on this work, as also on a portrait of himself which Palma painted for him. The Venetian academy possesses a fine *Assumption* by this master. The Louvre has four pictures by him, and the museum of Brussels one. W. J. S.

Palma, JACOPO, called IL GIOVANE (the younger), or PALMA GIOVANE: painter; date of birth unknown. He was a nephew of Palma Vecchio. His father was his first instructor in painting, but he imitated Titian, and before he was fifteen years of age he became the *protégé* of the Duke of Urbino, who first took him to his capital and then sent him to Rome to study. He returned to Venice in 1570, where his work did not seem much in request until Vittoria, the architect and favorite sculptor of the republic, gave him commissions which enabled him to compete with Tintoretto and Veronese. He painted a *Last Judgment* in the Sala dello Scrutinio, and a picture representing the pope permitting Otho to be reconciled to his father in the Sala del Maggior Consiglio, both in the ducal palace; also Alexis and the crusaders assaulting Constantinople, besides the naval fight on the Po, and the taking of Cremona, which is perhaps his masterpiece. After the death of Tintoretto and Veronese he contented himself with producing mere sketches. He painted innumerable altar-pieces for Venice, and examples of his art are to be found at Cremona, Pesaro, Urbino, and Bologna. D. at Venice in 1628. W. J. S.

Palma, RICARDO: author; b. at Lima, Peru, Feb. 7, 1833. In his younger days he was engaged in a revolt, and in 1860 was exiled to Chili for a short time. After his return he was secretary to President Balta, senator, and finally assistant in the National Library until it was sacked by the Chilians in 1881. In 1884 he undertook its restoration. About 8,000 books, a mere fragment of the original collection, were recovered, and these were supplemented by gifts, principally from foreign governments. The library was reopened under his directorship July 28, 1884. Señor Palma is called the Nestor of Peruvian literature. He has published several romances, sketches of country life, two volumes of poems, and a historical work, *Anales de la Inquisición de Lima* (1863), but he is best known for his volumes on the historical traditions and legends of Peru which have appeared since 1870. HERBERT H. SMITH.

Palma di Montechiaro: city of Italy; in the province of Girgenti, Sicily; 14 miles S. E. of the city of Girgenti (see map of Italy, ref. 10–F). Though at some distance inland it has a port with a considerable coasting trade. Soda, sulphur, wine, and dried fruits are exported. Pop. 11,702.

Palmas, Cape: See CAPE PALMAS.

Palmblad, paalm'blaat, WILHELM FREDRIK: writer; b. in Liljestad, Sweden, 1788. At the age of twenty he founded with ATTERBOM (*q. v.*) the phosphoristic society Auroraförbundet, and both as critic and creative writer he contributed largely to the advancement of the new literary movement. In this his success was the greater because of the comparative conservatism of his views. During the latter part of his life he was a professor at the University of Upsala. His earliest serious efforts consisted of a number of tales, *Amala*, *Holmen i sjön Dall* (The Island in Lake Dall), and others of considerable merit; but his two novels—*Familjen Falkensvärd* and *Aurora Königsmark*—are decidedly inferior, as are also his translations of Æschylus and Sophocles. His principal work, and the best on that subject in the Swedish language, is *Handbok i fysiska och politiska, äldre och nyare geografien* (Manual of Physical and Political Geography, Ancient and Modern, 5 vols.), which, however, was not completed. D. at Upsala, 1852. D. K. DODGE.

Palm-crab: See CRAB.

Palmer: town; Hampden co., Mass.; on the Chicopee, Swift, and Ware rivers, and the Boston and Albany and the Cent. Vt. railways; 15 miles E. of Springfield, 39 miles W. S. W. of Worcester (for location, see map of Massachusetts, ref. 3–E). It comprises several villages, and is noted for its manufactures, which include carpets, woolen dress-goods, cotton goods, wire, wire nails, and foundry and machine-shop products. There are two libraries (Y. M. C. A. and State Primary School), a high school, a national bank with capital of $100,000, a savings-bank with deposits of nearly $1,000,000, and a weekly newspaper. Pop. (1880) 5,504: (1890) 6,520; (1900) 7,801.

Palmer: in mediæval times, a pilgrim returned or returning from the Holy Sepulcher, so called from the fact that he bore branches of palm gathered near Jericho, which were placed upon the church altar after the palmer's return. The palmer also employed the consecrated scrip (a leathern wallet) and staff; and it was further customary for him to visit the holy places of other lands during his return. Thus after his visit to the shrine of St. James the Less at Compostella, he wore the seallop-shell (*Pecten Jacobæus*), the cognizance of the great apostle.

Palmer, BENJAMIN MORGAN, D. D., LL. D.: clergyman; b. in Charleston, S. C., Jan. 25, 1818; was educated at the University of Georgia and the Theological Seminary at Columbia, S. C.; was pastor of the First Presbyterian church, Savannah, Ga., 1841–43; of the First Presbyterian church, Columbia, S. C., 1843–56; and since 1856 of the First Presbyterian church, New Orleans, La. Dr. Palmer was Professor of Church History and Polity in the Theological Seminary, Columbia, S. C., 1853–56; moderator of the first southern assembly, Augusta, Ga., 1861; and has been commissioner to ten general assemblies. Since 1847 he has been one of the editors of *The Southern Presbyterian Review*, of which he was a founder. He is the author of *The Life and Letters of J. H. Thornwell, D. D., LL. D.* (Richmond, 1875); *Sermons* (2 vols., New Orleans, 1875–76); *The Family in its Civil and Churchly Aspects* (New York, 1876); *Formation of Character* (1889); *The Broken Home* (1890); and *Theology of Prayer* (Richmond, 1894). C. K. HOYT.

Palmer, EDWARD HENRY: Orientalist; b. at Cambridge, England, Aug. 7, 1840; graduated at the university of that city 1867; was a member of the Sinai surveying expedition of 1868–69, and the survey of Moab in behalf of the Palestine Exploration Society 1869–70; acquired a practical knowledge of Oriental languages, and became Professor of Arabic at Cambridge 1871. Author of *The Negeb, or South Country of Scripture* (1871); *The Desert of the Exodus* (1871); *Arabic Grammar* (1874); of several translations from and into the Persian language, of a *Persian-English and English-Persian Dictionary* (1876–83); and of the *Qur'an* (1880); *Song of the Reed* (1876); *Poems of Behà ed Din Zoheir* (1876–77). In 1882, during the British military operations in Egypt, he was commissioned to dissuade the Bedouins E. of the Red Sea from allying themselves with Arabi Pasha, but while on a journey from Suez was murdered, with his two companions, by Bedouins Aug. 11. See the *Life* by Walter Besant (1883).

Palmer, ERASTUS DOW: sculptor; b. at Pompey, N. Y., Apr. 2, 1817; was for some years a carpenter at Utica; be-

gan in 1846 to cut cameos; removed to Albany; began as a sculptor 1852; has produced above 100 works in marble, including several portrait-busts of eminent men; has executed various groups, including one representing the landing of the Pilgrims, intended for the Capitol at Washington.

Palmer, GEORGE HERBERT: See the Appendix.

Palmer, JOHN MCCAULEY: soldier; b. at Eagle Creek, Ky., Sept. 13, 1817; removed to Illinois 1831; settled at Carlinville; was admitted to the bar 1839; took an active part in politics; State Senator 1852–55; was prominent in the organization of the Republican party 1856; delegate to the peace convention at Washington, D. C., Feb., 1861; appointed colonel Fourteenth Illinois Volunteers in May; accompanied Gen. Fremont in his expedition to Springfield, Mo.; appointed brigadier-general of volunteers 1861; participated in battles of New Madrid, Island No. 10, Corinth, and Murfreesboro; and was made major-general of volunteers Nov. 29, 1862; was in command of the Fourteenth Corps Oct., 1863, to Aug., 1864; was in Sherman's Atlanta campaign and subsequently in command of department of Kentucky; was mustered out Sept., 1866; Governor of Illinois 1869–73; U. S. Senator 1891; Presidential candidate of the gold democrats in 1896. D. Sept. 25, 1900.

Palmer, JOHN WILLIAMSON, M. D.: author; b. at Baltimore, Md., Apr. 4, 1825; graduated at the University of Maryland 1847; studied medicine in Philadelphia; was city physician of San Francisco, Cal., in 1849; went in 1852 to China; served 1852–53 as surgeon of the East India Company's war-steamer Phlegethon in the Burmese campaign; was active on the Confederate side during the civil war in the U. S.; became afterward an editor in Baltimore, removing to New York city in 1870. Author of *The Golden Dagon* (1853); *The Queen's Heart*, a successful comedy (1858); *The New and the Old* (1859); and *After his Kind*, a novel (1886); has translated Michelet's *L'Amour* and other works from the French; compiled *Folk-songs* (1860) and several other volumes of selected poetry; is widely known for his admirable papers on East Indian life. His poem, *Stonewall Jackson's Way*, was a popular Confederate ballad during the civil war.—His wife, HENRIETTA (*Lee*) PALMER, b. at Baltimore in 1834 and married in 1855, is the author of *The Heroines of Shakspeare* (1858); *The Stratford Gallery*; *Home Life in the Bible*; of translations from the French, etc. Revised by H. A. BEERS.

Palmer, RAY, D. D.: clergyman and hymn-writer; b. at Little Compton, R. I., Nov. 12, 1808; graduated at Yale College 1830; studied theology at New Haven; was pastor of Congregational churches at Bath, Me., 1835–50, and at Albany, N. Y., 1850–66; and secretary of the American Congregational Union at New York 1866–78. He was author of many literary contributions to reviews, some doctrinal works, and several volumes of religious poems, among which is the favorite hymn, *My Faith looks up to Thee*. A collection of his poetical works was issued in 1875. D. at Newark, N. J., Mar. 29, 1887.

Palmer, ROUNDELL, Earl of Selborne, D. C. L.: b. at Mixbury, Oxfordshire, England, Nov. 27, 1812; was educated at Rugby and Winchester schools, and at Trinity College, Oxford, and graduated with high honors 1834, obtaining a fellowship at Magdalen College and the Eldon law scholarship; was called to the bar 1837; entered Parliament 1847; became queen's counsel 1849; knighted and appointed solicitor-general 1861; was attorney-general 1863–66; was counsel of the British Government before the Geneva court of arbitration on the Alabama claims 1871; became Lord Chancellor with the title of Baron Selborne of Selborne, Hampshire, Oct., 1872, retiring from that office Feb., 1874; became Lord Chancellor again in 1880, and Earl of Selborne in 1882. He was author of *The Book of Praise, from the Best English Hymn-writers* (1862), and was well known from his advocacy of the establishment of a law university in London. D. at Petersfield, England, May 4, 1895.

Palmerston, HENRY JOHN TEMPLE, Viscount, and Baron Temple: statesman; b. at Broadlands, Hampshire, England, Oct. 20, 1784; a son of an Irish peer of the family of Sir William Temple; succeeded in 1802 to the title; was educated at Harrow and St. John's College, Cambridge, where he graduated in 1803; declined the election to the House of Lords as a representative peer for Ireland; entered Parliament for Bletchingley 1806; represented Newport in Parliament 1807–11, and Cambridge University 1811–31, and after that represented Bletchingley, South Hants, and Tiverton; became a Junior Lord of the Admiralty 1807; was Secretary of War 1809–28, under five administrations, having abandoned high Tory principles for moderate Liberalism; was Secretary of State for Foreign Affairs 1830–34, 1835–41, and 1846–52, attaining great distinction as a diplomatist. He appears to have sympathized with Napoleon's *coup d'état* of 1851, and his avowal of his views resulted in his withdrawal from the cabinet. He was Secretary of State for Home Affairs 1852–55, and again sided with Napoleon on the outbreak of the Crimean war, favoring an alliance with France against Russia. When the war spirit in Great Britain flagged, he resigned from the cabinet, but returned to office upon receiving pledges of a warlike policy. He was Premier and First Lord of the Treasury 1855–58 and 1859–65. His premiership is distinguished by the warlike spirit shown by the Government in dealing with foreign affairs. He saw the Crimean war to a close, refused to mediate between France and Austria in the Italian war, standing firmly for the expulsion of the latter power from Italy, and on the eve of the Danish war, in conjunction with Napoleon III., he warned Prussia and Austria against any interference with the independence of Denmark; but when Napoleon drew back he looked about for allies with whom to defend Danish rights, but, finding none, left Denmark to her fate. In 1861 he was appointed lord warden of the Cinque Ports, and in 1863 was elected rector of Glasgow University. D. at Brockett Hall, Hertfordshire, Oct. 18, 1865, and was buried in Westminster Abbey. See his *Life*, by Lord Dalling (1870, incomplete).

Palmet'to [from Span. *palmito*, dimin. of *palma*, palm, palm-tree]: properly, a small palm-tree of Southern Europe (*Chamærops humilis*); also any one of certain other small palms. Of these the U. S. has the following: (1) *Sabal palmetto*, the cabbage palmetto, found as far N. as the Cape Fear river, in sandy soil near the coast. Its timber is useful in constructing piers, since it is durable and not subject to the attack of the teredo. The tree sometimes reaches the height of 50 feet. The leaves are largely used in making hats, and the "cabbage," or crown of young leaves, is very palatable when boiled. The root is highly astringent. (2) *Serenoa serrulata*, the saw-palmetto, has a creeping stem from 5 to 8 or more ft. 6 in. in diameter, with thick clusters of fan-shaped leaves, the abode of many rattlesnakes. (3) *Sabal adansonii*, the dwarf palmetto, is stemless and has leaves 2 or 3 feet high. It covers dense patches of ground in low coast regions. (4) *Rhapidophyllum hystrix*, the blue palmetto, is a low palm with long-stemmed fan-like leaves, in the axils of which are sharp needle-like thorns. The roots of the palmettos are in some soils so numerous and strong as to make the plowing of land very difficult and expensive. Much of the palmetto-leaf of commerce is derived from the Palmyra palm. Revised by L. H. BAILEY.

Palm Family [*palm* is from Lat. *palma*, possibly so named from the resemblance of the leaf to the palm of the hand, or possibly a corruption of the Oriental name; cf. Heb. *tamar* (Eng. *tamarind*)]: the *Palmaceæ*, a large group of monocotyledonous trees or tree-like plants, numbering 1,100 or more species, nearly all natives of tropical climates. Their flowers are small, with three sepals and three petals, usually six stamens, and a compound three-celled pistil (Fig. 1) or three simple pistils. Each cell of the ovary contains a single erect, ascending, or even pendulous inverted ovule, but in fruiting, as a rule, but one seed is developed. The embryo is small, conical or cylindrical, and lies imbedded in a large endosperm.

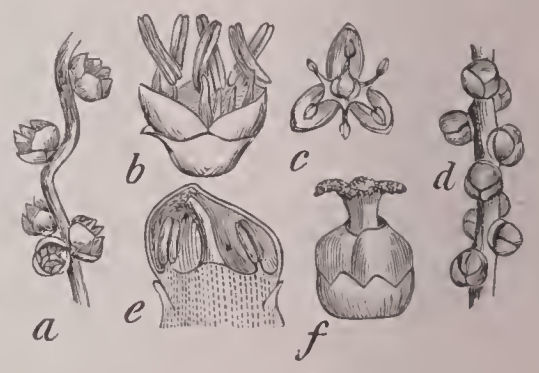


FIG. 1.—Flowers of various palms.

The stems of palms are mostly unbranched, cylindrical, or nearly so, and are covered with the decaying bases of the leaves. The crown of leaves always clothes the summit of the stem, and rises with its elongation, new leaves forming above, while the older ones die away below. The leaves are simple or palmately or pinnately compound, and are often many feet long and broad. (Fig. 3.)

Palms vary greatly in size, some scarcely rising above the ground, while others are 100 feet or more in height. In

their growth they first attain very nearly their full diameter, and then shoot up their cylindrical stems, which subsequently increase in size little or not at all. Some species, especially of the genus *Calamus* and its allies, are long, slender, prickly, climbing shrubs, often attaining a length of 300 feet or more.

It would be impossible in a short article to enumerate the many uses which palms serve for the world at large, and especially for the inhabitants of tropical regions. The grasses

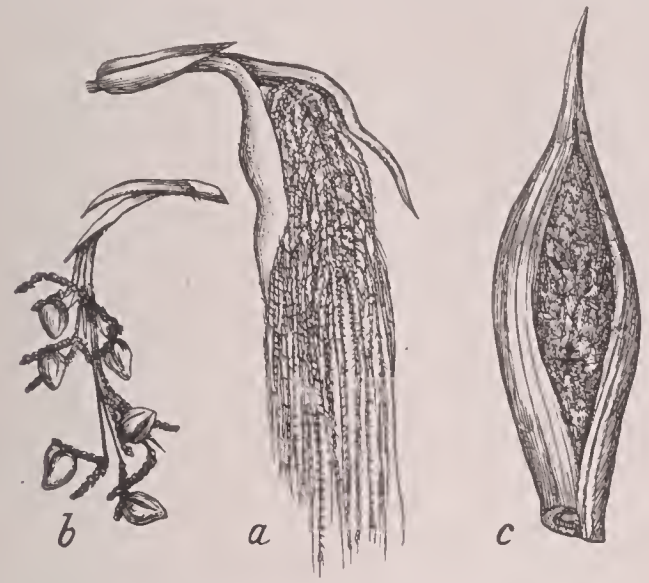


FIG. 2.—Inflorescences of palms.

possibly excepted, no other family of plants excels the palms in economic importance in relation to mankind. Food, clothing, shelter, furniture, utensils, tools, weapons, ornaments, medicines, and intoxicating drinks are sometimes all supplied by one or more species.

The family has been separated into five sub-families by Dr. Oscar Drude, as follows:

Sub-family I. *Coryphinæ* (Fig. 1, *a b c*; Fig. 3, *a b c*), with inflorescence diffusely branched; flowers with three free

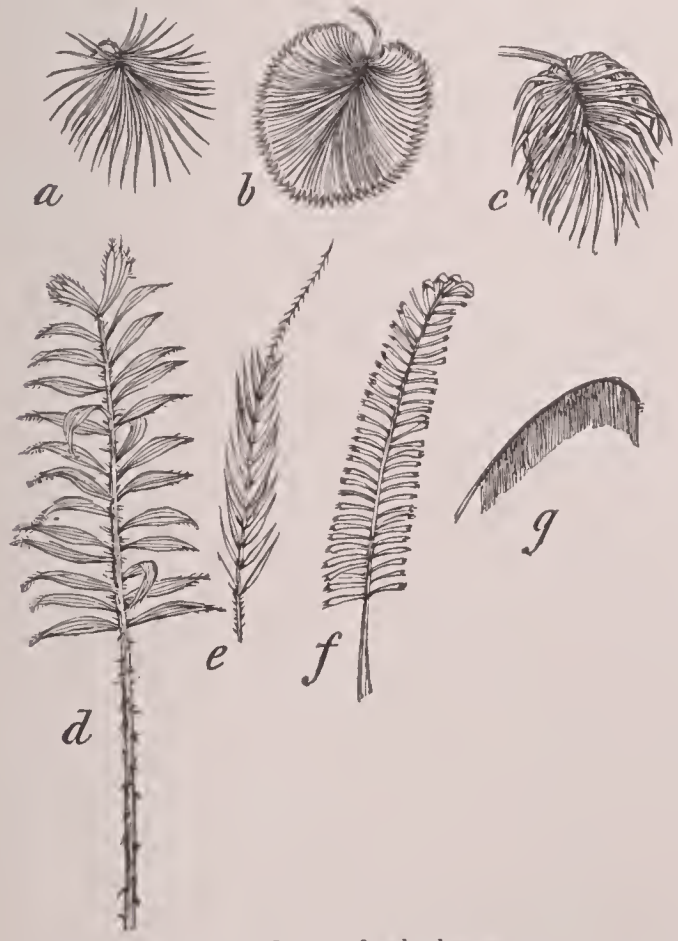


FIG. 3.—Forms of palm leaves.

carpels; fruit, a berry; leaves, pinnate in *Phœnix*, palmate in all others. Important members of this sub-family are the following: The date-palm (*Phœnix dactylifera*) of Western Asia, Northern Africa, and Southern Europe, bears large bunches of the well-known fruits. The talipot-palm (*Corypha umbraculifera*) of Ceylon and Malabar is remarkable for its gigantic leaves, the circular blades of which are sometimes 12 feet in diameter. (Fig. 3, *b*.) The palmetto (*Sabal palmetto*) is a short-stemmed species common in the Southern U. S. The wax-palm (*Copernica cerifera*) of Brazil is notable for the waxy coating on its young leaves, which is collected for making candles. (Fig. 3, *a*.) Nine other species in this sub-family are natives of the U. S.

Sub-family II. *Borassinæ* (Fig. 2, *b*), with inflorescence of simple or little branched, thickened axes; flowers with three united carpels; fruit, a drupe; leaves, palmate. The Doum palm (*Hyphœne thebaica*) of the upper Nile region is remarkable for its branching habit. Its large fruits have the flavor of gingerbread, whence the name gingerbread-palm which is often applied to it. (Fig. 2, *b*.) The Palmyra palm (*Borassus flabelliformis*) of tropical Africa and Asia is a stately tree 20 to 100 feet in height, yielding "Palmyra wood." Wine, toddy, and sugar are made from its juice. The double cocoanut (*Lodoica sechellarum*) of the Seychelles islands is 100 feet high, with a trunk 1½ to 2 feet in diameter. The large fruits weigh 30 to 40 lb. each, and grow in bunches of nine or ten. They take ten years to ripen.

Sub-family III. *Lepidocaryinæ* (Fig. 3, *d e*), with branched inflorescence; flowers with three united carpels; fruit, covered with scales; leaves, palmate or pinnate, generally spiny. The sago-palms (*Metroxylon rumphii* and *M. læve*) of the East Indian Archipelago yield sago, which is obtained by splitting their trunks and extracting the soft pithy central portions, whose cells are filled with starch. The rattan palms (*Calamus rotang*, *C. rudentum*, *C. royleanus*, *C. scipionum*, etc.) of India are much used for making walking-sticks, mattings, chairs, etc.

Sub-family IV. *Ceroxylinæ* (Fig. 1, *d e f*; Fig. 2, *c*; Fig. 3, *f g*), with simple or branched inflorescence; flowers with three united carpels; fruit, a smooth berry or drupe; leaves, pinnate.

The toddy palm (*Caryota urens*) of India attains a height of 50 to 60 feet, and furnishes great quantities of toddy. (Fig. 2, *a*.) The Gomuti palm (*Arenga saccharifera*) of the Indian Archipelago yields fiber, toddy, sugar, sago, casks, utensils, etc. (Fig. 3, *f*.) See GOMUTI PALM.

The Piassaba palm (*Attalea funifera*) of Brazil yields "Coquilla nuts," and a valuable fiber much used in the manufacture of cordage, mats, brooms, etc. The cocoanut-palm (*Cocos nucifera*), a native of the tropical parts of the Old World, now cultivated in all hot countries, yields the well-known cocoanuts of commerce. See COCOANUT.

Two genera of this sub-family, *Pseudophœnix* and *Oreodoxa*, are represented in the Southern and Southwestern U. S. The species of *Chamædorea* of South America are slender stemmed climbers, and are used in the construction of rude suspension bridges. (Fig. 1, *d e f*.)

Sub-family V. *Phytelephantinæ*, with spicate or capitate inflorescence; flowers with three or four united or free carpels; leaves, pinnate.

The ivory-nut palms (*Phytelephas macrocarpa* and *P. microcarpa*) produce very hard nuts, whose endosperm resembles ivory, for which it is used as a substitute.

LITERATURE.—*Popular History of Palms and their Allies*, by Berthold Seeman (London, 1856); *The Illustrated Dictionary of Gardening*, 4 vols., by George Nicholson (London, 1885–89); Bentham and Hooker's *Genera Plantarum* (vol. iii., London, 1883); Engler and Prantl's *Die Natürlichen Pflanzenfamilien* (vol. ii.); *Palmæ*, by Oscar Drude (Leipzig, 1887). CHARLES E. BESSEY.

Palmira, päl-mee'rää: a town of the department of Cauca, Colombia; 7 miles E. of the river Cauca and 86 miles N. N. E. of Popayan; on a plain called the Llanos de Malagana, about 3,200 feet above the sea (see map of South America, ref. 2–B). Until 1860 it was a small village; since then it has become the most important place in the department, after Popayan, and the center of a rich agricultural and grazing district. It is especially noted for its excellent tobacco. The climate is somewhat insalubrious. Pop. (1892) about 10,000. HERBERT H. SMITH.

Palmistry: See CHEIROMANCY.

Palmitic Acid: a fatty acid universally distributed in the fats of the animal and vegetable kingdoms. It is a colorless solid, lighter than water, crystallizes in small shining scales, and is without odor; insoluble in water, but freely so in hot alcohol and ether. Combined with glycerin, it occurs abundantly in palm oil, the fat of certain palms, in Chinese tallow, in Japanese wax, and the wax of *Myrica cerifera*. In the animal kingdom it is found in butter, in beeswax, in spermaceti, in human fat, etc. It is easily pre-

pared from palm oil by saponification with caustic potash, decomposing the soap with sulphuric acid, and recrystallizing the fatty acid several times from hot alcohol till it gives a steady melting-point.

The solutions of palmitic acid are acid, and if concentrated solidify on cooling, or if dilute yield tufts of slender needles with an acid reaction. This acid may be distilled unchanged, and, gently heated, evaporates without residue from an open dish. It burns like other fats with a light smoky flame. It forms with the alkali metals acid-salts analogous to the acid-acetates, and it forms normal or neutral salts with other metals according to their equivalence. The potassium and sodium palmitates are soluble in water and alcohol; the rest are insoluble.

Palmitic acid is made commercially for candle-making by fusing oleic acid with a large excess of caustic potash. The products formed are potassium palmitate, potassium acetate, and hydrogen. The potassium palmitate is washed, decomposed with sulphuric acid, the acid thus obtained washed and distilled.

Palmitins or *glyceryl palmitates* are others known as *mono-*, *di-*, and *tri-palmitin*, all crystalline fats which are artificially formed, of which the last is natural palmitin from palm oil and other fats. Revised by IRA REMSEN.

Palm Oil: the thick oil obtained from the fleshy pericarps of the fruit of *Elais guineensis* and *melanococca*, a palm-tree of Africa, and to some extent from other palms. It is extensively imported and made into soap, candles, and glycerin, and used for lubricating purposes. It is bleached and then pressed, and thus the palmitine is extracted for candle-making, while the elaine is used for lubricating, etc. The fresh oil is of a deep orange red, and has a pleasant smell as of violets. It may be used like butter. The oil palm is now naturalized in South America.

Palm Sunday: the Sunday before Easter, celebrated in the Greek and Roman Catholic and Lutheran Churches in commemoration of the triumphal entry of the Lord into Jerusalem (John xii.), on which occasion the multitude cast branches of trees before him. These branches are represented by sprays of palm, or, in countries where the palm does not grow, by those of other trees, as of the yew, willow, box, and fir. These branches are blessed by a priest and distributed to the congregation, who wear them for the rest of the day. The custom prevails, at least locally, of gathering and preserving the "palms," which are afterward burned, the ashes serving for use upon Ash Wednesday, the ashes of consecrated wood and of the old altar linen being also employed. It was another ancient custom that palmers returning from the Holy Land should bring with them leaves of the palm for service on Palm Sunday.

Palm-tree: See PALM FAMILY.

Palm Wine, or **Toddy**: an alcoholic beverage prepared from the saccharine sap of various species of palm. It yields by distillation a stronger drink called arrack. Palm wine is much used in India and other parts of Asia; it is made in Chili, and is almost the only fermented liquor made in Africa. See Johnston's *Chemistry of Common Life*.

Palmy'ra [Mod. Lat., named from the city of *Palmyra*, in Syria]: one of the noblest of the palm-trees, the *Borassus flabelliformis* of India and Ceylon. Its fruit is a valuable food, its timber is excellent, and it furnishes thatch, cordage, material for hats, fans, umbrellas; its leaves are used for writing tablets; sugar and arrack it produces abundantly. The young shoots are boiled and eaten, the seeds are edible, and the fruit yields a useful oil. This most useful tree is from 20 to 100 feet high and very beautiful, and its leaves are generally about 4 feet long, with stalks of about the same length. Each leaf has from seventy to eighty rays, and the stalks are spiny at the edges. The fruit is somewhat triangular, about the size of a child's head. It has a thick, fibrous, and rather succulent yellowish-brown or glossy-black rind, containing three seeds, each as large as a goose-egg, which are jelly-like and very palatable when young. As the palmyra is of slow growth, the wood near the circumference of the stem in old trees is very hard, black, heavy, durable, susceptible of a high polish, easily divided in a longitudinal direction, but very difficult to cut across. Palmyra-wood is the commercial name of this and of various other palms. In the north of Ceylon multitudes of people almost entirely depend on this tree for the supply of most of their wants, and in the palmyra regions of Southern Dekkan vast numbers of the inhabitants subsist chiefly on the fruit of this palm. The deleb-palm, so important to the inhabitants of Central Africa, is believed to be nearly allied to the palmyra-palm. Revised by L. H. BAILEY.

Palmyra: an ancient city of Upper Syria, situated in an oasis, 150 miles N. E. of Damascus; was founded or enlarged by Solomon (2 Chron. viii. 4), and formed at that time a bulwark against the Bedouin hordes of the desert. It is called in Scripture Tadmor (a name which in the Authorized Version appears in Kings ix. 18, where the Hebrew text and the Revised Version read *Tamar*), of which Palmyra, i. e. the city of palms, is the Greek and Latin equivalent. Under the wars between the Romans and the Parthians it acquired great importance, developed a vast commercial activity, and became a splendid city. In the second century A. D. it was the commercial metropolis of Northern Arabia. In the third century of our era, Odænathus, a native of Palmyra, established an independent Palmyrene kingdom, which was further extended, comprising the whole of Syria, and parts of Mesopotamia, and brought to great prosperity by his widow, Queen Zenobia; but when the queen refused to acknowledge the authority of the Roman emperor, Aurelian defeated her army, dissolved her empire, and captured her capital in 272. A revolt, during which the Roman garrison was slain, occasioned its destruction shortly after, and it never recovered, though in 527 Justinian rebuilt its fortifications and endeavored to restore it. In 633 it was devastated by the Saracens, and again in 744. In 1400 Tamerlane completely destroyed it, and at present it is only a vast field of ruins. A small village, Thadmor, inhabited by a few Syrian shepherds, is situated close by. The ruins, among which some tombs with inscriptions in the old Palmyrene language and characters, and a temple of Baal, are very remarkable, were first visited by English merchants in 1691, and explored by Robert Wood and Dawkins in 1751, who published their researches (London, 1753). See Saint-Mart, *Histoire de Palmyre* (Paris, 1823); Vogüé, *Syrie Centrale* (Paris, 1869); J. Seiff, *Reisen in der asiatischen Türkei* (Leipzig, 1875); also W. Wright, *An Account of Palmyra and Zenobia* (London, 1894). Revised by S. M. JACKSON.

Palmyra: city; capital of Marion co., Mo.; on the Chi., Burl. and Quincy Railroad; 15 miles N. W. of Hannibal, 15 miles S. W. of Quincy (for location, see map of Missouri, ref. 2–H). It is in an agricultural region, and contains waterworks, electric lights, several manufactories, a national bank with capital of $60,000, a State bank with capital of $50,000, and two weekly newspapers. The educational institutions include the Centenary High School (Methodist Episcopal South, opened in 1884), St. Paul's College (Protestant Episcopal, opened as the Ingleside Female College in 1848), and St. Joseph's College (Roman Catholic, opened in 1879). Pop. (1880) 2,479; (1890) 2,515; (1900) 2,323.

Palmyra: village; Wayne co., N. Y.; on the Erie Canal, and the N. Y. Cent. and Hud. Riv. and the W. Shore railways; 13½ miles W. of Lyons, 23 miles E. S. E. of Rochester (for location, see map of New York, ref. 4–E). It is in an agricultural region, has important manufactures, and contains the Palmyra Classical Union School, a national bank with capital of $1,000,000, a private bank, and 3 weekly and 2 monthly periodicals. Pop. (1890) 2,131; (1900) 1,937.

Palo Alto: town; Santa Clara co., Cal. (for location of county, see map of California, ref. 8–C): on the Coast Division of the Southern Pacific Railroad; 16 miles N. W. of San José, the county-seat, 34 miles S. by E. of San Francisco. It comprises a tract of over 8,400 acres, containing the costly mansion built by Leland Stanford and an extensive arboretum filled with a great variety of shrubs and trees, and is one of the three estates which Mr. and Mrs. Stanford deeded to the trustees of the LELAND STANFORD JUNIOR UNIVERSITY (*q. v.*) for university purposes. The beauty and healthfulness of this estate caused it to be chosen as the site for the university buildings. It has a State bank with capital of $20,000, and 1 weekly and 1 semi-weekly newspaper. Pop. (1900) 1,658.

Palpitation of the Heart [*palpitation* is from Lat. *palpita'tio*, deriv. of *palpita're*, throb, beat, intensive of *palpa're*, feel, stroke, whence Eng. *palpable*]: the forcible pulsations of the heart which make themselves felt or produce unpleasant sensations. Palpitation may be due to organic disease of the heart, but in perhaps a majority of all cases the heart itself will be found normal and the cause of the palpitation will be discovered elsewhere. The most direct and immediate extraneous cause of purely functional or non-organic

palpitation is pressure upon the heart by some pleural effusion, some tumor-mass, or a flatulent and distended stomach. Diseases of the stomach, however, act in a double way, not only by the pressure in cases of flatulence, but also through the nervous system by reflex action. The latter cause also applies to diseases of the ovaries or uterus and other organs. Reflex excitability is furthered by causes increasing the general nervous instability of the patient. Among these is the overuse of stimulants, such as tea, coffee, tobacco, and alcohol. Anæmic and hysterical or otherwise neurotic subjects are for a similar reason prone to palpitations: and in exophthalmic goiter, a form of nervous disease, cardiac palpitation is the most important symptom. Finally, there are the cases of palpitation due to diseases of the heart itself—such as hypertrophy, valvular disease, fatty heart, etc. See HEART DISEASE.

Palpitation is a paroxysmal affection, attacks coming on with greater or less frequency, lasting a short time or perhaps a day and then subsiding. The pulse is generally rapid, from 100 to 150 per minute; but there are persons with all the subjective sensations of extreme palpitation in whom the pulse-rate is actually less than normal. On the other hand, there are cases in which the most excessive rapidity, as much as 300 per minute, may occasion no subjective sensations, or very little. These cases are designated *tachycardia*. Constant or frequently repeated palpitation leads to hypertrophy of the heart from over-exercise, as in exophthalmic goiter, athletes, etc.

The treatment of palpitation varies with the cause. In nervous cases or in palpitation from fright, excitement, and the like, sedatives, such as bromide of potassium, valerian, or camphor are called for. When the heart is weakened by organic disease and palpitates from inefficient power of the individual contractions, digitalis and other stimulants are needed. Finally, local treatment directed to the stomach, ovaries, or uterus, or constitutional remedies to improve the condition of the blood, or the simple correction of dietetic errors may suffice to control long-standing tendency to palpitation. WILLIAM PEPPER.

Palpus (pl. PALPI): See ENTOMOLOGY.

Palsy: another term for PARALYSIS (*q. v.*).

Paludan-Müller, pää'loo-daan-mü'ler, CASPAR PETER, Ph. D.: historian; b. in Kjerteminde, Denmark, 1805; studied theology, but became a teacher; in 1840 rector of a Latin school; in 1872 Professor of History at the University of Copenhagen. His principal works are *Grevens Feide* (The Counts' Feud, 2 vols., 1853–54) and *De første Konger af den Oldenborgske slægt* (The Earliest Kings of the Oldenborg Line, 1874). D. in 1882. D. K. D.

Paludan-Müller, FREDERIK: poet; b. at Kjerteminde, in the island of Fünen, Denmark, Feb. 7, 1809; studied law, but never practiced; visited Germany, Holland, France, Switzerland, and Italy 1838–40. His principal work, *Adam Homo* (3 vols., 1841–48), is a novel written in verse, in the strophe of Byron's *Don Juan*. In its contents the book is national and original; in its form it is an imitation of Byron. It is a satire upon the spirit of worldliness and compromise of our time as represented in the person of the hero. Among his other novels and tales, *Dandserinden* (1833) is the best known. Of his dramas some treat mythological subjects, *Amor og Psyche*, *Dryadens Bryllup*, etc.; others romantic, *Alf og Rose*, *Prinds og Page*, etc.; and others biblical, *Adam og Eva*. Prominent among his works are *Kalanus*, an Indian tragedy (1861), and *Adonis*, a romance in verse (1874). D. Dec. 27, 1876. His *Poetiske Skrifter* were published at Copenhagen (8 vols., 1878–79).
Revised by D. K. DODGE.

Paludico'læ [Lat. pl. of *paludicola*, a marsh-dweller; *palus*, marsh + *colere*, inhabit]: an order, or sub-order, of birds containing the cranes, rails, and their allies; synonymous with ALECTORIDES (*q. v.*).

Paludism: See MIASMA.

Pamir Dialects: the Iranian dialects spoken in the central Asiatic table-land, the plateau of Pamir. Most important of these is the Munjī or Munjānī, spoken in the region of Mungān, near Kāfiristān; this tongue presents interesting resemblances to the ancient language of the AVESTA (*q. v.*). Other dialects are the Sanglichī, Ishkāshāmī, Wakhī, Shighnī, and the Yaghnōbī, or speech of the Galchas near the source of the Zarafshān. (See IRANIAN LANGUAGES AND LITERATURE.) Consult Tomaschek, *Centralasiatische Studien*, vol. ii., *Die Pamir-Dialekte* (Vienna, 1880), and W. Geiger, *Die Pamir-Gebiete* in Penck's *Geographische Abhandlungen*, vol. ii., 1 (Vienna, 1887). A. V. WILLIAMS JACKSON.

Pamirs: the geographical designation of the elevated region in Central Asia between lat. 36° and 39° N. and lon. 70° to 76° E. Politically it is divided between Chinese and Russian Turkestan, Bokhara, Afghanistan, and a number of petty states and independent tribes N. of the Punjaub. It extends from the Trans-Alai Mountains on the N. to the Hindu Kush on the S., and from the plains of Kashgar to the upper tributaries of the Oxus. It is a complex of mountains, valleys, and limited plains, all at elevations above 12,000 feet, and the mountains sometimes reaching 20,000 and 25,000 feet. It is divided into several individual isolated plains, as, from S. to N., the Little Pamir, the Great Pamir, Pamir Alichur, Pamir Rang-Kul, Pamir Sariz, Pamir Khartosh. The Pamir region is sometimes referred to as the "Roof of the World." It is traditionally the birthplace of the Aryan race, and some of the names of places still in use there present curious similarity to corresponding ones found in Genesis. The Anglo-Russian rectification of the Afghan boundary omitted the consideration of the Pamirs, as the region was little known and considered impassable. This omission attracted Russian and then British attention to it very strongly, and its resulting strategic importance has led to many explorations from both N. and S. since 1870. See Morgan, *The Pamir*, *Scot. Geog. Mag.*, viii., 1892, and Immanuel, *Die Pamirfrage*, *Petermanns Mitteilungen*, xxxviii., 1892—each article with a map. M. W. H.

Pamlico (or **Pamplico**) **Sound**: the largest of the sounds of North Carolina; fenced by long low islands from the open sea, with which it communicates by Ocracoke, Hatteras, Loggerhead, New, and other inlets. It is about 20 feet in average depth, with great areas of shoal water. It communicates with Albemarle Sound on the N. Its shores are low and often marshy. The fisheries are important. The Neuse and Pamlico are its largest tributaries.

Pampa, La: an ill-defined territory of the Argentine Republic, W. of Buenos Ayres and N. of the river Colorado; variously estimated to contain from 58,000 to 91,342 sq. miles. It lies partly in the region of the pampas, but there are also extensive tracts of woodland and hills of considerable size, especially toward the N.; in the open lands are numerous lagoons, often surrounded by *médanos*, or shifting sand-dunes. Since 1879, when the hostile Indian tribes were exterminated or driven beyond the Rio Negro, the land has been rapidly taken up by colonists. Sheep and cattle breeding are almost the sole industries. Pop. (1893) about 50,000. Acha, or General Acha, the capital, has about 2,500 inhabitants. HERBERT H. SMITH.

Pam'pas [plur. of *pam'pa*, probably Peruv. *bamba*, a plain]: in the southern and western parts of South America, any large open plains or rolling lands; hence the word is synonymous, or nearly so, with the terms llanos, savannas, prairies, etc., used in other parts of America. In a special geographical sense, the vast grassy plains which occupy a portion of the Argentine Republic. Roughly defined, they comprise an area of over 300,000 sq. miles, between the Paraná and the Atlantic on the E., the hills of Córdoba, San Luis, and Los Andes on the W., the Rio Salado on the N., and the Rio Negro on the S. The Gran Chaco and the eastern part of Patagonia are plains continuous with the pampas, but they are sufficiently distinguished by their vegetation and geological structure. To the eye the pampas are perfectly level; there is, however, a gentle slope southeastward, from 1,300 feet above sea-level, near Córdoba, to 50 or 60 feet by the Atlantic, S. of the Rio de la Plata. Slight depressions are occupied by shallow lakes and swamps; many streams are lost in these, and others have excavated deep ravines or *barrancas*; the western side of the Paraná presents a long line of clay cliffs, the cut edges of the plains. The soil is somewhat impregnated with salt; there are extensive salines, and in the northern and western districts many of the lakes and even the streams are brackish. The vegetation consists entirely of grasses and herbs, more luxuriant and perennially green in the depressions; in other parts they dry up in July and August, leaving the ground bare. The soil in the depressions is often well suited for agriculture, and good crops of grain and vegetables are raised; but the pampas are above all adapted for grazing, and they are famous for the immense herds of cattle and flocks of sheep which are pastured on them. The half-wild *gauchos*, or herdsmen of mixed race, who were formerly the only inhabitants, are gradually

giving place to European immigrants, who have introduced better methods of planting and herding. The clays composing the pampas are of late Tertiary and Quaternary age, and contain the bones of many species of extinct mammalia, including the *Megatherium*, *Scelidotherium*, and *Mylodon*. See PLAIN and ARGENTINE REPUBLIC.

AUTHORITIES.—Darwin's *Voyage of a Naturalist*; Napp, *The Argentine Republic* (1876); Ramon Lista, *Exploración de la Pampa* (1885). HERBERT H. SMITH.

Pampas del Sacramen'to: an extensive tract of more or less open land in Northern Peru, between the rivers Huallaga and Ucayali, similar in character to the Brazilian plateau. They were discovered by Simon Zara, a Jesuit missionary, in 1732, and until 1767 supported important missions, but are now nearly deserted. The area is at least 20,000 sq. miles. H. H. S.

Pampas Grass: the *Gynerium argenteum*, a reed-like grass from the temperate regions of South America, much cultivated for ornament. The recurved slender leaves are clustered thickly at the ground. From the middle of the tuft the flowering stems rise 6 to 12 feet high, and bear an ample silvery panicle. The staminate and pistillate flowers are borne by different plants; the flower-clusters of the female plant are distinguished by their larger size and greater spread; it is therefore the most ornamental.

Pam'philus: martyr; b. at Berytus in Phœnicia about 240 A. D.; embraced Christianity; became a friend and associate of Eusebius; founded a library at Cæsarea in Palestine, which he bequeathed to the Christian church there, and suffered martyrdom in 309. He wrote an apology for Origen, of which only the Latin translation by Rufinus of the first book has come down to us.

Pamphyl'ia (in Gr. Παμφυλία): an ancient district of Asia Minor, extending along the Mediterranean from Cilicia on the E. to Lycia on the W. With the exception of the plain of Perge-Aspendus, it is mountainous, being covered with ramifications of the Taurus Mountains, which formed its northern boundary. The inhabitants were a mixed race, composed of Greek colonists and aboriginal tribes, and their language and institutions exhibited a similar mixed character, half Greek and half barbarian. The country belonged to the Persian empire, and after its fall to the Macedonians. When Alexander died it fell to Syria, and became subsequently a Roman province. Its chief cities were Olbia, Attalia, Perge, Aspendus, Sylleum, and Cibyra. Its chief rivers were the Cestrus and the Eurymedon. See the monumental work of Niemann and Petersen, *Städte Pamphyliens und Pisidiens* (Vienna, 1890), vol. i., *Pamphylien*; Ramsay, *Historical Geography of Asia Minor* (London, 1890, p. 415 ff.). J. R. S. STERRETT.

Pamplo'na, or **Pampelu'na** (anc. *Pompeiopolis*): capital of the province of Navarre, Spain; situated on the Arga, a tributary of the Ebro (see map of Spain, ref. 12–H). It is fortified and defended with a strong citadel (modeled on that of Antwerp), and has a Gothic cathedral (1397), a natural history collection, a bull-ring (accommodating 8,000 spectators), a magnificent aqueduct on ninety-seven arches, manufactures of silk, leather, pottery, and a trade in wine. Originally a town of the Vascones, it was rebuilt by Pompey, from whom it derived its name. It was the capital of Navarre after 907. In the fourteenth century it was greatly strengthened by Charles III. It was taken by the French in 1808 and held until 1813, when it was freed by Wellington. In 1873–76 it was a point of attack by the Carlists, but never taken. Pop. (1887), 26,663.

Pamplona: a town of the department of Santander, Colombia; 84 miles N. E. of Socorro; in a mountain valley, 7,000 feet above the sea (see map of South America, ref. 2–C). It was founded by Pedro de Ursua in 1549, and soon after rich gold mines were discovered in the vicinity; these are now abandoned, and the town has lost much of its ancient importance. It is the seat of a bishopric and contains many old convents, etc. The climate is healthful, but the frequent thick mists make it disagreeable. Pop. about 9,000. H. H. S.

Pamun'key River: a stream formed in Virginia by the confluence of the North and South Anna rivers. It flows S. E. and at West Point joins the Mattapony to form the York river. Navigation by vessels of considerable draught once extended to Hanover Court-house, more than 60 miles, but the river is now shallow and full of sand-bars, and navigable only some 12 miles to White House.

Pan (in Gr. Πάν): a son of Hermes by a daughter of Dryops (or of Zeus by Callisto). He was a genuine Greek god, and was originally a light-god (*φάων*), though in poetry and art he was the patron of flocks and pasturage (*πάω* = *pasco*). The Greek conception of Pan is given beautifully in *Hom. Hymn.*, xix. (cf. *Theocritus*, i., 16 ff.). Pan had goat's legs, horns, beard, tail, ears, and face; he was so ugly that his mother was terrified when she first saw him. He was the inventor of the syrinx and of pastoral music; had a loud voice by which he frightened the wayfarer and even put armies to flight, wherefore such sudden flight is called *panic* (*πανικὸς φόβος*). He must not be confounded with the Satyrs, Sileni, or Roman Fauns. For Pan in art, see the article *Pan* in Baumeister's *Denkmäler*.

J. R. S. STERRETT.

Pana: city; Christian co., Ill. (for location, see map of Illinois, ref. 7–E); on the Balt. and Ohio S. West., the Cleve., Cin., Chi. and St. L., and the Ill. Cent. railways; 35 miles S. by W. of Decatur, 42 miles S. E. of Springfield. It is in a coal-mining region, and has considerable trade, a national bank with capital of $50,000, a private bank, and a daily and two weekly newspapers. Pop. (1880) 3,009; (1890) 5,077; (1900) 5,530.

Panætius (in Gr. Παναίτιος): Stoic philosopher of the second century B. C.; friend of Lælius and Scipio Africanus; author of a lost work *On Duty* (*περὶ τοῦ καθήκοντος*), which forms the basis of Cicero's *De officiis*. See H. N. Fowler, *Panætii fragmenta* (1885). B. L. G.

Panama': a department of Colombia, including the Isthmus of Panama to the confines of Costa Rica; area, 32,380 sq. miles. About half the territory, principally in the middle and western parts, is settled; the remainder is peopled only by a few roving Indians. The grazing industry has attained some importance in the western districts; agriculture is everywhere backward, and the manufactures are insignificant. Gold is mined in small quantities, and coal and other minerals are reported. The forests are rich in cabinet woods. The pearl-fisheries of the Pacific coast have existed since the conquest, and are still important. Panama was the first region in continental America settled by Europeans (see DARIEN), and since 1535 it has had a special importance owing to the trade across the isthmus. In 1698–1700 an unsuccessful attempt was made to plant a Scotch colony on San Blas Bay. The isthmus was incorporated with the viceroyalty of New Granada in 1718. It was independent from 1857 to 1860. Pop. (1885) 315,000. See PANAMA, ISTHMUS OF. H. H. S.

Panama: capital and largest city of the department of the same name; on the southern or Pacific side of the isthmus, at the head of the Bay of Panama; terminus of the Panama Railway, which connects it with Aspinwall (see map of Central America, ref. 9–N). It is the oldest city of European origin in continental America, having been founded by Pedro Arias Davila in 1519. The old city, 6 miles S. E. of the present one, was burned by the buccaneer Henry Morgan in 1670, and is now marked only by ruins. Panama was long the most important port on the Pacific side of Spanish America; the trade of Peru, Chili, Central America, and a portion of that of the East Indies, entered here; and there was a regular commerce with Spain through the Caribbean ports of Nombre de Dios and Portobello. With the development of the route around Cape Horn, and the transference of much of the Peruvian trade to the land route through New Granada, Panama declined in importance. The completion of the isthmian railway in 1855 gave it a new impetus; but it has suffered greatly from revolutions and from destructive fires. The modern city is built on a rocky peninsula. There is no proper harbor for large vessels; the anchorage, 11 miles from the city, is partly protected by reefs and islands, but during the prevalence of north winds it is inconvenient and sometimes dangerous. Owing to the force of the tides, which rise from 12 to 22 feet, landings can be effected with safety only at certain hours; small steamers and lighters are used to transfer passengers and freight. The port is free, and besides the commerce in transit there is a considerable trade with Central America and the Pacific ports of Colombia. Among the interesting old buildings are the cathedral (one of the largest in America), convents, the palace of the Audiencia, and the ancient walls and fortifications, which were of great strength. The climate is warm and damp, but more healthful than that of other parts of the isthmus. Pop. (1892) about 25,000. HERBERT H. SMITH.

Panama, Isthmus of: a neck of land connecting North America with South America, and separating the Caribbean Sea from the Pacific Ocean. Broadly speaking, the isthmal portion of the continent includes all of Central America and Southern Mexico; but the name is generally restricted to the narrow portion extending from the Bay of Chiriqui to the river Atrato, lying entirely in Colombia and including the department of Panama, with a small portion of Cauca. It extends from W. to E., forming a double curve. The length is nearly 470 miles, and the average width is nearly 70 miles. The bays of Panama and San Miguel on the S., and of Chiriqui and Urabá on the N., form three minor constrictions which bear distinctive names. Beginning at the W., the Isthmus of Chiriqui, opposite the bay of that name, has a minimum width of about 45 miles. Beyond this the neck is broadened to 118 miles by the Azuero Peninsula on the S. The Bay of Panama reduces it to 31 miles opposite the Bay of San Blas, or about 35 miles between Panama and Aspinwall; this is known as the Isthmus of Panama proper, or of San Blas. The Isthmus of Darien (a name sometimes applied to the whole neck) is properly the portion between the Gulfs of Urabá and San Miguel, 35 miles in minimum width. An irregular mountain chain, the Cordillera de Baudó, runs the whole length of the isthmus, generally near the northern coast; westward it has volcanic peaks said to be over 7,000 feet high; but eastward it subsides to a range of hills, with passes less than 400 feet above sea-level. Humboldt's theory that this range formed a continuation of the Andes has not been confirmed by later explorations. It is separated from the Andes by the valley of the river Atrato, which forms the true limit of the South American continent; the head of the Atrato is separated from the Pacific only by low hills, and the region between the river and the ocean may be regarded as a part of the isthmus. The coasts of the isthmus are generally low, swampy, hot, and often very insalubrious; there are numerous fringing islets and larger outlying islands, especially on the Pacific side. Many small rivers descend to both coasts. On the southern slopes of the Cordillera there are considerable tracts of natural grassland; all the rest of the surface, where uncleared, is covered with matted forest. Rains are very abundant during nine months of the year, with frequent violent thunder-storms. The dry months are February, March, and April; from August to October the heat is very great, except in the mountains. Balboa, who first established the existence of the isthmus in 1513, crossed it in the part known as the Isthmus of Darien. The difficulties of this route, and of that opposite the Bay of Chiriqui, early led to their abandonment in favor of the easier road from Panama, by the valley of the river Chagres. This has continued to be the ordinary route across the isthmus, and it attained a new importance during the early rush for the California gold-fields. Here the Panama Railway (opened in 1855) crosses by a pass only 263 feet above tide-water; and it was the route chosen for the Panama ship-canal. See SHIP-CANALS. HERBERT H. SMITH.

Panama Ship-canal: See SHIP-CANALS.

Pan-American Congress: a conference of representatives of the U. S. and the republics of Mexico, Central and South America, Haiti, San Domingo, and the empire of Brazil, held at Washington for the purpose of discussing and recommending measures to regulate and improve the international relations, business intercourse, and means of direct communication between these countries. It was summoned in accordance with the provisions of an act of the U. S. Congress of May 24, 1888, and met at Washington Oct. 2, 1889, but in consequence of the invitation of the U. S. Government to the delegates of the congress to visit different parts of the U. S. before entering upon their labors, it adjourned to Nov. 18, 1889, when it began its regular sittings. The idea of such a congress was not new. Henry Clay's scheme for a Panama congress comprised several features of the later plan, but was never carried out. To James G. Blaine more than to any one else was due the assembling of such a body. Among the subjects discussed by the congress, without definite results, were the establishment of an international bank, the protection of copyrights and patent rights, the granting of subsidies to steamship companies, and the adoption of an extradition treaty. Among the measures which the congress voted to recommend to the various governments for adoption were a uniform system of weights and measures, a uniform commercial coinage, and a common method of legalizing documents. Another important recommendation was that reciprocity treaties be adopted between the states. It adjourned Apr. 19, 1890.

Pan-American Exposition: See EXPOSITION.

Panard, păă'naar', CHARLES FRANÇOIS: song-writer; b. at Courville, near Chartres, France, Nov. 4, 1694; went early to Paris, where he became a Government clerk. Possessed of a great facility in rhyming, he composed more than eight hundred songs and vaudevilles. These were mainly improvised, written only on odd scraps of paper if written at all, and sung at a tavern for the delight of his companions. They are gay, light, and seldom coarse pictures of the manners of the time in a vein of good-humored satire, and are masterpieces of their kind. Only part of them were collected in *Théâtre et Œuvres diverses* (4 vols., Paris, 1764) and *Œuvres choisies de Panard*, published by A. Gonffé (3 vols., Paris, 1803). D. June 13, 1765. A. G. CANFIELD.

Panas, PHOTINOS, M. D.: ophthalmologist; b. in Cephalonia, one of the Ionian islands, Jan. 30, 1832; graduated M. D. at the School of Medicine in Paris in 1860; settled in Paris and was naturalized as a citizen; in 1863 was made an associate professor and surgeon to the Central Bureau; was appointed ophthalmic surgeon to the Bicêtre Hospital in 1864, to the Lourcine and the Midi hospitals in 1865, to the St. Antoine and St. Louis hospitals in 1868, to the Lariboisière Hospital in 1872, and to the Hôtel Dieu in 1879; in 1879 he was appointed professor of ophthalmology. He has published many papers on subjects connected with his specialty in medical journals, and he is the author of a number of works, among the most important of which are: *Leçons sur le strabisme, les paralysies oculaires*, etc. (Paris, (1873); *Leçons sur les kératites*, etc. (1876); *Leçons sur les affections de l'appareil lacrymal*, etc. (1877): *Leçons sur les rétinites* (1878). S. T. ARMSTRONG.

Panchatantra [Sanskr., having five books or sections]: an ancient Sanskrit collection of fables and tales, of ethico-didactic purpose. The form of the teaching bears much resemblance to that of the Buddhists, as exemplified in the Jātaka. The substance of the work is neither specifically Brahmanic nor Buddhistic, but rather, in general, Indic. The date of the extant form of the work is uncertain. The *Panchatantra*, or perhaps rather the earlier but now lost original thereof, has had a most remarkable history, and been transmitted through translations and translations of translations, sometimes under the name of the *Fables of Pilpay*, to almost all the peoples of Europe. The first known translation was the one into Pahlavī, about 550 A. D. Among the most notable are the Syriac version, Kalilag and Damnag (570 A. D.), text and translation by Bickell (Leipzig, 1876); the Arabic, edited by Silvestre de Sacy (Paris, 1816); Duke Eberhard's *Buch der Beispiele*, of marvelous popularity between 1483 and 1592; and Doni's *La moral filosophia* (Venice, 1552); of special interest as the immediate source of the first English version, that by Sir Thomas North (London, 1570). The last has been reprinted by Joseph Jacobs (London, 1888), under the title *The Fables of Bidpai*, with an introduction. Text edition by Kielhorn and Bühler (Bombay, 1885, 1891). Translations into German by Benfey, with famous introduction (Leipzig, 1859), and by Fritze (Leipzig, 1884); into French by Lancereau (Paris, 1871). For an account of the history of the work, see Lanman, *Sanskrit Reader*, pp. 311–316, or Jacobs's introduction. C. R. LANMAN.

Pancoast, JOSEPH, M. D.: surgeon; b. in Burlington co., N. J., Nov. 23, 1805; took his medical degree at the University of Pennsylvania in 1828; became, in 1831, an instructor in anatomy and surgery; surgeon to the Philadelphia Hospital 1838–45; Professor of Surgery 1838, and of Anatomy 1861–74, in the Jefferson Medical College, Philadelphia. He invented a number of new surgical operations; published *Operative Surgery*, *Essays and Lectures*, and other works; edited various reprints and translations of European works, and was author of many professional papers; and member of various learned societies. D. in Philadelphia, Mar. 7, 1882. Revised by S. T. ARMSTRONG.

Pancreas, or **Sweetbread** [*pancreas* is from Gr. *πάγκρεας*, sweetbread; *πᾶς*, *πάν*, all + *κρέας*, flesh]: a gland which in the human being is found behind the stomach, extending across the abdominal cavity. It weighs from 2 to 6 oz., though it seldom exceeds 5. A small posterior part (lesser pancreas) is sometimes detached. The right extremity is called the head, the left the tail, and the rest the body. In the octopus, a mollusc, the pancreas is a long,

convoluted, single cæcum. In other mollusks it is either absent or rudimentary. Some insects have analogous organs. (*Siebold.*) The pancreas of the cod is a cluster of cæcal follicles; in the higher cartilaginous fishes a number of such clusters are bound together into a glandular mass, with several distinct excretory ducts. In the higher vertebrates there is sometimes but one duct (the canal of Wirsung), but there are very often two even in man. In the human subject the larger canal usually unites with the common choledic duct. The minute structure and general aspect of the pancreas resemble those of the salivary glands. The secretion of the gland (called the pancreatic juice) is normally alkaline, viscid, and coagulable by heat. It is secreted in abundance only during digestion. Its specific gravity, according to Bernard (who derived his specimens generally from the dog by artificial fistulæ), is 1·040. It contains the principle PANCREATIN (*q. v.*), with other organic matters, and from 6 to 10 parts in 1,000 of ash. It is probable that it does not normally acidify the fats of the food, although it does so in the test-tube.

Revised by W. PEPPER.

Pancreatin: an extract derived from the pancreas. It should contain the four pancreatic ferments: trypsin, which digests proteids; steapsin, which splits up and emulsifies fat; amylopsin, which converts starch into sugar; and a milk-curdling ferment. It is by far the most important and most useful of the digestive ferments, either when administered by the physician or when acting in the secretion of the pancreas of the individual, and is used for the purpose of peptonizing foods. See PEPTONIZED FOOD. H. A. H.

Panda: See AILURUS.

Pandects: See ROMAN LAW.

Pando'ra [= Lat.= Gr. Πανδώρα, liter., all-gifted; πᾶς, all + δῶρον, gift]: in the old Greek legend, the first woman on earth, sent by Zeus to mankind in vengeance for Prometheus's theft of the heavenly fire. Aphrodite gave her beauty, Hermes cunning, and each of the gods bestowed on her some fatal gift for the punishment of mankind (Hesiod, *Works and Days*, 42–104). Again, it is said that the gods gave her a box full of blessings for mankind, but, prompted by curiosity, she opened the box, and all the blessings flew away except hope. Revised by J. R. S. STERRETT.

Paneas: See CÆSAREA PHILIPPI.

Pangenesis [Mod. Lat.; Gr. πᾶς, πάν, all + γένεσις, production]: a theory of reproduction propounded by Darwin in his *Animals and Plants under Domestication*, and best given in his own words: "It is universally admitted that the cells or units of the body increase by self-division or proliferation, retaining the same nature, and that they ultimately become converted into the various tissues and substances of the body. But besides this means of increase I assume that the units throw off minute granules which are dispersed throughout the whole system; that these, when supplied with proper nutriment, multiply by self-division, and are ultimately developed into units like those from which they were originally derived. These granules may be called gemmules. They are collected from all parts of the system to constitute the sexual elements, and their development in the next generation forms a new being; but they are likewise capable of transmission in a dormant state to future generations, and may then be developed. Their development depends on their union with other partially developed or nascent cells which precede them in the regular course of growth. . . . Gemmules are supposed to be thrown off by every unit, not only during the adult state, but during each stage of development of every organism; but not necessarily during the continued existence of the same unit. Lastly I assume that the gemmules in their dormant state have a mutual affinity for each other, leading to their aggregation into buds or into the sexual elements. Hence it is not the reproductive organs or buds which generate new organisms, but the units of which each individual is composed." F. A. LUCAS.

Pan'golin [from Malay *pangūlang*]: a common name synonymous with Manis, for any member of the MANIDIDÆ (*q. v.*).

Panicale, pä̆a-nē̆e-kaa'lā, MASOLINO, da: painter; b. at Valdesa, Italy, in 1378. He was a pupil of Lorenzo Ghiberti, and in early youth was an excellent goldsmith and engraver. At nineteen he gave himself up to painting and studied under Starnina for a while, then went to Rome, where he painted a room for the Orsini family. On his return to Florence he painted at the Carmine a figure of St. Peter beside the Chapel of the Crucifix. This work was so much praised that the Brancacci chapel was intrusted to him to adorn with subjects from the life of St. Peter. He is reported to have died in Hungary in 1415.

Panic, Commercial: See COMMERCIAL CRISES.

Pāṇini: the greatest of Sanskrit grammarians. His date is uncertain, but is probably to be set several centuries before Christ. He is believed to have been born in the extreme N. W. of India, at Çalātura, near Attock on the Indus. He had doubtless many predecessors, but his own work attained an authority which made it powerful in shaping the language of the later Sanskrit literature. It is composed in a style of enigmatical brevity, and its point of view is wholly different from ours. The principal Occidental work upon Pāṇini is by Böhtlingk (2 vols., Leipzig, 1886–87), with text, translation, explanations, indices, etc.

C. R. LANMAN.

Paniz'zi, Sir ANTONIO, K. C. B.: librarian; b. at Brescello, in the duchy of Modena, Sept. 16, 1797; took his university degree at Parma in 1818; was implicated in the revolutionary plot of 1821 and obliged to flee; after spending some years on the Continent and in England was offered the professorship of Italian in University College, London; in 1831 became an assistant in the British Museum; in 1837 was appointed keeper of printed books, and in 1856 succeeded Sir Henry Ellis as principal librarian. He reorganized the library, planned the catalogue, and designed the new library building. His most important literary works are critical editions of *Orlando Innamorato* and *Orlando Furioso* (London, 1830–34) and *Sonetti e Canzoni* (London, 1835). D. in London, Apr. 8, 1879.

Panjab: See PUNJAUB.

Panmixia: See EVOLUTION.

Panno'nia: province of the Roman empire; lying between the Danube and the Alps; bounded N. and E. by the Danube, which separated it from Germania and Dacia, S. by the Save, which separated it from Illyria, and W. by the mountains of Noricum. It was conquered and made a Roman province in the reign of Augustus, and 100 years later was divided into Upper and Lower Pannonia. Frequent rebellions compelled the Romans to build a large number of fortresses in the country, of which Vindobona, the present Vienna, was the most remarkable, and to keep large garrisons in the cities. During the decline of the Roman empire, Pannonia fell into the hands of the Huns, and from them it passed successively to the Ostrogoths, Longobards, and Slavs, till, in the ninth century, the Magyars settled on it and kept it.

Pannus: See GRANULAR LIDS.

Panopolis (Egypt. *Khemmis*; now *Ekhmîm*, or *Akhmîm*): one of the most ancient cities of Egypt; on the east side of the Nile (26° 36′ N. lat.). It contained one of the principal sanctuaries for the priapian worship of Min (whom the Greeks identified with Pan). The local ruins are disappointing and are falling into rapid decay. A necropolis, discovered by Maspero in 1884, furnished many mummies and other antiquities, some of them going back to the sixth dynasty. It is now a thriving town containing 10,000 inhabitants. CHARLES R. GILLETT.

Panormita'nus: the common surname of the great canonist Nicholas de Tudeschis; b. at Catania, in Sicily, in 1386; entered the Benedictine order in 1400; studied canon law at Bologna, and afterward taught it with eminent success at Siena, Parma, and Bologna. In 1425 he was made auditor of the Rota and *referendarius apostolicus* by Martin V., who also gave him the abbey of Maviaeum, in the diocese of Messina. In 1427, however, he entered the service of King Alfonso of Sicily, whom he represented at the Council of Basel. In 1440 he was made a cardinal by Felix V. D. at Palermo in 1445. His commentaries on the decretals of Gregory X. and on the Clementines, as well as his *Quæstiones, Consilia*, and other treatises on canon law, were considered authoritative by his contemporaries and nearest successors, and were quoted as such even by Melanchthon. They appeared in a collected edition at Venice (9 vols., 1617). See Schulte's *Geschichte der Quellen des canonischen Rechts* (2 vols., 1877).

Panormus: See PALERMO.

Panorpa'ta (*Panorpa*, a generic name): an order of insects frequently called Mecaptera (see ENTOMOLOGY), in

which there is a complete metamorphosis, jaws fitted for biting placed at the end of a beak-like prolongation of the head, and two similar membranous wings with few cross veins. These forms were formerly included in the Neuroptera, but their larvæ are more like those of the Lepidoptera, being caterpillar-like, the abdomen being furnished with eight pairs of fleshy legs. The scorpion-flies (*Panorpa*) are the most abundant members of the order. They derive the common name from the fact that the end of the abdomen of the male bears some resemblance to that of the scorpion, but in reality it is furnished not with a sting, but with a pair of clasping organs. *Boreus* contains the snowflies, brown or blackish forms found on the snow in the entire winter. All of the *Panorpata*, so far as known, are carnivorous. J. S. KINGSLEY.

Pan-Presbyterian Council: See PRESBYTERIAN CHURCH and ALLIANCE OF THE REFORMED CHURCHES.

Pansy: See VIOLET.

Pantellaria, păn-tel-laă-ree'ăă: a small island between Africa and Sicily, in the Strait of Sicily; included in the Italian province of Trapani. Area, 58 sq. miles. The soil is volcanic and well suited to the vine, the caper-plant, and to cotton, all of which are cultivated. The mineral springs have some reputation. The principal town, of the same name, is on the northwest coast. The island, anciently called *Cosyra*, was used by Roman emperors as a place of banishment for offenders. Pop. 8,000.
Revised by C. C. ADAMS.

Pan'theism: a word first used by Toland at the beginning of the eighteenth century to designate absolute monism; the identification of the totality of being with God. See the article GOD.

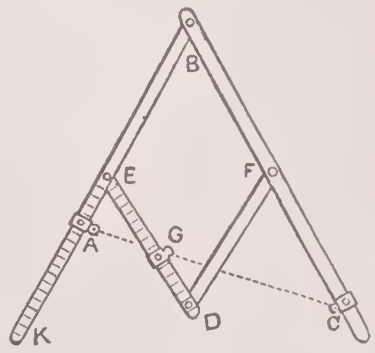
Pan'theon, or **Panthe'on, The** [= Lat. = Gr. *πάνθειον* (sc. *ἱερόν*, temple), temple dedicated to all the gods, liter., neut. of *πάνθειος*, of or belonging to all the gods, *πᾶς*, all + *θεός*, god]: the most perfectly preserved and one of the most admired structures of ancient Rome; situated in the Campus Martius (Piazza della Rotonda), and now used as a Christian church, St. Maria Rotonda. The building proper consists of a cylinder 142½ feet in interior diameter, surmounted by a hemispherical dome of same height above the floor. The walls of the structure are of concrete faced with brick, and are about 20 feet thick. In these there are alternating semicircular and square niches, seven in number, in addition to the opening for the door. The recess opposite the door contained originally a statue of Cæsar, flanked on either hand by statues of Mars and Venus. The remaining niches contained statues of gods, but their names have not been preserved. The building is lighted by a single opening in the center of the dome nearly 30 feet in diameter. Before the entrance opening there is a pronaos or portico 52 feet deep and 114 feet in width, which is faced by eight columns bearing an architrave with the inscription, *M. Agrippa L. f. cos. tertium fecit* (constructed by Marcus Agrippa, son of Lucius, in his third consulship, i. e. 27 B. C.). Another inscription in the building attests that it was restored by Severus and Caracalla in 202 A. D. It was transformed into a Christian church in 607 A. D.

There is no building at Rome which presents so many perplexing and baffling problems of an historical as well as an architectural character, and it has appropriately been called the Sphinx of the Campus Martius. Even the purpose for which it was originally intended has been a matter of dispute, many archæologists contending that it was originally designed for a warm bath (*calidarium*) in connection with the adjacent baths of Agrippa, and that its use as a temple was an afterthonght, occasioning the addition of the pronaos. This was argued partly from the form of the main structure and partly from the fact that the pronaos does not either in design or execution fit the edifice behind it. Later discoveries, however, have thrown much light on these problems. That the whole edifice dated from the Augustan period, in accordance with the evidence of the inscription on the architrave, was almost universally believed up to the winter of 1891–92, when some necessary repairs of the dome gave an opportunity for more thorough investigation than had been possible since the restoration of 1747. At this time a French architect, Chedanne, found that all of the bricks, made visible by the repairs in progress, bore the stamp of brick-makers from the time of Hadrian. Other portions of the building were then examined, and it was established beyond question that the whole structure, with perhaps the exception of the pronaos, dates from the reign of Hadrian and probably from the years 120–124 A. D. Further investigation in the floor revealed two pavements below the present surface, the lower one doubtless being the floor of the original Pantheon of Agrippa, the intermediate one belonging probably to the restoration of Domitian. Excavations beneath the floor of the portico revealed at a level corresponding to the lower floor within the edifice foundations for a larger portico, with places for ten instead of eight columns. These facts would seem to indicate that the present portico belonged originally to a building of different character (perhaps rectangular, as Lanciani suggests), and, having escaped the destruction which befell the original Pantheon of Agrippa, was removed from its site and with some alterations, placed back upon the present level by Hadrian.

LITERATURE.—R. Lanciani, *New Facts concerning the Pantheon* (in *Atlantic Monthly*, June, 1893); E. Guillaume, *Le Panthéon d'Agrippa* (in *Revue des Deux Mondes*, Aug., 1892); A. Michaelis, *Das Pantheon* (*Preussische Jahrbücher*, 1893), pp. 208–224; and especially Ch. Hülsen's review of the investigations in vol. viii. (1893), fasc. 4, pp. 305–318, of the *Mittheilungen des k. deutschen Archäologischen Instituts*. G. L. HENDRICKSON.

Panther [from O. Fr. *panthére* < Lat. *panthe'ra*, from Gr. *πάνθηρ*]: a name originally applied to the Old World leopard (*Felis pardus*; L.), but in the U. S. used for the puma (*Felis concolor*).

Pantograph [Gr. *πᾶς*, *παντός*, all, every + *γράφειν*, write]: an instrument used in copying maps and other drawings, either on the same or on some other scale.



The principle of the pantograph may be illustrated by the engraving, which shows the essential parts of the instrument in common use. It consists essentially of four brass bars with hinge-joints at B F D and E, forming a rhombus B F D E in every position. The sides B F and B E are extended so that F C and E K shall each be equal to one side of the rhombus. The parts E K and E D are graduated and numbered so that a line A G through two corresponding divisions shall always pass through C. This requires the graduation to be such that E A : E G :: B A : B C. The whole apparatus is supported by delicately formed castors. Three boxes, each fitted to hold either a pencil or a metallic tracing-point, are fitted to the beams, the one at C being fixed, and those at A and G capable of sliding along the beams, so that they may be set at corresponding points of the bars E K and E D. From the description already given, it is obvious that the three points A G and C will always remain in the same straight line, and that we shall always have A G : A C : G C :: A E : A B : E B; hence if either of these points is taken as a center of motion, the other two will trace out similar figures, whose homologous lines bear to each other a fixed ratio.

To use the instrument, the boxes A and G are clamped to the bars, so that A G and G C shall have the proper ratio, both being at corresponding points of the graduated scales. A metallic tracing-point is then clamped in the box C, which is taken as the center of motion; a second tracing-point is clamped in the box corresponding to the drawing to be copied; and a pencil is clamped in the remaining box; the tracing-points and the pencil are all arranged so as to press with proper firmness against the plane of the paper. When thus adjusted, the movable tracing-point is carried along the lines to be copied, and the pencil traces out a similar figure. If the movable tracing-point is at G, the copy is larger than the original; if at A, the copy is smaller than the original. If G is taken as the center of motion, the movable tracing-point and the pencil being at A and C, the copy will be reversed. In this manner the engraver is enabled to transfer the outlines of a drawing to the surface of the block or plate to be engraved, and either enlarge or diminish it in any given ratio. If the box A is at K and the box G at D, the copy will be of the same size as the original, but reversed. By copying the reversed drawing with the same relation of parts, a result will be obtained equal in all respects to the original.

The pantograph just explained was invented in 1603 by Christopher Scheiner, and was described by him in a pamphlet published in 1623. A more perfect instrument for accomplishing the same object was invented by Prof. Wallace, of Edinburgh; but as enlargements and reductions can now be made with more exactness and ease by photography. there is not so much use for the pantograph as formerly.

Pan'tomime [viâ Fr. and Lat. from Gr. *παντόμιμος*, pantomimic actor, liter., all-imitating; *πᾶς*, *παντός*, all + *μιμεῖσθαι*, imitate, mimic]: the art of representing thought, sentiment, will, and action by mimicry only, by attitude, gesture, and movement. It is a Roman invention (though the name is Greek), and originated in the time of Augustus. The Romans, who had more practical acuteness than imagination, had also more sense for virtuosity than for art. They seized on each single element of the representation and enjoyed it separately, the declamation through an elocutionist, the mimical expression through a pantomimist, the dance as a ballet, and the music as a concert. Of the old Roman *atellanæ*, a sort of improvised comedy performed at the festivals of the nobles by their own sons and for the sake of amusement only, the mimical imitation of what was awkward and ridiculous and the display of bodily adroitness and skill formed the principal part. In the last years of the republic these *atellanæ* received an artistic form through the *mimes* of Decimus Laberius and Publius Syrus. The *mime* was an imitation of everyday life, in the same manner as the modern comedy; but although the speech was written down and often elaborated with the greatest care, the acting or the mimical representation was still considered a most essential element. In general, mimical expression and imitation were highly appreciated by the Romans. Cicero and Roscius vied with each other as to who could express a certain state of mind best, the one with his eloquence, the other with his mimicry; and under Augustus the pantomime became the reigning fashion. Pylades and Hylas were celebrated pantomimists in the tragical line, Bathyllus in the comical; and of the rivalry between the first two, who danced *Agamemnon* and *Œdipus*, Macrobius tells some very amusing stories. Not only in public life, however, in the theater, but also in private life, at the dinner-party, the pantomime played a very conspicuous part during the time of the first Roman emperors. The social position of the pantomimist was nevertheless very low. Hylas was flogged publicly, at the prætor's request, on account of some blunder he had made on the stage. Augustus forbade such interference of the prætor with the actors, but under Tiberius it became a law that a senator who visited the dwelling of a pantomimist or was seen in his company in the streets should lose his senatorship. The reason for thus throwing contempt on a class of artists who happened to be very fashionable was not the old Roman prejudice against actors and acting, but the character of the art itself. The obscenity and indecency which these pantomimes displayed exceeded all description; that the female pantomimist often danced entirely naked on the stage was not the worst feature. At the fall of the Roman empire this, like all the other arts, decayed and lost its former prestige. It did not perish, however; and we have reason to believe that during the whole mediæval period pantomimists continued to exist, though mingled with the motley crowd of singers, jesters, acrobats, and other popular entertainers so vehemently denounced by the Church writers. Later they were now and then employed at the performance of the mysteries, and later still, by associating themselves with the *commedia dell' arte*, their representations assumed the form under which we now know them. They borrowed the masks Harlequin, Perrot, Columbine, and Pantalone from the *commedia dell' arte*, formed a loose plot, mostly of comical elements, and filled out the scheme in a manner half acrobatic, half ballet. In that form, however, they have continued to exercise a great charm over the mind. In all capitals of Europe, and at certain seasons in all the larger towns, there are found theaters which are exclusively devoted to the representation of pantomimes. See E. Munk, *De fabulis Atellanis* (Breslau, 1840); A. d'Ancona, *Origini del Teatro in Italia* (2d ed. 2 vols., 1893); E. du Méril, *Les Origines latines du Théâtre moderne* (1849); E. du Méril, *Histoire de la Comédie* (1864–69); Maurice Sand, *Masques et Bouffons*; Magnin, *Histoire des Marionnettes*.

Revised by A. R. Marsh.

Panwe: See Fans.

Panyas'sis, or **Pany'asis** (in Gr. *Πανύασσις*), of Halicarnassus: Greek poet of the fifth century B. C.; has been called the regenerator of the epos. A kinsman of Herodotus (*q. v.*), and, like him, involved in a struggle for freedom, he was put to death by Lygdamis, the tyrant of Halicarnassus, about the time that Herodotus withdrew from his native city. See Krausse, *De Panyasside* (1891). B. L. G.

Paola: city; capital of Miami co., Kan.; on Peoria creek, and the Kan. City, Ft. Scott and Mem., the Mo., Kan. and Tex., and the Mo. Pac. railways; 22 miles E. by S. of Ottawa, 34 miles S. S. E. of Lawrence (for location, see map of Kansas, ref. 6–K). It is in an agricultural, oil, coal, lime, and natural-gas region, and contains 3 national banks with combined capital of $200,000, 2 libraries (Normal School, founded 1879, and Free City, founded 1880) containing nearly 10,000 volumes, and 3 weekly newspapers. Pop. (1880) 2,312; (1890) 2,943; (1900) 3,144.

Paoli, Pasquale: revolutionist; b. near Morosaglia, Corsica, in 1726; was educated at Naples, where his father had taken refuge. after being exiled from the island in 1739 for participation in the revolt against Genoa; returned to Corsica in 1755; became the leader of the party which strove to expel the Genoese; defeated their army and even their fleet in several engagements, and deprived them of nearly all their strongholds in the island, at the same time introducing important reforms, improving the laws, and bringing the agriculture, commerce, and industry of the country to a flourishing state by his wise and energetic administration. His success was almost complete, and excited great sympathy in Europe; but in 1768 the Genoese sold their claims on Corsica to France, and in 1769 Paoli was driven from the island by a French army of 22,000 men. He fled to England, where he was held in general esteem, and received from the Government a large pension. After the outbreak of the Revolution in France he was appointed chief both of the civil and military administration in Corsica; but the anarchical state of the Government soon occasioned collisions. He again placed himself at the head of a revolution; but despairing of winning independence without foreign aid, he appealed to Great Britain, and proclaimed George III. King of Corsica, but he was not appointed viceroy, as he had expected, and he again went to England, where he died, near London, Feb. 5, 1807. See Boswell, *Account of Corsica* (Glasgow, 1768). and *Biographies* by Arrighi (Paris, 1843), Klose (Brunswick, 1853). and Bartoli (Ajaccio, 1867).

Paolo, Fra: See Sarpi, Pietro.

Paolo Veronese: See Veronese, Paolo.

Papacy: See Papal States and Pope.

Papal States, or States of the Church [*papal* is from Lat. *pa'pa*, papa, bishop, (later) pope]: that portion of Central Italy which, before the unification of the kingdom, was under the temporal government of the holy see. They extended, though with a very irregular shape, from the Adriatic to the Mediterranean; bounded S. by Naples, and on the W. and N. by Tuscany, Modena, and the Austrian possessions, and comprised an area of about 16,000 sq. miles, with 3,124,668 inhabitants, had Rome for their capital, and yielded (in 1859) a revenue of 14,453,325 scudi. The pope possessed temporal authority over a part of this region from the time of Constantine the Great, who is said to have endowed the episcopal see of Rome with large landed possessions. The spiritual supremacy of the holy see gave to it an impressiveness and dignity that facilitated the extension of its temporal power. In the centuries after the fall of the Roman empire, when the barbarians pushed forward to Rome and the Byzantine emperors showed themselves unable to defend their possessions in Italy, the so-called exarchate, it was quite natural that the people of Rome should look on the pope not only as their head, but as their leader. The strongest of the barbarous tribes, the Franks, had become orthodox Christians, and their kings supported the popes against their enemies. Charles Martel was about to enter Italy and defend the Roman see against the Lombards when he died, but his son, Pepin le Bref, fulfilled his promise. He defeated Aistolf, the king of the Lombards, and compelled him to yield up to the pope, Stephen III., the exarchate of Ravenna, comprising, besides the so-called Pentapolis or the five cities of Rimini, Pesaro, Fano, Sinigaglia, and Ancona, seventeen other cities, mostly situated on the coast of the Adriatic, and thus the foundation of the papal states was laid. Pepin's son, Charlemagne, confirmed and enlarged the donation, but in the ninth and tenth centuries much of the papal territory was lost, and in the first

half of the eleventh century the temporal jurisdiction of the pope was not recognized beyond Rome and its immediate vicinity. In 1053 the pope obtained the city of Benevento, and in 1114 the Countess Matilda of Tuscany left all her fiefs, consisting of Parma, Modena, Mantua, and Tuscany, to the pope, who secured the possession of them, though only after a long strife with the German emperors. The chief difficulty attending the establishment of the temporal sovereignty of the pope lay in the vague and undefined relation in which he stood to the German emperor. Pope Leo III. had crowned Charlemagne emperor of the Romans, and the emperor had given Leo III. the exarchate of Ravenna, Rome, and other Italian possessions. The title of Roman emperor was inherited by the German successors of Charlemagne, and they evidently meant to transform the title into a real authority. Hence the severe struggles between Gregory VII. and Henry IV. and between Innocent III., Henry VI., and Otho IV., and it was not until 1278 that Pope Nicholas III. succeeded in compelling the German emperor, Rudolf I. of Hapsburg, to acknowledge him as a free sovereign, thereby establishing the papal states as an independent empire. The Great Schism and the removal of the popes to Avignon brought confusion and misgovernment to the papal domains in the fourteenth century. The strife between the Guelphs and the Ghibellines kept Rome in constant turmoil, and in 1347 the popular leader Rienzi became the chief magistrate of a short-lived republic. The pontificates of Alexander VI. (1492–1503) and of his successor, the warlike Julius II. (1503–13), were marked by the consolidation and extension of the papal territory. It underwent some changes during the wars of Napoleon, being at one time entirely incorporated with France, but in 1814 it was restored to the pope with nearly its former boundaries. The administration, however, of the papal government, especially during the reign of Gregory XVI., caused a great fermentation in the population. Revolutions broke out in 1831 at Bologna and other places, and Gregory XVI. depended entirely on Austrian troops for the maintenance of his sovereignty. Pius IX. made some attempts at reform, but failed. In 1848 the revolution broke out in Rome, and the pope fled in disguise to Gaëta. He was restored by French soldiers, who held the city of Rome from 1849 to 1870. In the meanwhile, after the Italian war of 1859, the legations voted for annexation to Sardinia, and the troops of Victor Emmanuel entered Umbria and the Marches and defeated the papal forces at Castelfidardo. Rome and the patrimony of St. Peter were all that was left to the pope. The French garrison evacuated the city Aug. 2, 1870, and on Sept. 20 King Victor Emmanuel took possession of Rome, declaring it the capital of Italy, and thereby abolishing the temporal power of the pope, who was nevertheless guaranteed the possession of the Vatican and Lateran palaces, and continued to enjoy the honors and immunities of a sovereign. See Rome. Revised by F. M. Colby.

Papaveraceæ: See Poppy Family.

Papaw' [from Span. *papaya* (whence Mod. Lat.), from the native West Indian name]: (1) the fruit of a small tropical American tree (*Carica papaya*) of the family *Passifloraceæ*. This fruit is eaten, but is not very palatable. It has an acrid quality, and when boiled with meats renders them tender. The juice, at least before the fruit is ripe, contains a remarkable albuminous substance resembling or identical with fibrin, is anthelmintic, and has detergent powers. The root has an offensive odor. (2) In the U. S. the name papaw, or pawpaw, is given to *Asimina triloba*, *parviflora*, *grandiflora*, and *pygmæa*, handsome shrubs, or the first a small tree, of the family *Anonaceæ*. The pulpy fruit of the first mentioned is edible, but is not generally esteemed. Revised by L. H. Bailey.

Papayotin: a substance derived from a plant called *Carica papaya*, the juice of which possesses proteolytic power, or, in other words, is capable of transforming proteids into peptones. It is supposed to differ from pepsin not only in its vegetable origin, but also because it acts in the presence of either an alkali or acid. Other derivatives of the juice of *Carica papaya* have been introduced into medicine by various firms, the chief of which are papain and papoid, which it is claimed possess certain advantages not present in other preparations. H. A. Hare.

Paper [from O. Fr. *papier* < Lat. *papy'rus* = Gr. *πάπυρος*, papyrus, paper made of papyrus]: a substance made in the form of sheets or leaves, in varying thicknesses, and employed for writing or printing upon; also for wrapping purposes, and in the manufacture of various articles of common use or of industrial and scientific application.

Base.—Vegetable fiber is the base and chief component of the article of commerce known as paper. This is used in various forms and with different intermixtures, animal as well as mineral fibers being at times incorporated into its substance, with loading or filling material and coloring-matter. In its pure state vegetable fiber is known as cellulose. It is white, translucent, slightly heavier than water, without taste or odor, and is insoluble in all simple solvents; its chemical formula is $C_6H_{10}O_5$. All vegetable growths contain cellulose, some being specially valuable, and holding high rank as paper-making material, while others are of inferior importance. Generally, paper-making material is a by-product, derived from the waste or refuse of other manufactures—as rags, old bagging, old rope, waste paper, etc.—supplemented by other good fibers obtained so plentifully and cheaply as to warrant their conversion into paper pulp.

Leading Fibers.—The fibers chiefly used in the manufacture of paper are those of cotton, bast (as linen, jute, and hemp), those derived from whole stems or leaves and associated with various vessels and cells not properly fibers (as straw, esparto, sorghum, and bamboo), and lastly those derived from wood.

History.—It seems strange that nations known to have been adept in arts and sciences centuries in advance of the Christian era should have failed to produce an article at once so important and of so great simplicity of manufacture as is paper. Even the Maoris of New Zealand roughly produced it prior to contact with European civilization by chewing and macerating the leaves of certain plants and spreading the pulp so obtained on a flat stone to dry in the sun. Paper derives its name from an aquatic plant, the papyrus (*Cyperus papyrus*), which grew in Egypt. The material obtained from this plant was the first product, so far as known to us (except the wasp's nest), resembling that which we call paper. (See Papyrus.) The manufacture originated with the Egyptians at least 2,000 years before the Christian era, and the use of papyrus extended into Greece and Italy. The Egyptian reed held undisputed command of the market for hundreds of years: in Europe till

Fig. 1.—Illustration of a paper-mill of the sixteenth century, from Jost Amman's *Panoplia omnium liberalium mechanicarum et sedentariarum Artium Genera continens*, etc. (Frankfort, 1564).

the twelfth-century attempts were made to supersede it, notably by the use of parchment, but success in this direction was not attained until the introduction of paper made from cotton fiber. The Chinese are credited with the discovery of the art of paper-making by the use of fibers reduced to a pulp in water. Their raw materials were the inner bark of the mulberry-tree, bamboo, rice-straw, rags, etc. A Chinese mandarin is said to have invented a process of making paper from the bark of trees combined with the fibers of silk and hemp. This was in the year 95 A. D.

Two hundred years later the Romans made strong brown paper from the bark of trees, and 300 years afterward the same material continued in use. About the year 610 the bark of the paper-mulberry was employed as a paper-making material in Korea. The Aztecs also made a paper, resembling papyrus, from the fibers of the maguey (*Agave americana*) plant; but it is not known that any data exist to establish the date of its earliest use or invention.

The Chinese communicated their discovery to the Hindus, Persians, and Arabs, and in the latter part of the sixth or early in the seventh century the Arabians established factories, one of which is reported to have been in existence at Mecca. Another paper-mill is said to have been in operation at about the same time at Samarcand, in Turkestan. At these localities paper was made from cotton, reputedly the raw fiber. The art was carried to Spain, where the Moors, besides linen, hemp, and cotton, used rags as paper-making material. From Spain the business extended to other European countries. The earliest Italian paper-mill is said to have been started in 1250; the first in Germany, 1290; in France, 1340; in Switzerland, 1350; in Austria, 1356; in Belgium, 1405; in England, 1498, or a few years earlier; in America (at Roxborough, now in Philadelphia) in 1690; and in Russia in 1712. Holland probably began paper-making in the fourteenth century, although a much later date has been given. The growth of the industry was much increased by the discovery of printing in 1450.

Hand-made Paper.—The Chinese method of manufacturing paper embodies the principle on which all paper is made. Improvements in processes and appliances have all been in the direction of the more ready manipulation of paper-making material and increase in the production of the finished article. The cost of manufacture in China, even without the facilities afforded the paper-makers of Europe and America, is less than in Occidental countries, cheaper labor and material operating to this end. Chinese paper-makers use a variety of fibers, including those from hemp, rags, linen and cotton, cane, the paper-mulberry, and the bamboo. With all of these the first operation is to make the stock tender, that is, to bring it into a condition in which it may be readily reduced to pulp. This is done by retting, without allowing it to go too far in decomposition. The stalks of bamboo, for example, are soaked in running water, or in water which is frequently changed, for 100 days or more, until the outer covering of the fiber is sufficiently softened. The material is then beaten with mallets until the fibers are separated from the bark or outer covering, after which they are cooked in a vat to which slaked lime has been added, a continuous operation taking about eight days. The fibers are next washed in clean water, and again boiled in water made alkaline with wood ashes, after which they are subjected to another bath of water and ashes until they begin to decompose; they are then taken out, rewashed, and reduced to the degree of fineness required in mortars operated when possible by water-power. The pulp thus prepared is mixed in a vat with water to the necessary degree of diluteness, after which the work of the person who makes the sheet of paper begins. This workman has a mould or sieve made with a bamboo frame to which a fine network of threads of silk or other material is attached; he dips his mould into the dilute pulp, and, taking it out with a motion which serves to interlace the fibers, turns the thin film thus formed upon a flat, wooden surface. The sheets are laid one upon the other until a pile is made; a plank is then placed upon the heap, and pressure is applied until the water has been sufficiently pressed out of the sheets, which are then removed to an oven to be dried. Hand-made paper is manufactured in Europe* on almost the same lines, after the pulp has been prepared by machinery. The mould is covered on one side with fine wire-cloth, and has a movable frame, called the deckle, both forming a shallow tray. The vatman takes a mould and lays it upon the deckle; he then dips the mould into the pulp, which is kept uniformly mixed with the water in the vat by means of an agitator, and lifts up as much of the pulp as will form a sheet of paper; to this he gives a shake from him and back again, and then from right to left and back again; this done, he transfers the mould to his assistant, who is known as the coucher, at the same time removing the deckle, which he connects to another mould and proceeds as before. The coucher turns the mould upside down on a piece of woolen felt, and places another piece of felt on the sheet of paper thus deposited. The felts and sheets of paper are alternated until a pile is formed, which is then submitted to great pressure. When this pressure is taken off the felts and sheets of paper are drawn out and laid in separate piles. The paper is afterward put into another press to remove the felt marks and to get rid of more moisture; it is next hung up, sheet by sheet, to dry, after which it is sized with gelatin. The paper is again pressed, dried, sorted, counted, packed, and in this finished condition goes to market.

Western Methods of Preparing the Pulp.—The process of making the sheet of paper by hand has been described, but not the preliminary processes for reducing the raw material to pulp, as practiced in Europe and America. During the eighteenth century and at the beginning of the nineteenth the rags used in paper-making were sold unsorted to the paper-maker. They were therefore carefully picked over when they reached the mill, and graded, chiefly according to color. This work is now done to a certain extent by the packers or rag-gatherers. The rags were then cut into small pieces, soaked in water, and piled in vaults to ferment or rot. After the necessary stage of tendering or decomposition had been reached they were washed, and the next process consisted in reducing them to pulp. In the early days of paper-making this was done in mortars, or cylinders provided with stamps moved by water-power. Wooden troughs in which stamps operated were also used. About 1750 a machine was invented which in time superseded these rude appliances in Europe and America. This was brought out in Holland, and is known as the Hollander or beating-engine. The preliminary treatment of the rags has also changed, the retting process being done away with. When the rags reach the mill they are unpacked from the bale and sorted by hand, women being employed for the purpose. The first handling is for the purpose of removing all extraneous substances, and it includes the threshing, dusting, sorting and cutting, opening seams, removing buttons, pieces of metal, India-rubber, and other foreign materials. They are then cut into small pieces by machinery, or, for special grades of paper, by hand, at long tables, to which scythe-blades are fixed at intervals. After a final dusting the rags are put into large, cylindrical boilers, called rotaries, which are set horizontally. These boilers are provided with manholes, and steam-pipes pass through their trunnions to their interiors. A rotary is packed with rags, and milk of lime and water are added, after which the manholes are closed. The boiler is then slowly rotated, steam being admitted under pressure. Other kinds of boiling apparatus are sometimes used, such as kiers, into which the rags are run on small cars or trucks, which are withdrawn when the operation is completed, thus dispensing with the emptying necessary where rotary boilers are employed. This cooking thoroughly softens the grease or any dirt remaining in the rags, and the latter are in a condition which renders them more readily susceptible to treatment in the washing and beating engines. After draining, the cooked rags are taken to the engine-room, and are there washed by a stream of water through the washing-engine until the water runs clear. The washing-engine consists of an oblong tub or trough made of wood or iron, rounded at the ends. It is made in various sizes, to accommodate from 100 to 1,500 lb. of rags. In the center of the tub there is a partition, the "midfeather," with a passageway at each end for the circulation of the water and rags through the engine. On one side of the "midfeather," occupying the space between it and the wall of the tub, is a cylinder or roll set with a series of steel knives, and beneath this roll is a bedplate, also furnished with steel knives and set in the floor of the trough, which at this point rises with an inclination to and surrounding the roll at a short distance therefrom, and then drops in an inclined plane known as the "backfall" to the level of the tub bottom. On the other side of the "midfeather" the floor of the tub is flat and level with the ends, and on this side is located the washing apparatus, which consists of one or two cylinders, whose framework is covered with wire-gauze. The roll and the washing-cylinders are mounted in such a manner as to be raised or lowered at both ends. When the washing is going on the washing-cylinder is partially submerged in the contents of the engine, the water which passes through its gauze covering being discharged through an opening in the journal which rotates it. During the process of washing the stock or material is also treated in such a way by the knives on the engine-roll that the fibers are separated and drawn out so as to be long and flexible.

In some mills the stock is bleached in an engine inter-

* There is only one paper-mill in the U. S. where hand-made papers are produced. There are many vat-mills in Europe.

mediate between the washing-engine and the beating-engine; in others the bleaching is done in the washing-engine. It is effected by adding to the "half-stuff" in the engine a solution of bleaching-powder (chloride of lime), which oxidizes the fibers, its action being accelerated by the addition of a little sulphuric acid. Having reached this point the engine is emptied by the withdrawal of a plug or valve, which lets the "half-stuff" down through a pipe into large vats known as "drainers," and provided with stone flooring, in which there are minute perforations. Here the material remains until it is sufficiently acted upon by the bleaching agent, after which it is conveyed to the beating-engine.

The next operation is that of beating, in which process the "half-stuff" is reduced to that stage of fineness requisite to convert it into paper. The beating-engine is of the same type and form as the washing-engine, but it is provided with sharper knives and the roll is set down closer to the bed-plate. The cylinder-washer is employed for a short time to wash out the bleaching solution, and to eliminate entirely the action of the chlorine a solution of hyposulphite of soda or "antichlor" is added as a neutralizing agent. When this operation is completed, the beating is continued until the fibers are reduced to the proper length. The fibers during this process are in such condition that the cutting action does not impair their strength. Next follows the sizing if engine-sized papers are to be made; also the

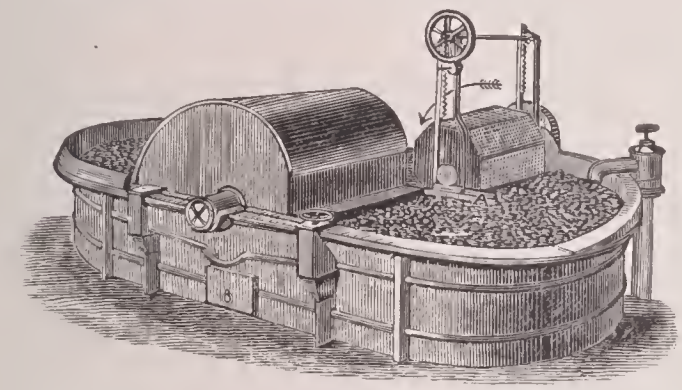


Fig. 2.—Beating-engine.

"loading." The material used for loading or filling purposes not only adds to the weight, but further serves the useful purpose of filling the pores and giving a finer surface to the paper when it is finished. The ordinary filling is china clay, but other substances in a state of fine subdivision are also employed. Among these are sulphate of lime and talc. Engine-sizing consists in adding to the pulp a resin soap made by boiling powdered resin with soda-ash, or crystals of soda, the alkali having been previously dissolved in water. If not thus sized the paper is treated with animal size as described below, or it may be both engine-sized and animal-sized. The coloring material is also applied in the beating-engine, or in making white papers the pulp is given an addition of ultramarine or other necessary color, mixed in water and strained. This "brings up" the tone of the paper and destroys the yellow tint which the paper would otherwise have.

At this stage the pulp is emptied from the beating-engine into the stuff-chests, which are large cylindrical vats, provided with agitators, in which more water is added to the pulp until it is well mixed and dilute enough to be transferred by means of a stuff-pump to a regulating-box, the function of which is to provide a regular supply of pulp to the machine; thence the pulp is carried to the screen, or strainer, an apparatus covered with smooth brass or bronze plates, having their faces cut into a number of long and narrow slits which widen on the under side to admit of the easier flow of the pulp. This strainer has a jogging motion, and while the pulp flows through the plates all knots and lumps are arrested. On leaving the strainer the pulp passes into a vat in which there is an agitator to keep it well mixed in suspension with the water.

There are numerous modifications of the beating-engine, designed with a view to economy of space, the more rapid and even treatment of the material, etc.

The greatest departure from the original form of the Hollander or beating-engine is in that class of machines known as refiners, of which the Jordan is the original type. This machine has no tub. It consists of a conical casing closed at both ends and having its interior surface provided with knives; inside of this casing there is fitted a plug or cone provided with knives on its exterior surface. The half-stuff is fed into this engine through a box located at its smaller end, and, power being applied to the shaft carrying the plug,

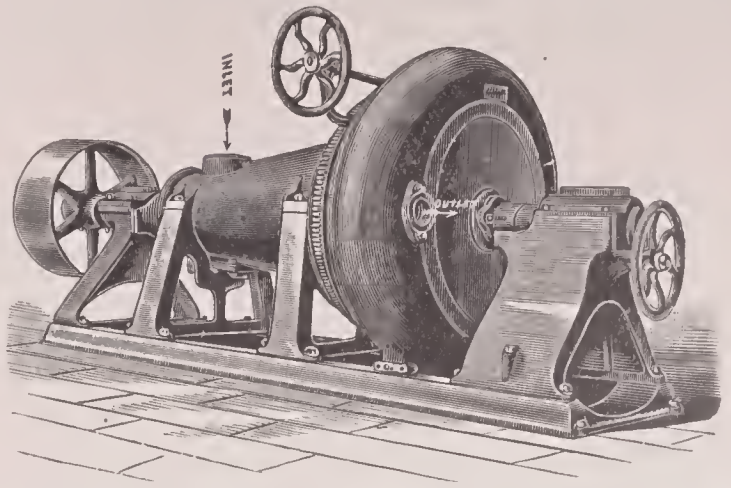


Fig. 3.—Refining-engine.

the material is drawn by the centrifugal operation of the machines from the small to the large end, where it is discharged through outlets, having undergone the action of the knives in its passage. The Marshall refining-engine is of the same character, except that at the large end of the casing there is a disk fitted with steel knives, which also operate upon the half-stuff and reduce it to the finished state necessary before running it to the machine stuff-chests. The refining-engine saves about one-third of the time usually consumed in beating the stock in the Hollander, from which it takes the material before it is thoroughly reduced; it "brushes out" the fiber, making it "mellow."

The Fourdrinier Machine.—We now come to the paper-making machine, of which there are several types. In 1799 Louis Robert invented a machine which successfully made paper in a continuous web. He put it in operation at the paper-mill of François Didot, in France, and secured a patent for it. In 1801 John Gamble, an Englishman, who accompanied Leger Didot from Paris with Robert's invention, obtained the first patent in England for that machine. Several improvements were patented both in England and France in the succeeding year, but it was not until 1803 that Bryan Donkin, who had been intrusted by Didot and Gamble with the construction of such a machine, succeeded in building one on the plan suggested by Robert, and in 1804 the second machine made by him was set up at Two Waters, England, and ran successfully. In this year Henry and Sealy Fourdrinier, stationers and paper-manufacturers in London, bought the English patents for the machine, and after making various improvements so perfected it that it has since been called the Fourdrinier machine. In 1805 this machine was capable of doing the work of six vats in one day, and the gain in time and labor, at that time so considerable, has been largely exceeded since. So many improvements have been added that the Fourdrinier machine of to-day is as a giant to its original model, not only as to size, but also as to its speed and capacity. The first Fourdrinier machine in the U. S. was set up in 1827.

The processes of paper-making have been described up to the point where the Fourdrinier machine is brought into action. From the vat into which the pulp discharges after it has passed the screens or strainers it flows down over an apron to the endless wire-cloth of the machine. This wire-cloth is generally from 32 to 40 feet long, its width being variable and based upon the greatest width of the sheet of paper which it is intended to make. The widest machine yet constructed is 136 inches in breadth of wire. The wire-cloth is made of fine brass wire woven specially for the purpose, the meshes varying from sixty threads upward to the inch. The ends of the cloth are sewn together with very fine wire. It is necessary that the wire-cloth shall preserve a uniformly even surface, and for this purpose it is supported on a series of brass rolls of small diameter, known as tube-rolls, placed near together, but not so closely as to be in contact. By this means uniformity in the layer of the pulp on the wire is gained, if the stuff in the vat is maintained of even consistency. These tube-rolls are supported in an iron frame to which a violent lateral motion is given by a device known as the "shake." This is done to cause the fibers as they enter upon the wire to interlace in various directions, and thus form a sheet which shall be nearly, if

not quite, as strong in one direction of its texture as another. The water drains from the pulp through the wire-cloth, and is received in a shallow box or trough called the "save-all," as it also catches fine particles of pulp which escape through the wire. The frame in addition to the tube-rolls carries a "breast-roll," a "guide-roll," on which there is a self-acting guide, and several other rolls. On top of the frame at the point where the pulp flows on the machine, and extending lengthwise of it for about two-thirds of the length of the wire, there is a "deckle-frame" supporting two endless rubber straps, each about $1\frac{1}{4}$ inches thick, and running over pulleys, one on each side of the machine. These "deckle-straps" rest upon the wire-cloth and prevent the pulp from spreading or flowing over its edges, and thus regulate the width of the paper. By the time the pulp has passed the deckles the sheet is formed, although yet in a very moist and weak condition. Next and near to the deckles is located the "dandy-roll," a cylindrical framework of brass covered with fine wire-cloth, which presses on the surface of the wet layer of pulp, and aids in expressing the moisture; it also performs the function of impressing what is known as the "water-mark" upon the paper. This impression is given by means of designs made from wire and soldered to the exterior wire covering of the roll, which thins the sheet at every point where it touches or indents it. If the paper is not intended to receive any special design, but is to be alike on both sides, no device is fixed to the exterior of the dandy-roll, and the impressions made by the latter upon the moist pulp are the same as those received from the machine wire on its under surface. In this case the paper produced is known as "wove." "Laid" paper is that which has parallel lines watermarked at equidistant intervals, the marking being done by a series of wires encircling the exterior of the dandy-roll. For the purpose of extracting a further amount of moisture from the pulp-layer before it leaves the wire, there are two or more suction-boxes having open or perforated tops. A suction-pump attached to these suction-boxes creates a partial vacuum in them, and the pressure of the air upon the pulp assists in withdrawing more of the water therefrom. At this stage the paper has acquired sufficient consistency to pass without breaking to the couch-rolls, two in number, the lower one carrying the wire-cloth and giving it motion. Both couch-rolls are "jacketed" with woolen felt. From the couch-rolls the web is conveyed on an endless woolen felt known as the "wet felt" between the two "first-press rolls." The paper is then carried to the "second-press," where it is transferred to another endless felt, which in turn conveys it further on its way to the "driers." Having come so far the paper is in pretty good condition, having gained in strength by reason of the loss of the greater part of its moisture. The "driers" are metal cylinders of large diameter heated by steam. These drying-cylinders vary in number on different machines, and are ranged one after the other, or in two tiers, one row above the other. A passageway between the second-press and the driers permits the machine-tender or his assistant to pass from one side of the machine to the other. The paper is carried from one drying-cylinder to another, and so on through the whole series, and is pressed against their heated surfaces by means of a felt, whereby it is made perfectly dry. Having passed the driers, the web is passed between a series of polished rolls, or "calenders," mounted one above the other in a frame, to form a "stack," their purpose being

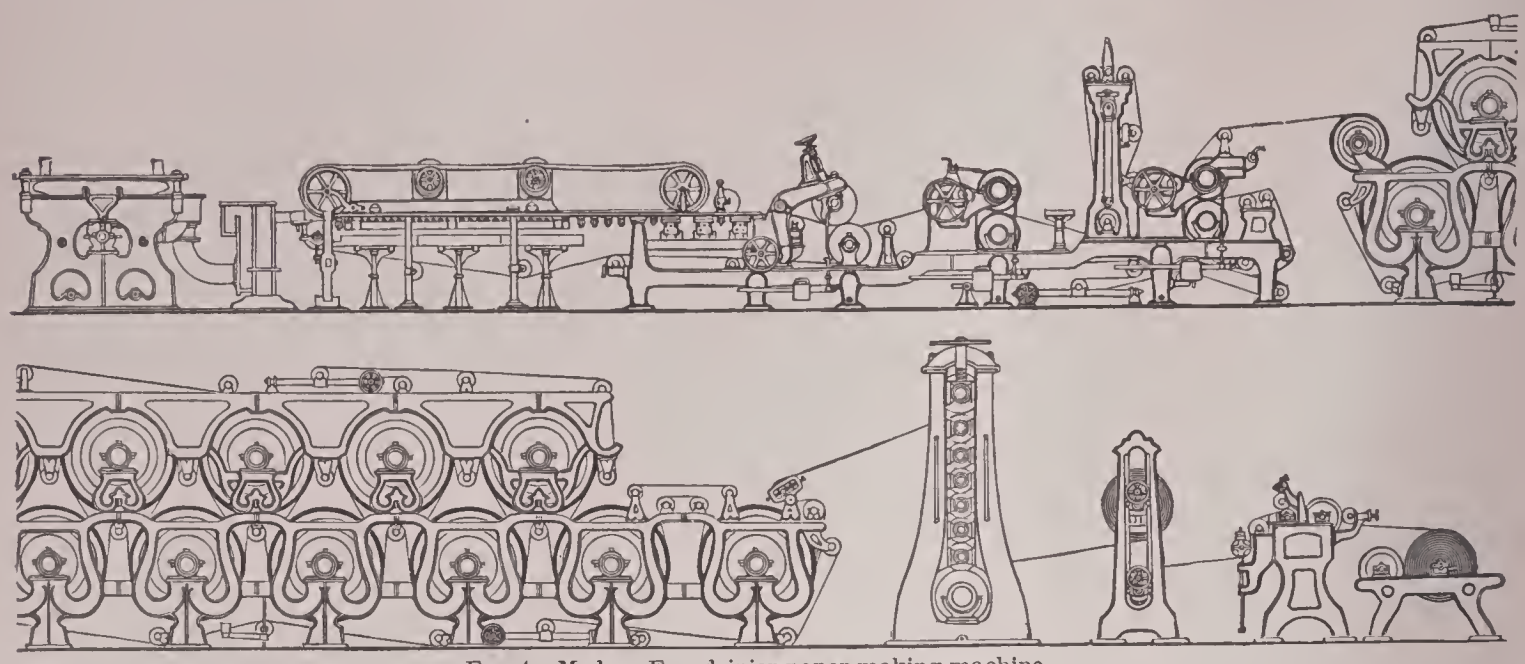


FIG. 4.—Modern Fourdrinier paper-making machine.

to give the paper a smooth surface. Leaving the calenders the web is wound on reels, and thence it goes to the cutter, where it is divided into sheets. Where the paper is intended for use on a web printing-press, it is always supplied in rolls. Should it be desired to give the paper a higher finish than it has so far received, it is taken to the finishing-room, where it is subjected to the action of super-calenders having rolls made from disks of paper or cotton-batting, mounted on steel shafts, and so solidly compressed by hydraulic pressure that they can be turned off truly cylindrical in a lathe. These rolls alternate with chilled-iron rolls in a frame. Another method of surfacing is to pass the sheets of paper between highly polished metal plates, through two heavy rolls which give a powerful pressure. So treated the paper is said to be "plated," and the apparatus is known as a "plating-machine." This mode of finishing or smoothing the otherwise rough surface of paper superseded that of pressing between two heated metal plates.

The paper-making machine is driven by power derived from a water-wheel or steam-engine carried through intermediate shafting and gearing, and generally directly connected. The latest form of communicating motion is through an improved driving-train of coned pulleys, subdivided to run the several parts of the machine at variable and graded speeds.

Sizing.—The method of sizing in the engine has been outlined. The sizing is done for the purpose of removing the porous and absorbent character of the paper, so that it can be written on. Further sizing is given on the machine, a weak solution of gelatin or animal size being placed in a shallow box through which the paper passes midway of the driers, going thence between two "squeeze-rolls," which remove the superfluous size; this is known as "tub-sizing" as well as "machine-sizing." Animal-sized paper is sometimes dried by passing it over a series of wire cylinders exposed to the action of currents of air. At other times it is dried, after being cut into sheets, by hanging it in a loft or drying-room, where an evenly warm temperature is maintained, and thus treated it is said to be "loft-dried." The best grades of writing-papers are thus manipulated.

The Cylinder Machine.—An English paper-maker named Dickinson is credited with the invention of the cylinder paper-making machine in 1809. This machine is of an entirely different type from the Fourdrinier in that part on which the web of paper is formed. It consists of a large and square vat, in which is mounted a framework of brass covered with coarse wire-cloth, over which an outer covering of fine wire is smoothly fitted. This is known as the making cylinder; it is of large diameter, and fits closely by means of interposed packing to the sides of the vat in which it rotates. The latter is kept supplied with pulp in the required state of dilution by an even flow, which maintains a uniform level of the fluid. As the cylinder rotates it takes up on its surface a thin film of pulp, which, as it encounters atmospheric pressure, is drained of some of its

water through the wire covering of the mould, the water passing out through the end of the cylinder and through the side of the vat. At the top of the vat, and connected therewith, is a framework carrying a couch-roll, which rests upon the face of the making cylinder, and rotates with the latter. An endless felt runs over the surface of the couch-roll, and passes to and between the first press-rolls, which are located in a stand next to the vat. As the thin film of pulp forms on the cylinder-mould it is brought up and in contact with the felt passing over the couch-roll, and, being taken up by the felt, is carried continuously onward to the first-press, where it loses a further proportion of moisture, thence to the second-press, as on the Fourdrinier machine, and then to the driers and calenders. There is less waste of pulp on the cylinder machine, but as there is no "shake" to give lateral motion to the fibers, the latter lie mostly in the line of travel of the web, the paper thus made being weaker across the grain than lengthwise. A double or triple cylinder machine consists in the combination of two or three vats and making cylinders, such a combination sometimes including twelve vats and cylinders. In such machines as many webs of paper as there are cylinder-moulds are formed and brought in contact prior to going through the press-rolls, where they are pressed together. Thus it is possible to make sheets of varying degrees of thickness. The inner layers may be made of cheaper stock, while the exterior surfaces may be of a better grade of material and colored as fancy may direct.

Wet-machine.—This is the first part of a single cylinder machine, having first-press rolls, and is arranged to wind the sheet of paper in continuous layers upon the upper press-roll until the desired thickness of material has accumulated upon the roll. When this has been attained an alarm-bell rings, and the attendant then operates a hand-lever which moves a knife down and on to the roll, by this means cutting open the paper cylinder formed on the roll and releasing the sheet. For some classes of work the upper press-roll is grooved along its length, so that the attendant by inserting a knife in the groove can cut the paper, or "board" as it is then called, dispensing with the lever knife arrangement. The wet-machine is used for making binders' board, wood-pulp board, leather-board, etc., and sometimes for straw-board.

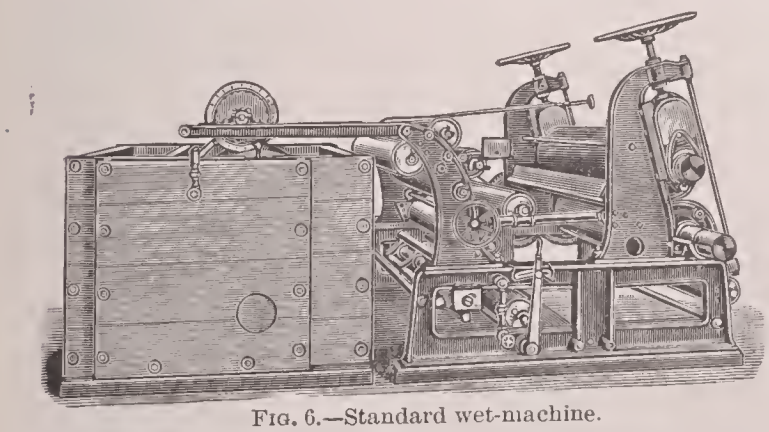


FIG. 6.—Standard wet-machine.

Harper's improved Fourdrinier is a combination of the Fourdrinier and cylinder machines. It has the wire-cloth and attachments of the Fourdrinier until it reaches the couchers, the lower roll of which is an open forming cylinder, on which the Fourdrinier wire is substituted for the fixed wire-cloth. The upper couch-roll rests on levers, and the wet felt passes thence upward and above the wire of the machine inversely to the direction of the formation of the web of paper and then to the press-rolls.

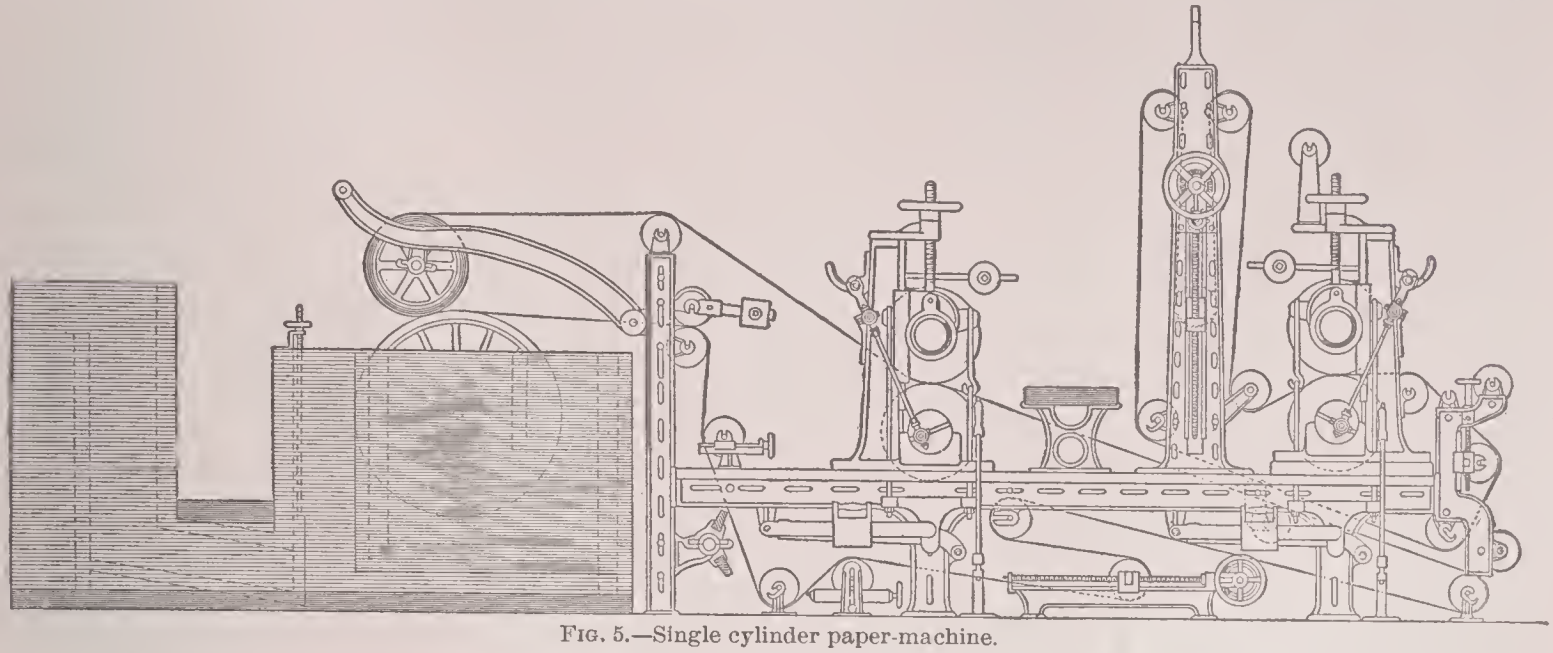


FIG. 5.—Single cylinder paper-machine.

In *mould-machines* the pulp is deposited on an endless series of square moulds similar to those used for making hand-made paper, but operating continuously after the fashion of the Fourdrinier machine, depositing the sheets on felts or carriers. These machines have found some use in Europe.

Wood and Esparto as Paper-making Materials.—Esparto grass (see ESPARTO), otherwise known as alfa and Spanish grass, is used to a great extent in Europe. When it is received at the paper-mill it is picked over by hand on a special apparatus having a traveling-apron, on either side of which the sorters are stationed. Roots, weeds, etc., are removed, and the grass is then shaken and dusted. It is then packed uncut in boilers, although in some mills open tubs are used. In general, the cooking is done under pressure in vertical boilers, a solution of caustic soda (10°) in water being used. This deprives the esparto of its silica and other incrustations. The fiber after bleaching is white, soft, and of excellent quality. A similar boiling process is employed for the production of pulp from ordinary straw. The alkali in the residuum is recovered by evaporation, in special apparatus, to the extent of about 80 per cent.

Wood-pulp.—One of the most important paper-making materials is derived from wood. There is a distinction between wood-pulp and wood-fiber. The first is obtained by mechanical means and the second by chemical treatment. Wood-pulp is produced by grinding. The apparatus for this purpose consists of a rotating grindstone inclosed in an iron casing provided with openings covered by pockets containing blocks of wood, which are kept in bearing against the periphery of the stone by means of pistons controlled by hydraulic pressure. The wood is first prepared by being deprived of its bark and knots, after which it is cut into convenient lengths, and then placed in the pockets of the grinder. Power being applied, the stone is rotated, tearing off the fiber of the wood. Water is introduced into the grinder during this operation, and the particles of wood are carried against a wire screen, which admits of the passage of the finer fibers, but retains the coarser for further treatment. When the wood has been thus reduced it may be shipped with a certain percentage of moisture to the paper-mill, where it undergoes the ordinary beating treatment, or it may be run off in sheets or made into wood-pulp board. This apparatus was invented by Henry Voelter, a German, in 1860, and is largely used in Europe and in North America. Wood-pulp has been the great cheapening agent in what are known as print-papers. While paper can be made entirely from wood-pulp, or mechanical pulp, as it is sometimes called, the fiber is too weak to make a sheet of paper of sufficient strength for most of the ordinary purposes of daily use, and for this reason it is mixed in varying proportions with

other material, wood- (chemical) fiber being the chief admixture.

Wood-fiber.—This is commonly known as chemical fiber. It is produced by two methods—the alkali and the acid processes. The alkali or soda process was invented in England by Charles Watt, who was aided by Hugh Burgess in bringing it into operation. This was in 1853, and since 1854, when Burgess constructed works in the U. S., it has maintained its position as a leading process for the manufacture of paper-pulp from wood. The incrustating matter of wood is easily operated upon by dilute alkali, the power of which is increased at a higher and increasing temperature. The alkali has a solvent and saponifying effect, and the acid products which result from the resolution of the wood are brought into the liquor as salts of soda. Poplar is the wood generally employed in the soda process, although other woods can be and are utilized, including pine, spruce, and hemlock. The wood is denuded of its bark and cut into chips, which, after being dusted, are put into boilers commonly known as digesters. These are about 22 feet long by 7 feet in diameter, and are heated by coils supplied with steam through the journals and rotating with the boiler. Sometimes "globe" or spherical boilers are used; at other times upright digesters are employed. The chipped wood having been packed in the digester, a solution of caustic soda is added to it, the strength of the liquor being from 8° to 15° Baumé. A steam-pressure of about 90 to 100 lb. from eight to ten hours is requisite to cook the wood. The resultant fiber, when washed and bleached, is almost entirely pure cellulose, soft and of a fair degree of strength. The alkali employed in the solution is afterward recovered by evaporation, the apparatus producing the best results, it is believed, being that known as a multiple effect, originally invented for the evaporation of saccharine liquor employed in the manufacture of sugar. The sulphate process is a modification of the soda process, and was invented by Dahl in 1888. In this the carbonate of soda is substituted to a large degree by the sulphate of soda.

The acid or bisulphite process has taken a leading position in the manufacture of wood-fiber. It was invented by Benjamin C. Tilghman, a native of the U. S., in 1867, but was not developed fully by him because of the difficulty at that time of securing the necessary apparatus. This invention is the foundation on which the acid fiber industry has been built up to large proportions. The process consists in boiling the previously prepared wood in a solution of bisulphite of lime. This solution is ordinarily made by burning sulphur or iron pyrites in a furnace, and combining the sulphurous acid thus obtained with water containing lime. Other bisulphites, such as bisulphite of magnesium or sodium, may be used, notably the former, which is employed in the Ekman process. This invention was taken up by Fry and Ekman in Sweden, and by Mitscherlich, Kellner, and others in Germany and elsewhere, but not until the apparatus for putting it into successful operation had been invented in Europe was it brought into action in the U. S. The wood is first prepared with great care, the bark and knots being removed, and also all decayed and stained pieces; it is then cut into chips or into disks about 1¼ inches thick, after which it is packed in the digester. The sulphite liquor is then run in quickly, the digester is closed, and steam-pressure is gradually turned on. The strength of the liquor is generally about 10° T., carrying about 3½ per cent. of sulphurous acid. The corrosive action of the bisulphite liquor is such that it is necessary to line the digesters with acid-resisting coatings. Lead has been used for this purpose to some extent, but is giving place to linings of enameled or glazed bricks set in cement with a leaden backing, or to cement linings, and again to coatings of sulphite of lime deposited by varying methods upon the interior of the steel shell of the digester. The woods chiefly utilized are spruce and Swedish fir and pine. The cooking takes from sixteen hours with high pressure to seventy-two hours at lower pressures. When the "cook" is complete the wood is washed in the digester and is then emptied out, or if the digester has been blown off into a drainer it is washed there, afterward going through the processes of washing, bleaching, and beating in the engines prior to conversion into paper. Unbleached sulphite fiber is of a light-brown color with a pinkish tinge, sometimes harsh and translucent, or again soft and nearly white, its variable quality being due to the treatment which the wood has undergone. When the fiber is well cooked and bleached it is soft, strong, and of pure color.

Classifications of Paper.

Paper is classified under various heads in different countries, and its subdivisions are known by varying names. Its chief divisions are printings, writings, wrappings, and boards. These include nearly all of the grades, there being some special products which do not come distinctly under these heads. Each class has numerous subdivisions. The different named sizes of papers are given in the subjoined table. The figures denote inches, and it will be observed that a name sometimes stands for several sizes. These differences are due to various classifications of paper.

NAMED SIZES OF PAPER.

NAME.	U. S.	U. K.	NAME.	U. S.	U. K.	NAME.	U. S.	U. K.
Antiquarian	31 ×53	31 ×53	Double foolscap	.....	16½×26½ 17 ×27	Letter	10 ×16	.....
Atlas	26 ×33 26 ×34	26½×34	Double imperial	22 ×30 32 ×46	22 ×30¼	Medium	16½×20¾ 17 ×22 18 ×23 19 ×24 20 ×24	17½×22½ 18½×23
Billet note	6 × 8	....	Double medium	18 ×46 23 ×26 24 ×38	.....	Medium and half	24 ×30	.....
Broad twelves	33 ×41	.....	Double post	.....	19 ×30½	Medium post	.....	18 ×22½
Cap	12¾×16½ 13 ×17	.....	Double pot	.....	15 ×25	Octavo note	7 × 9	.....
Check folio	17½×24	.....	Double royal	24 ×38 26 ×40	.....	Packet note	9 ×11½	.....
Colombier	23 ×34 24 ×34	23½×34½	Double super-royal	28 ×42	.....	Packet post	11½×18	.....
Commercial letter	11 ×17	.....	Elephant	23 ×28	23 ×28	Pinched post	.....	14⅛×18½
Commercial note	8 ×10	.....	Extra packet post	12 ×19	.....	Post	.....	15½×19
Copy	.....	16½×20	Extra size folio	19 ×24	.....	Pot	.....	12½×15
Crown	15 ×19	16¼×21	Flat cap	14 ×17	.....	Royal	18 ×22½ 19 ×24 20 ×25	19 ×24 20 ×25
Demy	14½×18½ 15 ×20 16 ×21 16 ×24	15½×20 17¾×22½	Folio post	17 ×22	.....	Small flat cap	13 ×16	.....
Double demy	16 ×42 21 ×32	.....	Foolscap	12½×16	13½×16½ 14 ×18¾	Super-royal	19 ×27 20 ×20 20 ×48 22 ×28	19½×27 19½×27½ 21 ×27
Double cap	17 ×28 17½×28	.....	Foolscap and half	.....	13½×24¾	Web	Varied widths.	60 in. wide.
Double crown	.....	20 ×30	Foolscap and third	.....	13½×22			
Double elephant	27 ×40	23 ×48 26½×40	Imperial	23 ×31	21 ×26			
			Large post	.....	16¾×20¾			
			Legal foolscap	8 ×24	.....			

Folded Paper.—Although sheets of paper vary in size, when folded to make up in book-form they have other designations, according to the number of leaves into which a sheet is subdivided. Thus a sheet of paper when folded is described as follows:

Folio,	folded once	=	2 leaves	=	4 pages,		folio.
Quarto,	" twice	=	4 "	=	8 "		4to.
Octavo,	" four times	=	8 "	=	16 "		8vo.
Duodecimo,	" six "	=	12 "	=	24 "		12mo.
Sexto-decimo,	" eight "	=	16 "	=	32 "		16mo.
Octo-decimo,	" nine "	=	18 "	=	36 "		18mo.
Quarto-vigesimo,	" twelve "	=	24 "	=	48 "		24mo.
Secundo-trigesimo,	" sixteen "	=	32 "	=	64 "		32mo.

Special Kinds of Paper.

There are several kinds of paper which call for special description. Some of these are used in the form in which they come from the mill, while others are subjected to treatment in various ways at the hands of manufacturers, broadly known as converters, who prepare the product for special uses. The following are of the first class, except that *coated paper*, *safety-paper*, and *tracing-paper* are also sometimes produced by converters. *Asbestos-paper* is not one of the regular makes of paper, but is a special product consisting

principally of asbestos-fiber, with which a certain proportion of paper-pulp is incorporated. It is used for roofing purposes and for covering steam-pipes to prevent radiation of heat. *Blotting-paper* is a bibulous product, unsized, and used for absorbing ink and fluids. *Cigarette-paper* is a thin tissue from which all chemicals have been removed or neutralized. It is used with tobacco for making cigarettes. The best is said to be made from straw, and it has been asserted that the finest quality is produced from the worn-out straw sandals of the Basque peasantry in Spain. There is a variety of cigarette-paper called *rice-paper*, but this is not the true product bearing that name.

Coated paper is a print paper to which a coating of white material, sometimes china clay, or gypsum, sulphate of barytes, etc., is applied. It is chiefly used for books or for fine prints from wood-cuts and process blocks. The coating is applied by machine brushes, after which the paper is dried in the web, and receives its final finish. White coated paper has a smooth, finely finished surface, enough only of the coating material being applied to fill up the pores of the paper and get the degree of finish desired. In this respect it does not come under the same classification as *surface-coated papers*, so called because a heavier coating is applied to their surfaces, various colors and shades of color, to which a glazed or dull finish is given, being used; *enameled papers* come under this class. Coated book-paper for printing upon with fine wood-cuts or half-tone plates was first adopted in the U. S., where the system of printing with hard packing on the cylinder of the printing-press prevails, and its use has established a distinct advance in the art of the printer.

Copying-paper is a thin tissue made specially for taking copies of letters, bills of lading, etc. *Detail-paper* is a special grade of heavy Manilla-paper for the use of artists and draftsmen, its surface being such as to submit to erasures without destroying the texture of the paper. *Enameled paper* is a glazed paper to the surface of which a metallic pigment has been applied and polished. *Filter-paper* is unsized, thick, and spongy, and is employed for filtering solutions in pharmaceutical or laboratory practice. The best is made in Sweden.

India-paper is used for taking those impressions from fine engravings on steel or copper known as India-proofs. It has also been utilized for proofs of the finest wood-cuts and photo-mechanical plates. It is of different qualities, and is made from the inner fiber of the bamboo, which, after separation from its outer covering and incrustating substances, is well beaten, the pulp being then spread on a polished flat surface, which gives it a smooth finish, the upper or reverse side of the sheet being rough. It is of thin, soft texture, taking a mark upon the slightest pressure, and when properly dampened showing the finest line. Cotton-fiber is sometimes used as an admixture in the manufacture of this paper. *Oxford India-paper* is a specialty of the Clarendon Press at Oxford, England, and is the thinnest of opaque papers, so thin indeed that five original octavo volumes of the Bible, containing 2,688 pages, have been printed on it and included in the space of one volume. *Ivory-paper* is Bristol-board coated with animal size, with an admixture of white pigment, and then polished.

Japan-paper.—The Government of Japan has a paper-mill at Opi, where a dozen different kinds of paper, including the silkiest tissue-paper, thick parchment paper, Bristol-board, and the paper much prized by artists, etchers, and plate-printers, are made. The last, generally known as Japan-paper, is made from the fiber of the paper-mulberry, which is also employed in other manufactures of this mill. It is produced in varying thicknesses, sometimes quite thin, and is of strong texture and a creamy color. There are several varieties of the paper-mulberry cultivated in Japan expressly for paper-making purposes, the best being that known as Ts'kuri-kake; but this is scarce and expensive. In making this paper the mulberry stalks are steamed, stripped, washed, and then boiled in water made alkaline with the ashes of buckwheat husks. After this treatment the fiber is again washed, and then a paste or size made from tororo-root or from rice is added. Then follows the pounding or beating of the fibers, the dilution of the stuff in a tub or vat, and the ordinary process of manufacture by hand or on the machine.

Localized Fiber-paper.—This is a specialty adopted by the U. S. Government for use in its Treasury notes and other certificates of indebtedness. It is a bank-note paper containing fibers of colored silk, which are added to the pulp as it is made into paper. *Manifold-paper* is a thin tissue used for writing upon with a stylus, which produces a number of copies upon as many sheets between which strips of carbon-paper are interposed. It is known in newspaper offices as "flimsy." *Nepaul-paper*, the bark of the *Daphne papyraceæ*, is after treatment converted into a strong unsized paper bearing this name. It is made in sizes many yards square.

Parchment-paper is made by passing unsized paper through a bath of dilute sulphuric acid. When dried it has a translucent, semi-transparent character, the paper gaining greatly in strength and resembling parchment. The paper is washed in water and then in dilute ammonia after undergoing the action of the acid bath. Glycerin is sometimes combined with the acid. Chloride of zinc is also employed for parchmentizing paper. A tough paper made in the ordinary way at paper-mills is called parchment-paper, but is not like the true parchment-paper or vegetable parchment.

Rice-paper is not paper in the ordinary sense of the word. True rice-paper is made from the pith of a tree indigenous to Asia, and known as *Fatsia papyrifera*. This grows to a height of 20 feet, and the pith is cut with a sharp knife into laminæ snow white in color. The sheets are sometimes 95 by 140 inches in size, and are subjected to pressure to make them smooth. Rice-paper is made into artificial flowers, and is also used for taking impressions of fine engravings. Another variety of this paper is made from the pith of the *Aralia papyrifera*. The pith of the *Echynome aspera* is also employed for this purpose, as well as that from the *Hydrangea paniculata* and the *Hibiscus manihot*. There is another so-called rice-paper made by the ordinary processes of paper-making, but it is of different material, and so made the name is a misnomer.

Safety-paper, sometimes known as *protective paper*, is chemically or mechanically prepared so that tampering with any printing or writing upon it may be detected. The chemicals may be applied to the surface or incorporated in the pulp, so that erasures or the action of acids or alkalies will change or discolor the paper. Water-marks of a special design are sometimes employed, as in the Bank of England notes, or silk threads are embodied in the fiber.

Silver tissue is a fine thin paper used for wrapping silverware. It is carefully prepared by the elimination of all chemicals likely to tarnish or discolor the bright surface of the ware, and also averts to a great extent the oxidizing influence of the atmosphere. It is sometimes known as *grass-bleached tissue*. *Sponge-paper* is made from paper-pulp containing pieces of sponge in a state of fine subdivision; used in surgery. *Toned paper or tinted paper* is tinted or has its whiteness subdued or modified by a very slight addition of color to the pulp.

Tracing-paper is thin paper which has been treated with oil or a thin solution of resin to make it transparent. It is used by artists and draughtsmen, and is made in various sizes and in rolls. Some kinds of tracing-papers are thin tissues without any treatment with oil, etc. A variety of this paper is known as *pounce-paper*.

The following papers are of the class known as converted papers:

Carbolic acid paper is a paper treated with carbolic acid in combination with stearin and paraffin. *Carbon-paper* is a thin tissue, saturated with a pigment carried in oil, and capable of imparting color to sheets of paper with which it may be brought in contact. It is used in connection with manifold-paper. *Emery-paper* is a tough paper to which a coating of glue is applied, powdered emery being then dusted on the glutinous surface. It is used for rubbing down rough surfaces of metal, etc. *Glass-paper* is an abrading agent, made by coating paper with glue and applying finely ground glass to the surface thus prepared. It is employed for rubbing down the rough surfaces of wood and metal. *Gold-* (or *gilt-*) *paper* is a paper on which a film or coating of gold-leaf, or metal simulating gold, is applied, and retained by means of size. It comes plain and embossed in fancy patterns. *Lace-paper.*—A soft paper with perforations and open-work patterns simulating lace. It is made by rubbing off the elevated sections of paper which has been embossed in various designs. The latest method of manufacture is by machines provided with special cutting dies. *Shelf-paper*, so called because it is used for covering and giving a decoration to the edges of shelving, comes under this head. *Lithographic transfer-paper* is prepared by coating paper with starch paste, and is used for transferring designs from one lithographic stone to another. Chinese (India-proof) paper is employed

for this purpose; also Saxe-paper and good book or writing paper. *Marbled Paper.*—A paper ornamented in various designs in colors representing the striations of marble. It is prepared by depositing the paper upon a surface of a thick solution of gum contained in a trough on which various mineral pigments in dilution are thrown or sprinkled, the disposition of the marbling being regulated by the use of tools which make varied patterns. The colors adhere to the surface of the paper, which when taken up and dried is polished by burnishing. *Moth-paper.*—A Manilla-paper impregnated with carbolic acid, tar, or other strong and malodorous solutions, and used for enwrapping furs and woolens, or for placing in closets, chests, etc., to prevent the incursions of moths. *Music-paper* is ruled with lines of the musical staff. *Oiled paper* is a thin paper saturated with an oil and then dried. It is used for tracing purposes. *Oiled board* is a thicker paper of the same character employed to interpose between leaves of paper in books used for copying letters or other written documents. *Pasteboards* are thick sheets made by pasting a number of sheets of coarse and common wrapping-papers together, and finished by glazing between friction calenders. *Pasted Bristols* are a variety of Bristol-boards made by pasting a number of sheets of unruled writing-paper together, after which a finished surface is given by passing the sheets through super-calenders or plating-machines. These are thus distinguished from *mill Bristols*, which are made of required thicknesses on the machine. The very best grades of stock are presumably used in making pasted Bristols. *Photographic paper* is coated or impregnated with various chemical constituents sensitive to light. It occurs under many different names. *Sand-paper* is made by coating paper with glue and applying fine sand, which is dusted over the surface. It is used in smoothing wooden and metal surfaces. *Satin-paper* has a fine glossy surface imparted by means of a satining machine, in which a brush operates in contact with the face of the web of paper. *Silver-papers* are sheets to which silver or white metal-leaf is attached by means of size. It is made plain and in embossed patterns. *Test-paper* is prepared by dipping paper into a solution or decoction sensitive to different reagents and then drying it. When used it is for the purpose of determining the presence of a substance in solution capable of changing the color of the paper. *Litmus-paper*, which is most commonly used, is made in two different colors—blue which changes to red in the presence of an acid, and red to blue in contact with an alkali. Other kinds of test-paper are *Brazil-wood paper*, *buckthorn-paper*, *cherry-juice paper*, *dahlia-paper*, *indigo-paper*, *iodine-paper*, *lead-paper*, *rose-paper*, *starch-paper*, and *turmeric-paper*. *Touch-paper* is a paper saturated with a solution of nitrate of potash and dried.

Velvet-paper and *wall-papers* are described under PAPER-HANGINGS.

Statistics.—The annual production of paper can only be a matter of rough estimate. The returns from the mills in the U. S. afford the nearest approximate for judging of capacity. Data gathered for *Lockwood's Directory of the Paper, Stationery, and Allied Trades for 1894–95* show that there were 1,231 paper and pulp mills in the U. S. at that date. The total daily producing capacity of the mills thus reported is given at 20,986,180 lb. The increase since 1881 (thirteen years) is almost 295 per cent. JAMES A. COLVIN.

Paper-hangings, or **Wall-papers**: ornamental papers intended to be pasted on the walls or ceilings of apartments. Paper-hangings are reported to have been made in Spain and Holland before 1555, but their manufacture has only in more recent times become a leading industry. The choicest wall-papers are made of good material, but for the low grade large quantities of woolen, hempen, and jute waste are employed. The paper was formerly all printed by hand, either by the process of block-printing or stencil. Cylinder-printing is now used, identical in principle with the processes employed in CALICO-PRINTING (*q. v.*); but choice styles are still hand-printed, the blocks being either engraved wholly in wood or partly made up with metal for the thinner lines. Some striped papers are colored by a simple process which can not be called printing, the colors being imparted through apertures, underneath which the paper is rapidly drawn. Flock-printing is done by printing the pattern in with varnish and then sprinkling on colored flocks, in powder, the flocks being the shearings of woolen cloth. Such papers are generally called velvet-paper. Satin-papers are finished with powdered steatite and polished.

Paper-mulberry: See FIBER.

Paper-nautilus: See ARGONAUT.

Paphlago'nia: in ancient times a district of Asia Minor, extending along the southern shore of the Euxine Sea, from Pontus to Bithynia, and bounded S. by Galatia. It was inhabited by wild and warlike tribes belonging to the Semitic race, and it was celebrated for the excellent horses it produced. Originally it formed an independent state, but it was conquered by Crœsus, and subsequently incorporated in the Persian empire. After the death of Alexander it became independent once more, but was conquered by Mithridates, and after his fall it was made a part of the Roman province of Galatia.

Pa'phos: the name of two ancient cities of the island of Cyprus. One of them, the present *Kukla*, was often called *Palaipaphos* (Old Paphos), and was famous for its temple of Aphrodite, who was said to have been born here from the foam of the waves. The other, the present *Baffa*, was called *Neopaphos* (New Paphos), and was the place where St. Paul preached to the proconsul Sergius.

Pa'pias: a Christian Father of the second century, Bishop of Hierapolis in Phrygia, according to Irenæus a disciple of John the apostle, and a companion of Polycarp. He suffered martyrdom at Pergamus during the persecutions of Marcus Aurelius about 163. Of his Λογίων Κυριακῶν Ἐξήγησις only eleven fragments have come down to us. It was a collection of sayings of the Lord, the apostles, and the disciples, with explanatory notes derived from oral tradition. The work existed as late as the thirteenth century, and it is not necessary to give up all hope of its recovery. See *Reliquiæ Sacræ* of Routh (Oxford, 1814; 2d ed. 1846); the *Apostolic Fathers* of Bishop Lightfoot (edited by Harmer, London and New York, 1893), pp. 515–525, and the translation, pp. 527–535. Trans. also in *Ante-Nicene Fathers* (New York), i., 151–155. He was a very strong millenarian.

Revised by S. M. JACKSON.

Papier-maché [= Fr., liter., chewed or macerated paper]: a manufactured material composed chiefly of paper-pulp or of paper in sheets, combined with various adhesive substances, coloring-matters, etc.; usually pressed to the desired form in suitable moulds. This material, although comparatively modern among civilized nations, is nevertheless of great antiquity in China, where doubtless it originated. In Kashmir the manufacture has long been established, and under the name of *kar-i-kalamdani*, or pen-tray work, the production of boxes, trays, and cases of papier-maché is a prominent industry. Paper-pulp was combined with gums and china clay by Martin, a German snuff-box maker, who is said to have learned the art in France about 1740. There are three processes by which the bodies of papier-maché articles are manufactured—the first consists in mixing paper-pulp with gum, resin, paste, or glue, and then placing a sufficient quantity of the mixture in a mould and subjecting it to heavy pressure; in the second process heavy sheets of softened mill-board made from pulp are pressed to the desired shape in moulds; the third process (invented by Henry Clay, of Birmingham, in 1772) employs spongy paper (similar to thin blotting-paper), layers of which are glued or pasted together and pressed into moulds. This process is considered the best, as from the uniformity of its substance it produces the strongest work; but the other methods are cheaper, and are still used for many small articles.

When the bodies of the articles are removed from the moulds, they are dried, filed, smoothed, varnished, ornamented, and polished. Soon after the invention of Henry Clay's process the manufacture of papier-maché in Birmingham rapidly increased, and in 1780 embraced a large variety of articles, such as tables, chairs, cabinets, tea-trays, caddies, panels for doors and ceilings, coaches, sedan-chairs, snuff-boxes, etc.

Pearl-shell inlaying was patented by George Santer in 1825. There is also a process of transferring colored designs from tracing-paper, which was patented in England in 1856. These methods of decoration have been used in a most extravagant and inartistic manner, and have contributed in no small degree to cause a decline in the popular appreciation of manufactures of papier-maché, which is a very suitable material for a large variety of decorative and constructive uses, being a light, tough, strong, durable substance, possessed of some elasticity, little liable to warp or fracture, and unaffected by damp. W. F. DURFEE.

Papiliona'ceæ: See LEGUMINOSÆ.

Pap'in, Denis: physicist and inventor; b. at Blois, France, Aug. 22, 1647; studied medicine at Paris and practiced for some time as a physician, but devoted himself subsequently to the study of physics and mathematics under Huyghens; visited England, and received in 1687 a professorship in mathematics at Marburg in the present Prussian province of Hesse, where he died about 1712. His writings are numerous, but are scattered in *Acta Eruditorum*, *Recueil de diverses Pièces*, *Philosophical Transactions*, etc.; they contain many valuable discoveries, most of which, however, were not fully recognized during his lifetime. He was the inventor of the so-called Papin's digester. (See Digester, Papin's.) It also appears that in 1707 he tried on the river Fulda a vessel propelled by paddles operated by a steam-engine. He improved the pneumatic machine invented by Otto von Guericke, and was active in the controversy with Leibnitz concerning the so-called "dead" and "living" forces.

Papineau, pä'pē'nō', Louis Joseph: political leader; b. at Montreal, Oct., 1789; studied at the Seminary of Quebec, and became an advocate; in 1809 entered the Canadian Parliament, and in 1815, and again in 1827, was Speaker of the lower house; but Lord Dalhousie, who had tried in vain to conciliate him with the conservative party, in the latter year adjourned the Parliament to prevent Papineau from acting as Speaker. He was after that the acknowledged leader of the Lower Canadian radicals, or French party, and after the breaking out of the rebellion of 1837 (which he did not approve) was accused of high treason and escaped to the U. S., and thence in 1839 went to France. In 1847 he returned to Canada, and though sent to Parliament and highly popular with the French element, he never again assumed leadership. D. at Montebello, Quebec, Sept. 23, 1871.

Papinia'nus, Æmilius: a Roman jurist, probably from Syria, who held high and influential positions under the reign of Septimius Severus, and was præfectus prætorio 205–212, but was put to death in 212 by Caracalla. His works—37 books of *Quæstiones*, 19 of *Responsa*, 2 of *Definitiones*, etc.—were considered the highest authority in Roman jurisprudence, and several of the most eminent Roman jurists, as, for instance, Ulpian and Paulus, were his disciples. The *Digests* contain 595 extracts from his works, but generally they are very short. See also Huschke, *Jurisprudentiæ antejustinianeæ*, pp. 436–449 (Leipzig, 1886).

Revised by M. Warren.

Pap'pus (in Gr. Πάππος) of Alexandria: a mathematician who flourished in the second half of either the third or fourth century A. D. His most important work was the Μαθηματικαὶ Συναγωγαί (Mathematical Collections), containing besides his own work explanations of earlier mathematicians, with extracts and his own criticisms on them, in eight books, of which the last six and part of the second have been preserved. These are of value in the history of mathematics. A Latin translation appeared in 1588, and portions of the Greek text have been published several times. A complete edition is by Friedrich Hultsch (3 vols., Berlin; 1875–78).

Papua: See New Guinea.

Papy'rus [= Lat. = Gr. πάπυρος]: a large reed, various parts of which were employed by the Egyptians in the construction of boats, mats, baskets, and other woven fabrics, but particularly in the preparation of writing-paper. It is known as *Cyperus papyrus* (*papyrus antiquorum*), and is extinct in Egypt, being found only in remote parts of Abyssinia. It is also said to occur in Western Asia. There is some doubt whether it was native to Egypt, but the representations on the monuments, showing rank papyrus-grown swamps where water-fowl abounded, indicate an absence of regular culture. In the hieroglyphic writing the papyrus plant is employed as the symbol of Lower Egypt. The stalks were triangular, from 4 to 6 inches in diameter, and 12 to 15 feet high. The roots were used for fuel, and a part of the inside of the stalk was edible. For paper-making a piece of the stalk of a length corresponding to the width of paper required was cut off, the rind was removed, and the inner portion was unrolled with a needle or a sharp knife. Upon this sheet another was placed transversely, and the two were joined by the juice of the plant or by a thin gum, the union being enforced by heavy pressure. The sheets were smoothed and afterward bleached by exposure to the sun. The color varied from a gray or yellow to a rich brown. The sheets varied from 6 to 17 inches in width, and any required length was obtained by fastening a number of sheets together end to end. The usual width was about 8 inches. The *Papyrus harris* in the British Museum is the longest known, being 135 feet, and a fairly full copy of the Ritual of the Dead (*q. v.*) required a roll 15 inches wide and from 80 to 90 feet long. The better qualities had only two layers of fibers; three layers indicate inferior grades. Specimens have been preserved which date from the Middle Kingdom, and the use of papyrus continued till the twelfth century in Europe. For a long time it was an article of Egyptian export, and in great demand. Probably it was never cheap even in Egypt, if we may judge by the fact that it was often used a second time, the first writing having been removed by washing. In later times there were various grades which were known as charta regia, Augusta, hieratica, Livia, Saitica, etc. Fanniana was the name given to a papyrus retreated and improved at Rome. With regard to writing on papyrus, its methods and subjects, see Egyptian Language and Literature. See also Taylor, *Transmission of Ancient Books*; Birt, *Das antike Buchwesen*; and Budge, *The Mummy*. See also Sedge Family.

Charles R. Gillett.

Pará: a state of Brazil, occupying the lower portion of the Amazon valley; bounded N. by British, Dutch, and French Guiana, N. E. by the Atlantic, E. by Maranhão, S. by Goyaz and Matto Grosso, and W. by Amazonas. Area (allowing the Brazilian claims for disputed boundaries on the side of Guiana), about 714,000 sq. miles. Pop. (estimated, 1892) 495,417. The Guiana table-lands, in the northern part, have an elevation of some 2,700 feet, and outlying portions near the Amazon are nearly 1,000 feet high; the Brazilian plateau, 2,500 feet high on the confines of Matto Grosso, falls gradually to about 300 feet near the Amazon. Between these the plains of the Amazonian depression are in some places not more than 30 miles wide, but broaden out westward into the state of Amazonas and eastward toward the Atlantic; the flood-lands of the river have an average width of about 25 miles above the mouth of the Xingú, and below it they are much wider. The Amazon itself, with its numerous side channels, forms an unrivaled system of interior communication. This is supplemented by the Pará and Tocantins, with a network of channels connecting them with the Amazon. The whole state seems covered with forest; but, hidden from the river by lines of trees, there are extensive tracts of grass on the flood-plains, and especially on the great island of Marajo; large areas on the plateaus, with some near the river, have only the low, scrubby growth of the Brazilian *campos*. Though the state is directly under the equator, the climate, tempered by the trade winds, is nowhere excessively warm; its equability and general healthfulness make it especially beneficial for invalids. Malarial fevers are confined to portions of the swampy lowlands and to the branches of the Amazon; yellow fever is rarely epidemic; the African disease called beri-beri is sometimes prevalent on the flood-lands. From the first the settlement of Pará proceeded along the lines of the rivers, and it has never gone much beyond them; with only one short railway and hardly any common roads, communication is almost entirely by steamboats or canoes. A few Indians wander wild in the interior, but the greater part are civilized or submissive to the whites, forming the mass of the country population. The most important industries are the extraction of forest products, especially rubber; sugar-cane (used mainly for making rum), cacao or chocolate beans, tobacco, and manioc are the principal agricultural products; and on the open lands the grazing industry has attained some importance. The principal exports, in the order of their value, are rubber, cacao, hides, and Brazil-nuts; much of the trade is with the U. S. The revenue is derived mainly from a tax on rubber, and the state has nearly always a surplus. The Portuguese settled Pará in 1616, driving out Dutch and French traders. After Brazil became independent this region was ravaged by a rebellion of the lower classes, 1835–37. Amazonas was separated from Pará in 1852. See H. H. Smith, *Brazil* (1879); the *Travels* of H. W. Bates, A. R. Wallace, and William H. Edwards; *The State of Pará: Notes for the Exposition of Chicago* (1893).

Herbert H. Smith.

Pará, officially *Belem*: capital and principal city of the state of Pará; on a low point at the mouth of the river Guamá in the Pará; 85 miles from the mouth of the latter in the Atlantic (see map of South America, ref. 3–F). It is regularly laid out with wide streets, which, except in the

business portion, are adorned with mangrove and other trees. The principal public buildings are the cathedral, the custom-house (formerly a Jesuit convent), and the Government theater; the president's and bishop's palaces and the house of the legislature are plain buildings. The finest residences are in the quarter called Nazaré, formerly a suburb; many of them are surrounded by extensive gardens, which are often allowed to run partly to waste, presenting an exceedingly picturesque appearance. The chapel of Nazaré is a noted resort, and the yearly festival held here attracts thousands of visitors. Tropical forest, swampy in many places, comes close to the city, and the suburban streets require constant care to keep them from the encroachments of vegetation. Pará has a marine arsenal, a botanical garden, a small museum, library, theological seminary, and good public and private schools. It is the commercial metropolis of the Amazon valley; its exports of rubber far exceed those of any other port in the world, averaging (including that in transit) over 8,000,000 lb. annually. Owing to strong tides and shallows near the city the harbor facilities are poor; light-draught river-steamers discharge directly at wharves, but large vessels are obliged to anchor some miles below. Pop. (1892) estimated with suburbs, 65,000. H. H. Smith.

Parable [from O. Fr. *parable, parabole* > Fr. *parabole* < Lat. *para'bola* = Gr. παραβολή, a placing beside, comparison, parable, liter., a throwing alongside; παρά, beside + βάλλειν, throw]: a short fictitious narrative intended to illustrate some point in moral or religious teaching. Parables abound alike in the teaching of Christ and in the Jewish Talmudical writings; but the parables of Christ (not used by him in the beginning of his ministry, but only after he had encountered opposition) immensely surpass all others.

Parab'ola [Mod. Lat., from Gr. παραβολή, parabola, liter., a throwing alongside, so called from its direction as compared to a side or element of the cone. See Parable]: a plane curve of the second degree, with a single branch extending to infinity. In modern geometry it is defined as a curve of the second degree, touching the line at infinity. (See Geometry.) This curve is the section of a right cone by a plane parallel to one of its tangent planes, from which point of view it was originally considered.

It is a property of the parabola that every part of the curve is equally distant from a fixed point and from a given straight line. The fixed point is called the *focus*, the given line is the *directrix*, and a straight line through the focus perpendicular to the directrix is the *principal axis*. At every point of the curve the line from the focus and a parallel to the axis make equal angles with the tangent—that is, the two first lines are reflections of each other with regard to the surface formed by the revolution of the curve round its axis. (See Paraboloid.) Any line parallel to the principal axis is called a *diameter*, and every diameter bisects all the chords of the curve that are parallel to the tangent at the point where it meets the curve. The principal axis is therefore a line of *right* symmetry, and every other diameter is a line of *oblique* symmetry. The breadth of the curve through the focus is called the *parameter* of the curve; it is also called the parameter of the principal axis. The parameter of any diameter, including the parameter of the principal axis, is equal to four times the distance from the focus to the vertex of that diameter. If we neglect the resistance of the air and consider gravity as acting in parallel lines, the path of a projectile is a parabola with its axis vertical and its vertex at the highest point of the path. The equation of the parabola in Cartesian co-ordinates is $y^2 = px$, where p is the parameter, and it has this form if the curve be referred to any diameter and the tangent at the point where it meets the curve. The curves included in the form $y^n = px^m$, where m and n are positive integer numbers, have been called parabolas. Thus the curve $y = px^3$ is called the cubical parabola and $y^2 = px^3$ the semi-cubical parabola. The curve $y = a + bx + cx^2 + dx^3 +$ etc. $+ fx^n$ has also been called a parabola of the nth degree.

Revised by R. A. Roberts.

Parab'oloid [Gr. παραβολή, parabola + suffix *-oid*, having the form of]: a surface of the second order whose plane sections parallel to a certain right line are parabolas. In modern geometry it is defined as a surface of the second degree, touching the plane at infinity. There are two principal kinds, the elliptic and the hyperbolic. In both paraboloids all sections parallel to the straight line called the axis are parabolas, while in the elliptic paraboloid all other sections are ellipses. If the sections of the latter perpendicular to the axis are circles, the surface is generated by the revolution of a parabola about its axis. This surface is such that parallel rays of light falling upon it in the direction of the axis are accurately reflected to a fixed point called the focus. (See Parabola.) It is also the form of the free boundary of a fluid rotating under the action of gravity. (See Hydrostatics, *Surface of Liquids.*) Hyperbolic paraboloids are ruled surfaces admitting of two modes of generation. All sections except by tangent planes and those mentioned above are hyperbolas. R. A. Roberts.

Paracatú: a town in the western part of the state of Minas Geraes, Brazil; close to the boundary of Goyaz; near a river of the same name, a western affluent of the São Francisco. It was formerly noted for its rich gold washings, which are now nearly abandoned; it is the center of a rich grazing district, and has a thriving trade with Goyaz and Bahia. Coffee and sugar-cane are grown on a considerable scale in the vicinity. Pop. 10,000. H. H. S.

Paracel'sus: physician and author; the assumed name of Philippus Aureolus Theophrastus Bombastus von Hohenheim; b. at Einsiedeln, Switzerland, in 1493; the son of a physician. He read the works of the alchemists and magicians, and traveled on foot far and wide collecting information regarding the healing art from barbers, blacksmiths, and wise women; spent much time in the mines of the Tyrol; took the degree of doctor in medicine; served for a time as a military surgeon in Denmark, the Low Countries, and Italy, and then resumed his wanderings. Œcolampadius procured him a professorship of medicine and surgery at Basel (1526), but he was soon compelled to leave the place (1527) by the Galenic physicians, for he openly burned Galen's books and denounced the Arabian masters, then so generally studied. Erasmus was one of his patients. If we may believe his adversaries, Paracelsus was almost always drunk, and was guilty of gross irregularities; certain it is that he had to resume his wandering life, and that after many strange vicissitudes he was thrown from a window and killed by the servants of a physician at Salzburg, Sept. 23, 1541. He left six professional treatises, besides a large number of works which bear his name, some of which were written by his enemies to injure his reputation, and others by fanatical admirers. His lectures also were delivered with great rapidity, and published by his hearers in a very imperfect state. Paracelsus, though he displayed many traits of the charlatan, lived a useful life. The profession of medicine at his time needed reformation quite as much as the Church did. He destroyed the humoral pathology, broke the tyranny of Galen and his Arabian followers, and introduced many new and valuable remedies. His empiricism was based upon the principles of careful observation now universally recognized. He paid great attention to diet, condemned the use of strong evacuants and the abuse of mercury, avoided the excessive mixing of drugs, and strove to reduce the overdosing then so prevalent. He is called an alchemist, although he condemned the search for the transmutation of gold, and an astrologist, although he opposed the study of astrology. A curious work regarding spirits is ascribed to him, and the strange jargon regarding sylphs, pygmies, undines, gnomes, salamanders, and other "elemental spirits" is commonly thought to have been invented by him; so that believers in the existence of such beings are called Paracelsists; but it is probable that he never wrote the work (*Liber de Nymphis*, etc., Basel, 1590), for he elsewhere ridicules all such ideas. He taught a singular theosophy—a kind of pantheistic system in which the Cabbalah was combined with natural science founded on experience and experiment, but the distinction he made between faith and reason as two different organs of perception, each with its own field of activity, resembles modern attempts of the same tendency. See *The Hermetic and Alchemical Writings of Paracelsus* (2 vols., London, 1894).

Parachute [= Fr. (by analogy of Lat. *para're*, get ready, ward off, or of words beginning with prefix *para-*); *parer*, prepare, ward off + *chute*, fall]: a machine first successfully employed by Blanchard at Strassburg in 1787, and designed to enable aëronauts to descend safely to the ground from a balloon. It is shaped like an umbrella, and is taken up in a collapsed or closed form. The car is first attached beneath the parachute, and the balloon above the whole; a rope passing through the hollow stem of the parachute attaches the balloon to the car; this rope is cut at the proper time, the car falls rapidly, and the parachute is expanded by the action of the air. The car's downward motion is thus

checked, and it descends slowly toward the earth. In practice, the parachute is not to be depended upon. It is liable to oscillations, which frequently prove fatal to the aëronaut.

Paradise [from O. Fr. *paradis* < Lat. *paradi'sus* = Gr. παράδεισος, from Zend *pairidaēza*, inclosure; *pairi*, around + *diz*, throw up, pile up]: a park or pleasure-ground; especially the Hebrew Eden (*q. v.*). The Bible uses the term in a double sense—first, for the garden of Eden, and next for the abode of the blessed in heaven (Luke xxiii. 43). It is remarkable, however, that in the discourses of Christ, public or private, the word occurs only this one time, in the words which Christ spoke to the penitent robber. Metaphorically, it is often used synonymously with heaven, denoting the future bliss which awaits the righteous. See Heaven.

Paradise'idæ [Mod. Lat. See Paradise]: a family of birds containing the Birds of Paradise (*q. v.*), distinguished by their curious plumage, and closely related to the *Corvidæ*. The bill is moderately elongated, strong, slightly decurved; the base of the bill, as well as nostrils, is covered to a greater or less extent by short feathers; the wings are long and rounded; in addition to the ordinary plumage are developed feathers of various forms and styles, diverging from the shoulders, sides, and caudal region; the feet are robust; the toes with long curved claws. The species are confined to the islands of New Guinea and its vicinity. Something like forty-five species are known, most of which are described and figured in Elliot's *Monograph of the Paradiseidæ*. Revised by F. A. Lucas.

Paradise of the West: See Sukhāvatī.

Paradox'ure [from Mod. Lat. name *Paradoxu'rus*; Gr. παράδοξος, incredible + οὐρά, tail]: any member of the genus *Paradoxurus* of the family Viverridæ (*q. v.*).

Paræsthesia: See Formication.

Paraffin, or **Paraffine** [Lat. *pa'rum*, little, too little + *affi'nis*, akin]: a beautiful white waxy solid which occurs native in the mineral wax ozokerite, found in Galicia, Utah, and elsewhere, and in some kinds of petroleum, and also found in coal and shale oil, and the products of the destructive distillation of many other organic bodies, as oil, fats, wax, wood, peat, albertite, grahamite, etc. It was discovered by Reichenbach in 1830 in wood-tar.

Preparation.—(1) Paraffin is obtained from ozokerite by distillation, cooling, and pressing the product, and purifying it by treatment with sulphuric acid and caustic soda, washing and pressing. It is also purified by repeatedly melting it with petroleum naphtha and subjecting it to pressure. (2) By similar means it is prepared from the heavier portions of coal oil and petroleum, which solidify on cooling, owing to the crystallization of the paraffin.

Composition.—Paraffin is generally a mixture of two or more members of the paraffin series of hydrocarbons, $C_{27}H_{56}$, $C_{28}H_{58}$, $C_{29}H_{60}$, $C_{30}H_{62}$, etc. $C_{27}H_{56}$ contains carbon 85·26 and hydrogen 14·74; $C_{30}H_{62}$ contains carbon 85·31 and hydrogen 14·69.

Properties.—A translucent crystalline solid, white in masses, odorless and tasteless, resembling spermaceti. Its specific gravity is about 0·870; it melts at from 113° to 149° F., and forms a colorless oil which solidifies into a crystalline mass. It boils at about 600° F., and may be distilled with but little decomposition, especially if the distillation is aided by a current of superheated steam. That obtained from ozokerite has the highest melting-point, and is consequently preferred for the manufacture of candles. It is insoluble in water, but dissolves in 2·85 parts of boiling alcohol, separating almost completely on cooling, in crystals. It is more soluble in ether, oils, and naphthas. Acids, alkalies, and chlorine have little effect upon it; whence its name. By the long-continued action of nitro-sulphuric acid it is converted into paraffinic acid. Heated with sulphur, it yields impure sulphuretted hydrogen.

Uses.—Paraffin has numerous important applications in the arts. Beautiful candles are made from it, but when the more fusible varieties are employed, the candles are liable to droop and lose their form. The crystalline structure also interferes with the manufacture of candles, but this is met by the use of small percentages of wax, etc., and by chilling the moulds, after the melted paraffin is poured into them, by placing them in cold water. It is extensively used for waterproofing fabrics, cloth, and leather for shoes, even dress silks, which are thus protected from stains. It is used for protecting from rust or decay, and putrefaction, meat, fruit, timber, metals, cartridges, pills, etc.; for making tight the stoppers of acid bottles; as a substitute for sulphur in the manufacture of matches; for oil-baths of constant temperature; for refining alcohol and spirits, by passing the vapor during distillation through melted paraffin, which abstracts the fusel oil; considerable quantities are used for chewing-gum. Uncrystallized or amorphous paraffin is in very common use in the well-known vaseline or petroleum ointment. See Bitumen, Hydrocarbons, and Petroleum.

Revised by S. F. Peckham.

Paraguay, par'ăă-gwī (Sp. *República del Paraguay*): the smallest of the South American republics, except Uruguay; between Bolivia on the N., Brazil on the N. and E., and the Argentine Republic on the S. E., S., and W. Area, according to official figures, 97,707 sq. miles; but this is only approximate, as the boundary with Bolivia is unsettled.

Topography.—The river Paraguay divides the country into two well-marked sections. The portion W. of the Paraguay is a low plain, a wilderness of swamps, forest, and grass-lands. This region, the Paraguayan Chaco, is described in the article Gran Chaco (*q. v.*). The remaining and larger portion (about 62,000 sq. miles) is sometimes distinguished as Paraguay proper. It occupies a peninsula formed by the rivers Paraguay and upper Paraná, which unite at the southwestern extremity; the northern boundary is the river Apa, a branch of the Paraguay, and the northeastern is formed by lines of hills, the continuation of a line of heights which begins about 75 miles E. S. E. of Asuncion, and extends N. N. E. across the country. The heights, improperly called *sierras* and *cordilleras*, appear to be nothing more than the eastern and southern edges of an extension of the Brazilian plateau, which occupies all the northern and central parts of Paraguay; but this plateau is so cut up by river valleys and varied with hills that it has lost the character of a table-land. The maximum elevation is probably less than 2,500 feet. The steep edges are, at the highest part, close to the divide between the affluents of the Paraguay and Paraná. On the western side the country falls irregularly but gradually to the rolling lands and plains bordering the Paraguay. The hills of Southern Paraguay and the upper Paraná valley are spurs and outlying portions of the same plateau. The southwestern corner of the country is nearly all occupied by an extensive swampy plain, with several shallow lakes; and there are smaller swamps farther N., along the course of the Paraguay. A large portion of the valley of the upper Paraná and the central hills are covered with forest; toward the Paraguay this gives place to open lands suitable for grazing. The rivers Paraguay and Paraná (*qq. v.*) are natural highways of great importance. The Jejuy and Tibicuary, affluents of the Paraguay, are both navigable, and promise to be of great commercial value. The other Paraguayan branches of the two rivers are numerous, but generally short and navigable for only a few miles.

Climate.—Though two-thirds of the republic is in the south temperate zone, the climate is tropical; but the temperature varies considerably, according to the prevalence of S. or N. E. winds. The mean for the year is about 73° F.; in December and January the thermometer occasionally rises above 100° at Asuncion, and from May to August light frosts are sometimes felt when the S. wind blows. There is no well-marked dry season; showers are more abundant in the warm months, from October to April. In November and December and in June there are frequent tempests, with torrential rains. The whole of Paraguay is healthful, even in the swampy districts of the southwest; malarial fevers are not common, and destructive epidemics are rare. The common diseases arise mainly from poor and insufficient food; lung troubles are almost unknown. Goitre and elephantiasis are endemic in a few districts.

Fauna, Flora, etc.—The animals and plants resemble those of Brazil, but there is an intermixture of the temperate forms of the Argentine Republic. Jaguars, tapirs, deer, wild hogs, etc., are abundant in the wilder districts, and the Paraguay, especially, swarms with alligators. The river-fisheries are very productive. The forests are rich in almost untouched cabinet woods and various drugs. The most valuable forest product is mate or Paraguay tea. The soil, especially in the forest districts, is very fertile. Paraguay is poor in minerals; iron, which is abundant, is little utilized, owing to the lack of coal; copper is reported, and limestone and some varieties of marble are quarried on a small scale.

Population.—Nearly all the civilized population is found in the southern part in a strip along the east side of the Paraguay. The first Spanish conquerors formed numerous unions with the native Guarany women, and their offspring became the ruling class of the country. This half-and-half stock has been perpetuated by intermarriages; it is still the most influential, and by courtesy is called white. The great mass of the population contains far more Indian, and some Negro, blood; almost the only pure whites are a few thousand foreigners. A corruption of the Guarany tongue is still the common language, though Spanish is also spoken in the larger places. The very imperfect census returns of 1886 gave a population of 239,774, evidently much below the truth. The white population was officially estimated in 1898 at 565,000. The wild Indians, nearly all in the Chaco, probably do not exceed 100,000. Before the bloody war of 1864–70 the population was larger. This war was especially destructive to the males, and the excess of women over men is even now very noticeable, especially in the cities. Education and refinement are confined to a small class; the mass of the population is densely ignorant and very poor.

Industries.—The only important industries are agriculture, grazing, mate-gathering, and timber-cutting. The common crops are mandioca, maize, beans, sugar-cane, oranges, and tobacco. The small Paraguayan cigars are greatly esteemed in the Platine states. The republic has (1899) about 2,500,000 head of cattle, principally on large *estancias* in the western and northern districts. There are few good roads, and the only railway runs from Asuncion 156 miles E. and S. E. to Villa Rica, Caazapá, and Pirapó. Ocean steamers ascend regularly to Asuncion and beyond, and there is telegraphic communication with Europe. Owing to its poverty and its inland position, Paraguay is ill able to compete in trade with other South American countries. The exports, generally less in value than 3,000,000 pesos annually, are mainly to the Argentine Republic; the principal items are mate, tobacco and cigars, timber, hides, and oranges. See PARAGUAY in the Appendix.

Government.—The government is a centralized republic; the president is elected for four years, and congress consists of two houses. The recognized and common religion is the Roman Catholic, but all sects are tolerated. Education is nominally compulsory; in 1897 there were about 400 Government or subsidized schools, and there is a national college at Asuncion. The army and navy are insignificant. Owing to bad faith little benefit was derived from foreign loans made soon after the war of 1864–70; and though obligations have been partly met by the sale of public lands, there have been recurring deficits and even default of interest on the foreign debt. A large amount of inconvertible paper currency has been issued. Aside from this the internal debt is small; the entire foreign debt, on Jan. 1, 1893, was 26,523,712 pesos. The basis of value is the silver peso or dollar, nominally worth about 96 cents U. S. currency, but commercially much less. The metric system is legalized, but the old Spanish weights and measures are still in general use.

History.—Sebastian Cabot, seeking a more direct route to Peru, explored the lower Paraguay in 1527. After Pedro de Mendoza founded the first colony of Buenos Ayres, he sent an expedition up the Paraguay under Ayolas, who founded Asuncion about Sept., 1536; Buenos Ayres was abandoned soon after, and Asuncion became the capital of Paraguay, a name which then included the whole Platine region; this was soon after attached to the viceroyalty of Peru. The Guarany Indians, who inhabited the country E. of the Paraguay, were at first very friendly, and though they subsequently rebelled, they were easily subdued. The more warlike Indians of the Chaco resisted the whites from the first, and there were constant struggles with them until the tribes were exterminated or driven into the interior. In 1620 Buenos Ayres was separated from Paraguay, both remaining provinces of Peru until 1776, when Paraguay was attached to the new viceroyalty of Buenos Ayres or La Plata. The Jesuit order had little power in Paraguay until 1611, when it was practically given control of the whole Indian and rural population. Among the Guaranies the missionaries formed numerous and rich establishments, principally in the valley of the upper Paraná and in Misiones (now in Argentina). Each mission was a huge, well-ordered farm; all work was under the absolute control of the Jesuit director, and all produce, after providing for the needs of the workmen, was sold for the benefit of the mission or the order. This system saved the Indians from want and from Spanish slavery, and gave them the rudiments of religious instruction; but it left them childish and fit tools for the political tyrants of later times. The Jesuits had many disputes with the civil and ecclesiastical authorities at Asuncion; several times they were temporarily expelled, and at others they had entire control of the Government. After 1685 the missions suffered severely from the incursions of Portuguese slave-hunters from São Paulo. The order was expelled in 1767, the missions fell into decay, and only the ruins of their fine churches and buildings remain in the forest. Paraguay, following Buenos Ayres, declared its independence in 1811; but it fell almost immediately under the dictatorship of Francia, and took no further part in the struggle for South American independence. Francia was succeeded, after a short interval, by Carlos Antonio Lopez (1841), who bequeathed the government (1862) to his son, Francisco Solano Lopez. All these dictators or presidents continued the policy of isolation which had been introduced by the Jesuits. Foreigners were seldom allowed to enter the country or Paraguayans to leave it, and ignorance and low morals were deliberately fostered. Under cover of this isolation nearly all industries and commerce were drawn into the hands of the chief of state, who practically managed the country as his own property. Though the country made hardly any material or intellectual progress, it was free from debt and generally at peace. The mad ambition of the younger Lopez plunged it into a war with Brazil, the Argentine Republic, and Uruguay, which lasted from 1864 to 1870. (For events of this war see LOPEZ, FRANCISCO SOLANO.) It ended with the death of Lopez, but left the whole country ruined, and its population reduced to little over one-third. Misiones, part of the Chaco, and a considerable territory on the N., were given up to Argentina and Brazil. The present constitution was adopted soon after the war, and since then the republic has enjoyed internal and external peace, but its recovery is necessarily slow. The tide of immigration is slowly increasing. In 1894 an unpopular president was deposed by a bloodless revolution—the first since the war. A boundary dispute with the Argentine Republic, involving part of the Chaco, was referred to the arbitration of the President of the U. S., and in 1878 was decided in favor of Paraguay.

See Demersey, *Histoire physique, économique, et politique du Paraguay* (2 vols., 1860–64); du Graty, *La république du Paraguay* (1865); Washburn, *History of Paraguay* (2 vols., 1871); Bourgade la Dardye, *Paraguay* (Eng. trans. by Ravenstein, with map, 1892).

HERBERT H. SMITH.

Paraguay River: a river of South America; rises near the center of the continent, on the Brazilian plateau of Matto Grosso; flows S. through Brazil, between Brazil and Bolivia, through Paraguay and between Paraguay and the Argentine Republic, and finally joins the upper Paraná to form the lower Paraná near lat. 27° 13′ S. The Paraguay rises in a group of little ponds, the Sete Lagôas, on a low part of the Brazilian plateau, 1,000 feet above the sea. Swelled by numerous affluents it is already a large stream at Villa Maria; 30 miles below and only 400 feet above the sea it enters the great depression of the Paraguay and Paraná. This is a continuous low plain occupying all of Southwestern Matto Grosso, Eastern Bolivia, Western Paraguay, and a large tract in the Argentine Republic W. of the two rivers. By its vegetation and its relations to the river it is divided into three regions—the Charaés marshes, the Gran Chaco, and the pampas. The two latter are described in separate articles. The Charaés marshes, called the Pantanaes by Brazilians, form the northern end of the plain, a tract about 400 miles long from N. to S., and at least 150 miles wide in parts. The Brazilian plateau falls to it sharply, often precipitously, on the N. and E. On the W. there are hills bordering the Paraguay, but through breaks in these the marshes extend far into Bolivia. On this side the great depression is separated from the head-waters of the Madeira only by a low ridge. The Charaés marshes are a confused labyrinth of channels, islands, marshes, and lakes, through which only an experienced pilot can follow the Paraguay and its branches. Most of the land is open, but narrow strips of forest generally follow the channels. The only inhabitants are a few Guató Indians; the few Brazilian settlements are on the highlands bordering the west shore of the river. The Paraguay in this region rises every year, sometimes 40 feet, overflowing the plain and barely leaving a few acres dry here and there. It is remarkable

that the highest waters are toward the end of the dry season (July and August) and the lowest during the rainy season. The reason is that it takes several months for the rains which have fallen on the plateau to spread themselves over this vast basin, and several more mouths are required to drain them off. Near the southern end of the Charaés spurs of the plateau and isolated hills border the river. The Feeho dos Morros (lat. 21° 26′ 40″ S.) is a narrow pass where the river runs between two of these hills. Below this the river hugs the highlands on the eastern side of the great plain and cuts deeper and deeper into the plain itself, which is thus beyond reach of the overflow. In the Chaco, however, large tracts are swampy or are flooded by the rains. The Paraguay is over 1,800 feet wide at Asuncion, and about three-quarters of a mile at its confluence with the Paraná. The longest affluents are the Pileomayo and Bermejo, which join it from the W. in the Chaco region, but they are tortuous and only navigable for short distances. Nearly all the other branches are on the eastern side. The most important navigable ones are the São Lourenço (with its branch, the Cuyabá), the Jaquary, and Miranda in Brazil, and the Jejuy and Tebicuary in Paraguay. The main river is open to free navigation; it is the only commercial outlet of Paraguay and Matto Grosso. Steamers drawing 9 feet ascend to Corumbá, Brazil, at all seasons, and smaller ones to Villa Maria and by the branches to Cuyabá and Miranda. The Paraguay was discovered by Cabot (1526), and explored nearly to its source by Irala and others before 1550. See Page, *La Plata, the Argentine Confederation and Paraguay* (1859); Fonseca, *Viagem ao redor do Brazil* (1880). H. H. S.

Paraguay Tea: See MATE.

Parahyba, păă-răă-ee′băă: one of the smallest states of Brazil; on the extreme eastern part of the coast, between Rio Grande do Norte on the N. and Pernambuco on the S. Area, 28,849 sq. miles; pop. (1894) estimated, 559,271. The coast lands for 30 or 40 miles inland are low; the country then rises abruptly to the Brazilian plateau. As in Ceará, the dry season (April to October) is strongly marked, the vegetation drying up except in favored places; occasionally there are severe droughts, lasting several years. The only river of importance is the Parahyba do Norte, and its mouth forms the only harbor. The principal occupations are grazing and agriculture; the exports are hides, sugar, cotton, tobacco, and rubber. Parahyba, the capital and largest town, is on the right bank of the river Parahyba do Norte, 11 miles above its mouth; pop. about 15,000 (see map of South America, ref. 4–H). It is one of the oldest towns in Brazil, dating from 1579; among the ancient buildings are the cathedral and the college of the Jesuits; the modern Government buildings are unpretentious. Only light-draught vessels can ascend to this point, larger ones anchor at Cabadello, near the mouth of the river, a thriving little town which is rapidly superseding Parahyba as a commercial center. HERBERT H. SMITH.

Parahyba, or **Parahyba do Sul**: a river of Southeastern Brazil; rises in São Paulo, flows eastward between Minas Geraes and Rio de Janeiro, nearly parallel to the coast, and enters the Atlantic near lat. 21° 38′ S. Length (with its principal head, the Parahytinga), 658 miles. The valley of the Parahyba, which separates the Serra do Mar from the Serra da Mantiqueira, is populous, and is one of the richest coffee regions in Brazil. Vessels of light draught ascend to São Fidelis, 54 miles, and an upper section of 193 miles is also navigable for small steamers. H. H. S.

Paral′dehyde: a clear, colorless liquid, having a peculiar ethereal odor and a warm followed by a cold taste. It is prepared by treating ordinary aldehyde at a moderate temperature with small quantities of hydrochloric acid, and is purified by repeated freezing and rectifying. It is employed in medicine as a hypnotic, but has the disadvantage that it is apt to disturb the stomach and that the dose is bulky.

Paralepid′idæ [Mod. Lat., named from *Para′lepis*, the typical genus; Gr. παρά, beside, near + λεπίς, λεπίδος, scale]: a remarkable family of fishes of the open seas, allied to the *Scopelidæ*. The form is elongate and pike-like; the body covered with deciduous scales; the head pointed; opercular apparatus with the subopercular much reduced; the upper jaw with its margin formed by the intermaxillaries, behind which, and closely adherent to it, are the supramaxillaries; teeth on the jaws as well as palate; branchial apertures enlarged; dorsal fin short, far behind, and still farther behind an adipose fin; anal elongated; caudal emarginate; pectorals well developed; ventrals small, inserted below or in front of the dorsal fin. The species are few and confined to northern waters, some occurring at considerable depth, others chiefly in the Arctic. Revised by D. S. JORDAN.

Parallax [from Gr. παράλλαξις, alternation, change in direction between two lines forming an angle, parallax; deriv. of παραλλάσσειν, change alongside of, go aside, deviate; παρά, beside + ἀλλάσσειν, change]: in the most general sense of the word, the difference in the directions of an object as seen from two different points. It is evident that if two observers, A and B, look at the same object, the direction in which they see it will be different according to their distance apart and the character of the triangle which they form with it. The term is mostly used in astronomy, and is applied in a variety of ways, according to circumstances.

In its common acceptation the word is used to mean the difference between the direction of a body from the center of the earth and from any point on its surface. Let us, for illustration, take the case of the moon. From no two points on the earth's surface will the moon appear in absolutely the same direction. Hence in the astronomical ephemeris the direction of the moon at any moment is given as it would be were it seen from the center of the earth; in other words, the right ascension and direction of the moon are those corresponding to a line drawn from the center of the earth to the center of the moon. Actual observations of the moon, however, are made from the surface of the earth. Hence the difference between the direction as seen from the center and from the surface must be computed. If the position of the moon is given by right ascension and declination the difference in question is called *parallax in right ascension* and in *declination*, respectively. If the altitude of the moon above the horizon is in question, the difference between the altitudes as seen from the earth's center and from the position occupied by the observer is called *parallax in altitude*. The same appellations are used in the case of a planet or any other body of the solar system.

As a standard of parallax astronomers take the difference between the direction of a body as it would appear in the horizon to an observer at the equator and as it is seen from the center of the earth. This difference is called the *equatorial horizontal parallax*. It is equal to the angle subtended by the earth's equatorial radius as seen from the object itself, and is therefore an index to the distance of the latter. Actually it is calculated by the aid of the known distance of the body.

The fixed stars are so distant that they appear in absolutely the same direction from every point of the earth. They have therefore no parallax in the preceding sense; but the refined measurements of recent times have shown that there is a slight difference in the direction of a few of the nearest stars as seen from one part of the earth's orbit and from the opposite part. This gives rise to a new parallax, called *annual*, which is defined as the difference between the direction of a star seen from the sun and seen from the earth. This difference does not in any case amount to a single second of arc. Since the parallax of a body depends on its distance, the determination of the distance of the sun, the moon, or a planet is the same as that of determining its equatorial horizontal parallax. For the determination of the parallax or distance of the sun, see SOLAR PARALLAX. S. NEWCOMB.

Parallel′ogram [from Gr. παραλληλόγραμμον; παράλληλος, parallel + γράφειν, write, draw]: a quadrilateral whose opposite sides, taken two and two, are parallel. If one angle of a parallelogram is a right angle, all the other angles are right angles, and the figure is a rectangle. If two adjacent sides are equal, the other sides are also equal, and the figure is a rhombus. The diagonals of a parallelogram mutually bisect each other; conversely, if the diagonals of a quadrilateral bisect each other, the figure is a parallelogram. If the diagonals of a parallelogram are equal, the figure is a rectangle; if they are perpendicular to each other, the figure is a rhombus; if they are equal and perpendicular, the figure is a square. The area of a parallelogram is equal to the product of its base and altitude.

Parallelogram of Forces: See COMPOSITION OF FORCES.

Parallelopi′ped [from Gr. παραλληλεπίπεδον, liter., neut. of παραλληλεπίπεδος, having parallel sides or surfaces; παράλληλος, parallel + ἐπίπεδον, a plane (liter., neut. of ἐπίπεδος, on the ground, level; ἐπί, on + πέδον, ground]: a polyhedron bounded by six parallelograms. If the faces are rectangles, the volume is a rectangular parallelopiped; if the faces are

squares, the volume is a cube. In any parallelopiped opposite faces are equal to each other, as are also diagonally opposite polyhedral angles. A plane through two diagonally opposite edges divides the volume into equivalent triangular prisms. The volume of any parallelopiped is equal to the product of its altitude and the area of its base.

Parallels of Latitude [*parallel* is from Gr. παράλληλος, parallel, liter., alongside of each other; παρά, beside + ἀλλήλων, (of) one another]: on the terrestrial sphere circles drawn around the earth on planes parallel to the equator. Through the center of each circle passes the earth's axis. The equator itself is the only one of these parallels which is a great circle. The others are smaller circles, whose limits are the great circle (the equator) on the one hand, and zero (at the poles) on the other. The tropics and polar circles are important parallels. See EARTH.

Paralysis [= Lat. = Gr. παράλυσις, palsy, deriv. of παραλύειν, disable on (one) side; παρά, beside + λύειν, loosen, dissolve, destroy]: loss of voluntary or reflex motion, generally through failure of nervous excitation. A partial loss of motion is termed *paresis*. A knowledge of the causes of paralysis is easily gained. There are on the surface of the brain certain areas known as motor centers, in which all impulses to voluntary motion originate. From these centers nerve-fibers travel downward, converging at the base of the brain to enter the spinal column. In the latter are secondary motor cells or centers which produce motion only after receiving impulses from the brain, through the fibers indicated. From the secondary spinal-cells originate nerve-fibers which constitute the nerves of the body, and which carry the impulse to the muscles. Paralysis may be due to disease or some destructive change anywhere along this tract, from the cells of the surface of the brain down to the terminal nerve-fiber as it enters the muscle. If the disease is in the brain, we speak of cerebral paralysis, as in apoplexies; if in the spinal cord, of spinal paralysis, as in essential palsy of infants; if in the nerves, of peripheral palsy, as in paralysis from pressure of a crutch on the recurrent spiral nerve of the arm. It is conceivable and possible also to have paralysis due to disease of the muscle without affection of any part of the nervous system, but such cases are exceedingly rare. Idiopathic muscular atrophy is an example of this form of paralysis.

Any part of the body containing muscle fibers, either striped or unstriped, may be paralyzed. Thus we have paralysis of the heart, of the arteries (vaso-motor paralysis), of the intestines, of the limbs, the face, the eyeballs, the pupil, etc. In the study of paralysis it is customary to divide the cases into groups according to the parts of the body affected. HEMIPLEGIA (*q. v.*) is the name used to designate paralysis of one lateral half of the body. It is generally due to a cerebral lesion, and nearly always follows after cerebral hæmorrhage or APOPLEXY (*q. v.*). Sometimes the face is paralyzed on one side, while the arm and leg of the opposite side are affected. This "crossed palsy" is due to disease in the *pons Varolii*. PARAPLEGIA (*q. v.*) is paralysis of the lower half of the body, affecting both legs and perhaps part of the trunk. It is due to disease of the spinal cord, or more rarely of the nerves of the legs. It is practically, though not theoretically, impossible to have paraplegia of cerebral causation. *Monoplegia* is the paralysis of a single member, as one arm or leg. It is due to disease of the peripheral nerves, or to affection of the motor center on the surface of the brain. In the lower part of the brain and in the spinal cord a diseased area is more apt to involve fibers of many muscles.

Multiple paralysis is the term by which are designated groups of palsies of irregular distribution. Glossoplegia (paralysis of the tongue), cycloplegia (paralysis of the pupil), laryngeal palsy, etc., are instances of *local paralysis*, in which only a certain muscle or group of muscles is affected. See FACIAL PARALYSIS, and for *General Paralysis* see INSANITY.

WILLIAM PEPPER.

Paralysis Agitans, or **Shaking Palsy**: a disease of advanced age, characterized by weakness, tremor, and rigidity of the muscles. Men are more often affected than women, and worries and mental strain are important causes. Sometimes the shaking of fear has been followed directly by this disease. There is a fine and continuous tremor of the hands, feet, and less commonly of the head, which, however, ceases during sleep. The muscles are apt to be rigid, and a peculiar mask-like immobility of the facial expression is a marked characteristic. The weakness of the muscles is rarely marked, but is a constant symptom. There is a peculiar staggering gait in which, as one author remarks, the patient seems to be running after his center of gravity. The disease is incurable.

WILLIAM PEPPER.

Paramar'ibo: capital and principal town and port of Dutch Guiana; on flat land by the right bank of the Surinam river, which is navigable beyond this point; 19 miles above its mouth (see map of South America ref. 2–E). It presents a very fresh and pleasing appearance, owing to its wide streets, shaded with orange and tamarind trees, and the gardens around most of the houses. Nearly all the buildings, and even the governor's mansion, are of wood. There are many Protestant and Catholic churches, hospitals, barracks, etc. The climate is warm, and the place has a reputation for unhealthfulness, but it is improving in this respect. The principal export is sugar. Paramaribo dates from the end of the sixteenth century; it was twice bombarded by the French, and has repeatedly been almost destroyed by fire, the last time in 1822. Pop. (1890) 28,831.

HERBERT H. SMITH.

Paramat'ta: town of New South Wales, Australia; on a river of the same name, near its entrance into Port Jackson, on which Sydney is situated (see map of Australia, ref. 7–I). It is a well-built and growing town. Pop. (1891) 11,680.

Revised by C. C. ADAMS.

Param'eter [Gr. παρά, beside + μέτρον, measure]: in mathematics, a term generally expressing a quantity, by whose variation systems of equations or curves, etc., are represented. Thus if the shape and magnitude of a curve be considered, but not its position, the radius is the sole parameter of a circle, and the major and minor axes of an ellipse are its two parameters. The coefficients in the equation, or equations, of a curve may be considered as parameters determining its shape, magnitude, and position in a plane or in space, as the latter differ from those of another curve of the same species. In particular if a conic section be written in rectangular co-ordinates

$$y^2 = px \pm mx^2$$

(which represents a parabola if $m = o$), the quantity p is called the parameter. (See PARABOLA.) Further, a parameter is also used to denote a variable, in terms of which the co-ordinates of a point on a curve can be expressed. If the co-ordinates involve the parameter rationally, that is, without square roots or other radicals, the entire curve can be described by continuous motion of a point, and is said to be *unicursal*.

R. A. ROBERTS.

Pāramitās [Sanskr.]: in Buddhism, "transcendent virtues," the practice of which leads to Nirvāna, or "the other shore." These are six in number, but other four are sometimes added. They are (1) charity, or generosity in giving to all who ask; (2) moral conduct; (3) patience; (4) energy or fortitude; (5) fixed contemplation, or meditation (see DHYÁNA); and (6) wisdom. The four added virtues are variously given. Those usually enumerated are (*a*) truth; (*b*) steadfastness of resolution, or fixedness of purpose; (*c*) good-will, or kindness; and (*d*) imperturbability, or apathy.

R. LILLEY.

Paraná, păă-răă-naa': a southern state of Brazil, bounded N. by São Paulo, E. by the Atlantic, S. by Santa Catharina, and W. by the river Paraná, which separates it from Paraguay and Matto Grosso. Area, 85,438 sq. miles; pop. (1894) estimated, 223,942. A strip of low and often swampy land along the coast is succeeded, 20 miles inland, by the Brazilian coast range, which here rises in parts to more than 5,000 feet, but with passes below 3,200 feet; the mountains and coast strip are covered with forest, the most abundant trees above 3,000 feet being Araucaria pines. W. of the coast range is the open table-land of Curitiba, 3,000 feet above the sea; farther inland this falls, by a succession of terraces, toward the Paraná; the western part of the state is an almost unknown forest, with intervals of open land, and is inhabited only by roving Indians. All the important rivers flow to the Paraná; the principal ones are the Paranápanéma on the northern frontier, the Ivahy, the Piquiry, the Taquary, and the Iguassú on the southern boundary; none of these is freely navigable. Nearly all the population is gathered on the high plateau, where there are considerable colonies of German and Italian immigrants. Paraná is one of the poorest and most backward of the Brazilian states, though it has abundance of fertile land, especially in the western part. Agriculture, grazing on the open lands, and the collection of mate are the only important industries; almost the sole export is mate. The capital, Curitiba,

is connected with the principal port, Paranaguá, by railway. Paraná was separated from São Paulo in 1853. See Bigg-Wither, *Pioneering in South Brazil* (1878). H. H. S.

Paraná (originally *Bajada del Paraná*): capital and largest town of the province of Entre Rios, Argentine Republic; on a bluff overlooking the right bank of the river Paraná, nearly opposite the mouth of the Salado (see map of South America, ref. 8–E). It is the center of a rich grazing region, and in the vicinity are thriving colonies of Germans, Swiss, and Italians; steamers ascending the river touch regularly at this port, which is connected by railway with Concepcion, on the Uruguay. Paraná was founded in 1730. From 1852 to 1861 it was the capital of the Argentine Republic. Pop. (1892) about 20,000. H. H. S.

Paraná: one of the largest rivers in South America; draining, with the Paraguay, nearly all the space between the Brazilian coast range and the Andes, from about lat. 16° to lat. 35° S. It rises in Brazil, flows at first S. W., then S. and W. along the borders of Paraguay, separating that country from Brazil and the Argentine Republic; and finally, after being joined by the Paraguay, keeps a southward course through the Argentine to the Rio de la Plata and the Atlantic. The upper Paraná, or the portion above the junction of the Paraguay, is essentially a highland river. Its two main heads are the Parnahyba, 500 miles long, rising in the Pyreneos Mountains of Goyaz, and the Grande, 650 miles long, rising in the Brazilian coast range of Minas Geraes; both are obstructed by rapids and falls. They meet at the angles of the states of Minas Geraes, São Paulo, Matto Grosso, and Goyaz, near lat. 19° S. The united flood, now called the Paraná, separates São Paulo and Paraná from Matto Grosso. Shortly below the junction is the little-known cataract of Urubú-ponga. Below this the river flows over the table-land without serious obstruction for 600 miles. At the foot of this navigable part it is broken by a large island, and forms a lake-like expanse. Suddenly the whole flood is poured into more than twenty narrow clefts, spreading over an arc 2 miles wide, and converging in a basin 70 feet below. In each chasm the water leaps over a fall, and then rushes down a slope with immense velocity. This is the celebrated but seldom visited cataract of Guayrá, or the Sete Quedas, where the Paraná begins to form the frontier of Paraguay (lat. 24° 2′ 59″ S.). Below it the river rushes for 400 miles through a deep valley, often between cliffs, and with a constant succession of rocky shallows and rapids. The last obstruction is the rapid of Apipé, 150 miles from the junction of the Paraguay, and marking the limit of navigation on the lower river. The valley of the upper Paraná, above Apipé, has few civilized inhabitants, and from the Guayrá fall down it is occupied by an extensive forest. In direct contrast the lower Paraná is a river of the plains—like the Paraguay. It is, indeed, properly a continuation of the Paraguay (*q. v.*), pursuing the same southerly course; but in length and volume of water the Paraguay is the lesser of the confluents. The lower Paraná has cut rather deeply into the pampas, which appear as clay cliffs on the west side. In parts it is over 2 miles wide, and by its sea-like reaches resembles the Amazon. It is entirely navigable for large vessels. The most difficult navigation is near the mouth in the Plata, where for over 200 miles a multitude of low islands forms a delta. The deepest channels in this region give over 15 feet when the river is lowest. The Rio de la Plata is properly the estuary of the Paraná, though also receiving the Uruguay, which may be regarded as a branch. The length of the lower Paraná is 850 miles, or, with the Plata, 1,080 miles. From the mouth of the Plata to the head of the Rio Grande, which may be regarded as the source of the Paraná, the distance by the rivers is about 2,950 miles. Aside from the Paraguay with its numerous branches, the principal affluent of the lower Paraná is the Salado, on the western side, and it is not navigable. The chief branches of the upper Paraná are on the eastern side, in Brazil (São Paulo and Paraná). The most important are the Pardo, Tiete, Agoapehy, Paranapanéma, Piquiry, and Iguassú. These rise on the well-peopled western slope of the coast range, and they are navigable for greater or less distances in their upper courses, but are obstructed by falls and rapids as they approach the Paraná. Those which join it in the great gorge below the Guayrá fall often have cataracts at or near their mouths. One of these, on the Iguassú (or Yguazú), 6 miles above its mouth, is easily accessible, and hence has often been visited by travelers. The river, divided into several channels, falls over a horseshoe-shaped precipice nearly 200 feet high, forming a scene said to rival Niagara. Herbert H. Smith.

Paranaguá, pă̆ă-ră̆ă-nă̆ă-gwaa′ (sometimes written *Parnaguá*): principal seaport of the state of Paraná, Brazil; on Paranaguá Bay; terminus of a railway which crosses the mountains to Curitiba (see map of South America, ref. 7–F). Pop. about 7,000. The harbor is large and good, but there is little commercial activity. The principal export is mate. There are few good buildings, the streets are badly paved, and the climate is hot and often unhealthful. H. H. S.

Paranahyba: See Parnahyba.

Paranaphthalene: See Anthracene.

Paranhos, José Maria da Silva: See Silva Paranhos.

Parapet: See Fortification.

Paraple′gia [Mod. Lat., from Gr. παραπληγία, hemiplegia, deriv. of παραπλήσσειν, to strike beside or at the side; παρά, beside + πλήσσειν, strike]: loss of motor power in both legs. It is almost always due to injury or disease of the spinal cord or its membranes, though it sometimes happens that a neuritis involves the nerves of the legs alone. The onset is sudden when caused by wounds, hæmorrhage into the substance of the cord, or fracture or dislocation of the spinal column, rapid when caused by myelitis or meningitis, and slow when due to pressure from a tumor or from Pott's disease. Paralysis of the bladder and rectum are generally present. The character of the palsy varies with the level of the lesion in the cord. If it involve the whole transverse area of the cord there is complete loss of sensation below. If it be in the lumbar region, there is absence of the reflexes and wasting of the muscles. If higher up, there is rigidity, no wasting, and the reflexes are increased. The term is sometimes used, but improperly, to include cases in which the arms as well as the legs are palsied. See Paralysis.
William Pepper and C. W. Burr.

Pará River: a large inlet in the coast of Brazil, state of Pará, S. E. of the island of Marajó, generally regarded as the southern mouth of the Amazon. Physically, it is the estuary of the river Tocantins, but through a network of channels S. and W. of Marajó it receives a volume of Amazonian water exceeding that of the Tocantins itself. These channels are navigable for large vessels, and owing to the strong currents and unsheltered banks of the true mouths of the Amazon, the Pará has always formed the natural outlet of that river. The Pará, up to the junction of the Amazonian channels, is 120 miles long, 10 miles wide above and over 30 miles at the mouth. The effect of the tides is felt in strong currents, but no salt water enters it.
Herbert H. Smith.

Par′asang [from Gr. παρασάγγης, from O. Pers.; cf. Pers. *farsang*]: a Persian measure of distance. Herodotus (ii., 6, etc.), Xenophon (*Anab.* ii., 2, § 6), Suidas, and Hesychius are all agreed in estimating the parasang at 30 stadia, or about $3\frac{2}{5}$ miles. Afterward the measure seems to have varied; for in a Byzantine writer, Agathias (about 530 A. D.), we find the parasang reckoned at 21 stadia. Strabo (xi., p. 518) states that it was variously reckoned at 30, 40, and even 60, stadia. According to Pliny (*Nat. Hist.*, vi., 30), the Persians themselves were divided as to its length. The parasang is still in use among the Persians. Modern travelers concur with Herodotus and Xenophon in fixing its length variously at from $3\frac{1}{2}$ to 4 miles.

Paraselenæ: See Halo.

Parasita: a sub-order of insects which includes the Lice (*q. v.*). See also Entomology.

Parasites [from Gr. παράσιτος, liter., eating beside or at another's table; παρά, beside + σιτεῖν, to take food, deriv. of σῖτος, food]: originally, persons who flattered the rich and were fed at their tables; in zoölogy, animals that live in or on other animals. In its broad sense parasitism includes all cases where one organism depends upon another for its food; but, as more usually employed, it is limited to those still numerous cases where there is a more or less intimate connection between the gainer in the process, the *parasite*, and the form lived upon, the *host*. Even with these limits there are different degrees of parasitism to be recognized, which may be grouped under the heads commensalism, symbiosis, and parasitism proper. In commensalism there is an association of forms wherein, so to speak, one profits from the crumbs which fall from the other's table. Thus in the mouth of the menhaden there frequently occurs a crustacean "messmate" which holds to the roof of the mouth by

its sharp legs, and there selects its food from the objects eaten by the fish. In symbiosis there is a reciprocity which does not exist in commensalism. Each profits to a greater or less extent by the other's presence. Thus we have certain hermit-crabs which constantly bear sea-anemones about upon the shell which they inhabit; the anemone profits from the particles of food dropped by the crab, while the crab receives protection from its enemies, many of which do not care to brave the nettle-cells of the anemone. Slightly different is the case of the "yellow cells" of the Radiolaria. Here we have an association of animal and plant, the former profiting by the oxygen given off by the latter, while the plant in turn uses the carbon dioxide produced by the animal. In parasitism proper the parasite lives directly upon the substance of the host. The union between them may be only temporary, as in the case of the leeches, which attach themselves to other animals only while sucking blood; or it may be permanent, as in the great majority of parasitic worms. In the latter there may be external or internal parasitism; but in all cases there is such an adjustment of one to the other that while the host is weakened by the drain, it but rarely, and then slowly, succumbs. Its preservation is necessary to the perpetuation of the parasitic species.

In one way or another all groups of the animal kingdom present instances of parasites. Passing by the tapeworms, trichina, etc., we may here instance a few of the more interesting cases. Among the vertebrates the fishes alone afford cases of parasitism, and prominent here are the lampreys and hagfishes, the former living upon the slime excreted from the bodies of other fishes, the latter actually burrowing their way into the body-cavity of the cod. Among the molluses parasites are rare. Most striking is the case of *Entoconcha*, the young of which is a true gasteropod, while the adult, an elongate worm-like body without a trace of mollusean features, lives in the intestine of certain holothurians (*Synapta*). In the Crustacea parasites occur among the Isopoda, the barnacles, and especially among the Copepoda, and in the latter group almost every grade can be found to illustrate that law of nature that the more perfect and more prolonged the parasitism, the more complete the resulting degradation. Thus in the Lerneans almost every crustacean feature has disappeared; all that remains may be summed up as means of fixation and absorption, combined with enormous organs for the reproduction of the species. True parasitism is rare among the Cœlenterates, but here must be instanced the hydroid *Hydrichthys*, described by Fewkes as parasitic upon certain fishes.

LITERATURE.—Cobbold, *Entozoa* (London, 1864); P. J. van Beneden, *Animal Parasites and Messmates* (New York, 1876); Leuckart, *Die Menschlichen Parasiten* (Leipzig, 1863–68).

J. S. KINGSLEY.

Parasites, Human: Man is liable to invasion of a considerable variety of parasitic organisms, both animal and vegetable. The latter, by far the more important and numerous, belong to the families of bacteria. Upon them are dependent many of the infectious diseases, such as tuberculosis, typhoid fever, and diphtheria. (See BACTERIOLOGY.) The animal parasites are much less varied and frequent, but are still quite numerous. Some forms live upon the exterior parts of the body, and are known as *Ectozoa*; others within the cavities or tissues, and are called *Entozoa*.

Ectozoa.—These include representatives of the Inseeta, such as lice, fleas, chiggers, etc.; and of the Arachnoidea, such as the mites found in acne pimples, or the itch-mite. A very important class of lower organisms belonging to the Protozoa have recently been discovered in certain skin diseases, such as molluscum contagiosum and Paget's disease of the nipple. These belong to the genus *Coccidium*. They invade the epithelial cells of the skin and lead to their destruction. A similar organism is claimed as the cause of cancer. The evidence is not yet conclusive, but is very suggestive.

Entozoa.—Among the internal parasites are species of various families of Protozoa, Arachnoidea, and Vermes. Of the Protozoa, to which of late attention has been specially directed, the important forms are the *Amœba coli*, which occupies the intestinal canal and causes certain forms of dysentery; the *plasmodium malariæ*, an organism which thrives in the blood in malarial fever and is doubtless the cause of this disease. The *coccidia* occur in the intestines and liver as well as in the skin. Other Protozoa of the intestinal canal, such as *Trichomonas* and *Cercomonas*, *Megastoma entericum* and *Paranœcium coli*, are relatively unimportant.

Of the Arachnoids but one occurs, and that rarely—the *Pentastoma tœnioides*. This organism occupies the nasal cavities and frontal sinuses of various animals, and occasionally of man. Its larvæ, *Pentastoma denticulatum*, are found in the liver or spleen, less frequently in other organs, of man and various animals.

By far the most important group of animal parasites of man are the worms, of which the cestodes or tapeworms, the trematodes or flukeworms, and the nematodes or roundworms are the subdivisions met with. The commonest of the tapeworms in America is the *Tœnia saginata*, the beef tapeworm, but occasionally *Tœnia solium* (pig), and *Tœnia elliptica* (cat and dog), and *Bothriocephalus latus* (fish) are met with. The last named is very common in parts of Switzerland, Norway, and other countries. Man is the occasional host of the adult *Tœnia echinoccous*, a dog tapeworm; but very frequently the larvæ of this form occur in man, producing the so-called hydatid cysts of the liver and other parts. This disease is common in Iceland and Australia. Rarer tapeworms of man are *Tœnia nana*, *T. flavopunctata*, *T. madagascariensis*, *T. negré*, *T. tarella*, *T. algeriana*, *T. of Cape of Good Hope*, also *Bothriocephalus cordatus* and *cristatus*.

The trematodes or flukeworms are comparatively unimportant, being much less frequent. There is a number of the genus *Distoma*, including *D. hepaticum*, the liver fluke, *D. hæmatobium*, the blood fluke, and the less frequent *D. lanceolatum*, *D. conjunctum*, *D. rathonisi*, *D. heterophyes*, *D. spathalatum*. An interesting form is *D. pulmonale*, the lung fluke of Japan, Korea, and other Eastern countries. *Monostoma lentis* and *Amphistoma hominis* are rare forms.

The nematodes include some of the most frequent and important forms, such as the common roundworm, *Ascaris lumbricoides*, the seatworm or pinworm, *Oxyaris vermicularis*, and the destructive *Trichina spiralis*, derived from improperly cooked meat of the hog. Relatively unimportant forms are *Ascaris mystax*, *Anchylostoma duodenale* (the organism so prevalent among the workers at St. Gothard's tunnel), *Strongylus longevaginatus*, *Eustrongylus gigas*, *Rhabdonema intestinalis*, *Trichocephalus dispar* (the whipworm), *Filaria bancroftii*, *medinensis*, and *loa*. *Echinorhynchus hominis* is the only representative of the Acanthocephali.

It will be seen that the number of animal parasites is large, and that the variety of forms is very great: moreover, very frequently several forms are found coexisting, and a patient may suffer invasion by a number of the same or different forms in succession. Habits of uncleanliness are the greatest cause of internal and external parasites. The larvæ are carried to the mouth or exterior of the body by unclean hands, clothing, and the like. Tapeworms are conveyed to man in the larval form in "measled" flesh of the beef, hog, or fish, or more directly by the eggs being taken in water or food. The prevention of parasites therefore requires careful attention to habits of cleanliness and to the proper preparation of food.

WILLIAM PEPPER.

Parasites, Vegetable: plants which live upon other living organisms, and obtain their food wholly or in part from their living tissues. They are to be distinguished from SAPROPHYTES (*q. v.*), which obtain their food from dead tissues.

As in animals, so in plants, we must regard all parasites as having been derived from non-parasitic forms. In many cases this derivation is quite obvious: thus the dodders (species of *Cuscuta*) are clearly modified members of the morning-glory family (*Convolvulaceæ*), the Indian pipe (*Monotropa*) is essentially a modified heath (*Ericaceæ*), the downy mildews (*Peronosporaceæ*) are structurally so nearly like the green felts (*Vaucheriaceæ*) that they have been long associated with them, etc. In other cases their derivation is not so obvious, as in the black fungi, rusts, and smuts.

It is a well-known law that parasitism is always followed by structural degradation, especially of the vegetative organs, and where the parasitism is excessive, all parts of the organism suffer degradation. Thus parasitic flowering plants are usually leafless, or nearly so, as in *Cuscuta* and *Monotropa*, and the degradation has been carried so far in *Rafflesia* and its relatives, and in *Balanophoraceæ*, that the ovules and seeds are reduced to a state of great simplicity. Where the parasitism is partial, as in the Mistletoe, the leaves are still well developed, both structurally and functionally, but with an increased dependence of the parasite

upon its host the leaves are chlorophyll-less and bract-like, as in *Arceuthobium*, a relative of the mistletoe.

The principal families in which parasites occur in the vegetable kingdom are distributed as follows: In the Protophytes, the bacteria; in the Phycophytes, the black moulds, fly-fungi, water-moulds, downy mildews, etc.; in the Carpophytes, many families (twenty or more) of the fungi; in the Anthophytes, the orchids (a few genera), vine-rapes (*Cytinaceæ*), mistletoes (*Loranthaceæ*), Balanophorads, Indian pipes (*Monotropeæ*), morning-glories (the dodders, of the genus *Cuscuta*), and broom-rapes (*Orobanchaceæ*). Few, if any, of the mossworts and fernworts are true parasites, and none of the Gymnosperms. It is impossible to give the total number of parasites in the vegetable kingdom, but from 12,000 to 15,000 lower plants (Protophytes, Phycophytes, and Carpophytes), and about 1,000 Anthophytes are true parasites. To these should be added also many species which are partially parasitic. See DEGENERATION and VEGETABLE KINGDOM.

CHARLES E. BESSEY.

Parasols: See UMBRELLAS.

Parcæ: See FATES.

Parchments [M. Eng. *parchemin*, from O. Fr. *parcamin*, *parchemin* : Ital. *pergamena* : Span. *pergamino* < Vulg. Lat. **pergami'num* for *pergame'num*, deriv. of Pergamum, a city in Mysia where parchment is said to have been first used]: the well-cleansed and carefully dried skins of hares, rabbits, calves, asses, or sheep. Common parchment is prepared from sheepskins, but vellum, a far finer variety, is made from the skins of young calves, goats, or still-born lambs. Sheepskins are often split and made to yield two sheets of parchment. The skins are soaked in water, and then subjected to the action of milk of lime. The wool or hair is then removed, the skins are washed, planed with a sharp knife to remove superfluous parts, and then stretched on frames singly and dried in the air. For bookbinders' use the dried parchment is planed to impart a rough surface, capable of being dyed or written upon. The dried parchment is finally dusted over with chalk and rubbed with pumice-stone. Drum-heads are made from calves' skins, heads of kettle-drums from asses' skins, sieves for gunpowder-mills from hogs' skins. Parchment was known long before the invention of paper. It is made at Bentheim and Schuttorf in Hanover, at Augsburg, Nuremberg, Breslau, and Dantzic, and in Holland, England, and France.

Revised by IRA REMSEN.

Pardessus, pär'dā'sü', JEAN MARIE: jurist; b. at Blois, France, Aug. 11, 1772; studied jurisprudence; became mayor of Blois in 1805; member of the Legislative Assembly in 1807; Professor of Mercantile Law at Paris in 1810; member of the Chamber of Deputies 1815–16 and 1824–27, but retired from public life after the Revolution of 1830. D. on his estates near Blois, May 26, 1853. By his numerous works, of which the most prominent are *Traité des Servitudes* (1806), *Traité du Contrat et des Lettres de Change* (1809), *Éléments de Jurisprudence commerciale* (1811), *Cours de Droit commercial* (1814–19), *Collection des Lois maritimes antérieures au 18e siècle* (6 vols., 1828–45), *Us et Coutumes de la Mer* (1847), a *Collection des Ordonnances des Rois de France*, with an introductory essay on the organization of the French courts, etc., he exercised a great influence on French jurisprudence.

Par'do, MANUEL: statesman; b. at Lima, Peru, Aug. 12, 1834. He came of a wealthy family, was educated in Chili and Europe, and was established as a banker in Lima, besides conducting several large plantations and holding various public positions. From Aug. 2, 1872, to Aug. 2, 1876, he was president of Peru. He was the first civilian ever elected to this office, and was one of the best and most popular presidents that Peru ever had. Subsequently he was president of the senate. He was assassinated by an obscure person, who attacked him in front of the senate-house at Lima, Nov. 16, 1878. HERBERT H. SMITH.

Pardo Bazán, EMILIA: novelist and critic; b. at Corunna, Galicia, Spain, in 1852. In 1868 she was married to Señor Quirogariche, a proprietor in her native province. Later, however, she lived mainly in Madrid, though her imagination still preferred Galician themes. As a novelist she is distinguished by great truth of local coloring, and by the kind of realism in depicting life and action of which Mr. Howells is the chief representative in the U. S. Among her novels may be mentioned *Los Pazos de Ulloa* and its continuation, *La madre naturaleza*; *La piedra angular*; *La tribuna*; the novelettes *Insolación* and *Morriña*; *Pascual Lopez, autobiografía de un estudiante de medicina*; the collection of tales, *Cuentos de Marineda*; *El Cisne de Vilamorta*; *Una Cristiana* and its sequel, *La Prueba*. As critic she has written *Estudio crítico de las obras del P. Feijóo* (1876); *San Francisco de Asis*; *Siglo XIII.* (2d ed. 1886); *La Revolución y la Novela en Rusia* (1887); *La Cuestión palpitante* (realism *vs.* romanticism, 4th ed. 1891). In *Mi Romería* (1888) and *De mi Tierra* (1888) we have impressions, recollections, and reflections of a more serious kind connected with her Galician home. This also is the character of her studies in folk-lore—*Folk-lore gallego*—*Miscelánea* (1884). In 1891 she began to issue a periodical, devoted to theatrical criticism, written wholly by her own pen—*Nuevo Teatro crítico*. On the whole, she is the most important woman of letters now writing in Spain. Her *Obras Completas* in a new edition began to appear in Madrid in 1891 (9 vols., 1891–93). A. R. MARSH.

Pardon [from O. Fr. *pardon*, deriv. of *pardonner*, concede, indulge, pardon; *par-* (< Lat. *per-*), thoroughly + *donner*, give]: an act of grace by which an offender is released from the consequences of his offense, so far as such release is practicable and within the control of the pardoning power. In monarchies it is a prerogative of the king, who is deemed the source of justice. It is properly employed to correct some injustice for which the ordinary judicial machinery does not provide, or to make allowances for exceptional circumstances, or from considerations of public policy.

Power to Pardon.—A serviceable Parliament once declared that the King of Great Britain hath the whole and sole power of pardon, "united and knit to the imperial crown of this realm." (27 Hen. VIII., c. 24.) The royal prerogative, however, even in the matter of pardons, has been greatly curtailed since the age of the Tudors. A pardon can not be pleaded to an IMPEACHMENT (*q. v.*). The committing any person to prison out of the realm is unpardonable by the crown. (31 Car. II., c. 2.) Nor can the British sovereign by pardon inflict an injury on an innocent person, "as in the case of a nuisance yet unredressed, or of a breach of certain statutes after an informer has become entitled to a reward payable out of the penalty." The pardon can operate only to relieve the offender from his liability to the crown. It can not affect the private rights of individuals. At present the sovereign exercises this prerogative upon the recommendation of the Home Secretary. It is rarely employed, save in cases of serious miscarriage of justice, which can not be remedied otherwise: or in the cases of political offenders who engaged in riots, unlawful assemblies, or other like proceedings for the purpose of influencing the action of Parliament or public officials.

In the U. S. the pardoning power is the subject of constitutional provision. It is generally vested in the executive. The Federal Constitution authorizes the President "to grant reprieves and pardons for offenses against the U. S., except in cases of impeachment." (Art. ii., § 2.) It is to be noticed that "offenses against the U. S." can be pardoned only by the President. Offenses against the several States are pardonable by the injured State alone. Again, the private consequences of a wrong are not subject to the pardoning power of the President. Within the constitutional domain, however, the President's prerogative of pardon is unlimited; "it conveys the idea of the power exercised by the English crown, or by its representatives in the colonies"; it "extends to every offense known to the law, and is not subject to legislative control." (*Ex parte* Wells, 18 Howard 307; *ex parte* Garland, 4 Wallace 333.) It may be exercised before conviction, or even before indictment; and there is judicial authority for the doctrine that it extends to persons committed for contempt of court. (*Re* Mullee, 7 Blatchford 23.) This view has been severely criticised. See 45 *Albany Law Journal*, 1, and authorities cited.

Forms of Pardon.—In Great Britain a warrant of pardon must be certified by the great seal affixed by the Lord Chancellor, or, in cases of felony, by the sovereign's sign-manual countersigned by a principal Secretary of State. In the U. S. the usual form is a writing signed by the executive, with the great seal attached. Where this form is employed, delivery and acceptance are necessary to its validity. A pardon may be limited to a specified individual and a particular crime, or it may be framed to include a number of named individuals, or even a class of persons designated otherwise than by name. It may be granted by a general

proclamation, and take effect from the time it is signed. It may be absolute, or it may be given upon a condition precedent or subsequent. It may also take the form of a commutation of punishment, though it can not substitute a punishment of a different nature.

Its Effect.—An absolute pardon releases the offender from all disabilities imposed by public law, and restores him to all his civil rights, in the absence of a statute to the contrary—e. g. 2 N. Y. R. S. 139, § 7. It gives him a new credit and capacity. It does not make amends for the past, nor afford relief for what has been suffered by imprisonment, forced labor, or otherwise. (*Knote* vs. *U. S.*, 95 U. S. 149, 153.) It restores a convicted criminal's competency as a witness, even though it recites that it was granted because his testimony was desired by the Government (*Boyd* vs. *U. S.*, 142 U. S. 450); but the conviction may be used to affect his credit. If the pardon is granted upon a condition precedent, the condition must be performed before the pardon takes effect. If the condition is subsequent, its breach operates to annul the pardon, and to transform its effect into a reprieve or stay of execution. In such a case the prisoner can not be arrested and remanded to his original punishment upon the mere order of the executive, unless the pardon contains an express provision, or a statute gives clear authority therefor; but he is entitled to a hearing before a competent court, though not to a jury trial, upon the question whether he has broken the condition. (*State ex rel. O'Connor* vs. *Wolfer*, 53 Minn. 135.) A pardon induced by deception is void. An executive pardon must be brought to the attention of the court by appropriate procedure, generally by a special plea; but courts are bound to take judicial notice of a pardon by act of Parliament.

FRANCIS M. BURDICK.

Paré, păă′rā′, AMBROISE: surgeon and author; b. at Bourg-Hersent, near Laval, Maine, France, 1517; became an apprentice to a barber-surgeon in Paris; also studied surgery; joined the society of St. Côme, and in 1536 entered the army in Italy as a surgeon. His introduction of the ligature for bleeding arteries after amputation was the foundation of modern surgery, and he wrote a work on gunshot wounds which is still of value. His great invention dates from 1536. When the supply of oil failed the army in Piedmont (for up to that time hot oil was used to stanch bleeding), he was obliged to tie arteries with a thread, and found that cases where the ligature was employed did much better than the others. From 1552 to 1590 he was surgeon to four French kings. He was a devout Huguenot (although Malgaigne denies it), but his reputation for surgical skill saved him at the massacre of St. Bartholomew and at other critical junctures. His professional works are very much in advance of his times, in spite of the fact that he was only a barber-surgeon, and as such unrecognized by the surgical faculty. His principal work was *Cinq Livres de Chirurgie* (1562). D. in Paris, Dec. 22, 1590. See the *Life* by Paulmier (Paris, 1884), and the article SURGERY.

Paregoric [from Lat. *parego'ricus* = Gr. παρηγορικός, deriv. of παρήγορος, soothing, consoling; παρά, beside + ἀγορεύειν, speak, harangue, deriv. of ἀγορά, assembly]: a well-known anodyne compound (*tinctura opii camphorata*), made by taking 4 grammes of powdered opium, benzoic acid, and camphor, and adding 4 cc. of oil of anise, 40 cc. of glycerine, and enough diluted alcohol to make 1,000 cc. The preparation is completed by shaking, maceration, and filtration. It is a mild anodyne and antispasmodic.

Pareira Brava [Portug.; *pareira*, from the Brazilian name + *brava*, brave, i. e. of full strength]: the dried woody root of some South American climbing plants of the family *Menispermaceæ*. It is a tonic and diuretic drug, used especially in chronic inflammations of the bladder and the urinary passages. The plant in question was long supposed to be the *Cissampelos pareira*, but Hanbury ascertained that it is *Chondodendron tomentosum* of Ruiz and Pavon, *Cocculus chondodendron*, D. C.

Parenchyma: See HISTOLOGY, VEGETABLE (*Soft Tissue*).

Parent and Child: English common law secures to the parent the right to the custody and discipline of his minor children, and to their services.

Custody and Discipline.—This right is accorded to the parent that he may properly train his offspring, and give them a proper education in learning, morals, and religion. It is subject to the state's supervision. A serious abuse of it by the parent, or by one to whom he has delegated it—for example, a school-teacher—is treated as a CRIME (*q. v.*), and will also sustain an action in TORT (*q. v.*) against the offending delegate. It has been held, however, that public policy forbids the maintenance of a tort action by the child against the parent in such case (*Hewlett* vs. *Ragsdall*, 68 Miss. 703); but its abuse may work a forfeiture of the parental right. In *Wellesley* vs. *Duke of Beaufort*, 2 Russell's Reports, the father insisted "that a man and his children ought to go to the devil in their own way if he please;" but Lord Eldon decided that the law recognized no such right. It is well settled that if a father is guilty of gross ill-treatment or cruelty toward his infant children, or if he habitually indulges in drunkenness, or blasphemy, or gross debauchery, or if his domestic associations tend to the corruption of his children, or if his acts are in any manner seriously injurious to their morals or interests, a court of chancery will deprive him of their custody and discipline, and appoint a suitable person as their guardian, to care for them and superintend their education. This practice is based upon the doctrine that parents have no right of property in their offspring; that their parental rights are accorded to enable them to perform their parental duties, and that such rights are held in trust to be forfeited to the state by their abuse. However, courts will interfere between parents and children with great caution, and only in cases where the parent's wrongdoing and the child's danger are clearly established. In many of the U. S. societies for the prevention of cruelty to children have been incorporated, with authority to institute various proceedings on behalf of minors whose parents, guardians, or custodians treat them unlawfully. See ch. 122 *N. Y. Session Laws*, 1876.

Services.—The parent has a legal right to the services of his minor children while within his custody, and to any wages which they may earn in the service of others. He may waive this right by emancipating or freeing the child from parental subjection; or, in some States, by his failure to notify the employer, pursuant to statutory requirement, that the wages must be paid to him and not to the child. According to the prevailing view, the legal marriage of a minor emancipates him or her from parental control. (*Commonwealth* vs. *Graham*, 157 Mass. 73.) An unlawful injury to the child, which invades any parental right, will subject the wrongdoers to an action by the parent as well as to one by the child. Hence where a child had recovered $2,800 for personal injuries, the parent was allowed to recover against the same defendant for loss of service and for reasonable expenses in the care and cure of the injured child. *Horgan* vs. *Pacific Mills*, 158 Mass. 402.

Parental Duties.—It is generally declared that these are maintenance, protection, and education, though to what extent the common law obliges parents to perform them is a matter of much diversity of opinion. The weight of judicial authority in England favors the doctrine that the parent is under no common-law duty to support his child; that his legal duty in this regard is the creature of statute. According to this view, if a parent refuses to provide for his child the latter can not pledge the former's credit for necessaries, nor can he maintain any legal proceeding against the parent. His "only resource, in the absence of anything to show a contract on the parent's part, is to apply to the parish," which may take the proper steps to enforce the parent's statutory duty. The same view prevails in some of the U. S. (*Kelley* vs. *Davis*, 49 N. H. 187.) Other State courts have held that "the duty of the parent to maintain his offspring until they attain the age of maturity is a perfect common-law duty." (*Porter* vs. *Powell*, 79 Ia. 151.) In these jurisdictions, persons who supply minor children with necessaries (see INFANT) which the parent refuses or neglects to provide can recover their value from the parent on a quasi-contract. Where a child possesses an estate in his own right, a court of equity will authorize the father, in a proper case, and the mother in almost every case, to use the income, or even the principal, of such estate for the infant's suitable maintenance and education. A parent may lawfully resort to force in repelling an attack upon his child, as he may in repelling an ASSAULT (*q. v.*) upon himself. If he incurs a great risk in attempting to save his child from injury, he is not chargeable with NEGLIGENCE (*q. v.*), and he may uphold his children in their lawsuits without being guilty of MAINTENANCE (*q. v.*). Although the parental right of protection is unequivocal, the law does not compel its exercise. The parental duty of educating children, which was very imperfect at common law, has been regulated to some extent by recent statutes both in Britain and in the U. S. (See EDUCATION.) A

parent's duty to support his children does not survive him, but he is free, in the absence of a statute on the subject, to disinherit them. The parental liability upon the contracts and the torts of his children is governed by the law of MASTER AND SERVANT (*q. v.*). A husband does not assume the legal relation of parent to his wife's children by a former marriage. While they remain in his family he has the right to control them, and the law presumes, in the absence of any contract on the subject, that he supports them and they render services to him without charge.

Under modern legislation, though not at common law, the legal relation of parent and child may be instituted by ADOPTION (*q. v.*). While the adopted person becomes the legal child of the adopter, he retains the right of inheriting from his natural parents, unless the statute expressly deprives him of such right. *Wagner* vs. *Varmer*, 50 Iowa 532.

Filial Rights and Duties.—Most of these have been set forth in presenting the duties and rights of parents. At common law the child was not legally bound to maintain his parents, but modern legislation has subjected him to an enforceable duty in this respect.

For the rules of law relating to illegitimate children, see BASTARD.

LITERATURE.—Schouler's *Domestic Relations*; Blackstone's *Commentaries*, bk. i., ch. xvi.; Kent's *Commentaries*, lect. 29; Church's *Habeas Corpus*; Story's *Equity Jurisprudence*. FRANCIS M. BURDICK.

Parepa-Rosa: See ROSA.

Par'esis: loss of power less marked than that to which the term paralysis is applied. The causes and the manifestations of paresis are similar to those of PARALYSIS (*q. v.*), differing only in degree.

Paresis, General: See INSANITY (*General Paralysis*).

Parga: town; in the vilayet of Yanina, European Turkey; surrounded on three sides by the sea and defended on the fourth by an almost impregnable citadel (see map of Turkey, ref. 5–B). From 1401 to 1797 it was a prosperous commercial republic under the protection of Venice. From 1797 to 1814 it was nominally subject to the Ottomans, who gave it to Ali Pasha of Yanina. The inhabitants, about 5,000 Christian Albanians, refused to submit, and by desperate exertions maintained their independence, being aided after the treaty of Tilsit (1807) by the French. On the fall of Napoleon the Pargiotes solicited and obtained the protection of Great Britain, which placed a British garrison in the city; but in 1819 the British Government quietly delivered Parga to Ali Pasha, whereupon the Pargiotes dug up the bones of their ancestors, burnt them, abandoned their city, and went into exile. See Mustoxides's *Exposé des faits qui precedèrent et suivirent la cession de Parga* (Paris, 1819). E. A. GROSVENOR.

Parhelia: See HALO.

Paria, paa'rĕē-ăă, **Gulf of**: a small inland sea (105 miles long from E. to W.; 40 miles wide) between the lowlands at the mouth of the Orinoco, the island of Trinidad, and the peninsula of Paria, a rocky extension of the Venezuelan coast range. It communicates with the Caribbean Sea by the Boca del Drago, or Dragon's Mouth (between Trinidad and the peninsula), and with the Atlantic on the S. E. by the Boca de la Sierpe, or Serpent's Mouth. Columbus, who discovered and named these straits in 1498, had great difficulty in passing through them owing to their strong currents. Here he first saw the continent.

HERBERT H. SMITH.

Pa'riah [from Tamil *paraiyan*, a man of low caste performing the lowest menial services, liter., a drummer (the pariahs being hereditary drum-beaters), deriv. of *parai*, a large drum used at certain festivals]: one of the lowest class in India, which does not belong to any of the four castes. The pariahs have woolly hair and thick lips, and are found especially in the south of India; they are supposed to represent the aboriginal race conquered by the Sudras. In the Madras Presidency they number more than 4,000,000. They are very degraded, are not allowed to approach within many feet of any Hindu, and have to some extent adopted a system of caste among themselves. Chandalas and outcasts sink to the rank of pariahs. Successful efforts are being made by missionaries and others to elevate the character and intellect of these wretched beings. See CASTE.

Paridæ [Mod. Lat., from Lat. *parus*, a titmouse (the typical genus) + *idæ*, family termination]: a family of small thick-set birds, containing the titmice, characterized by soft, loose plumage; short, stout, rather conical bill; strong feet, with a pad beneath the hind toe; ten primaries, first short or spurious. The titmice are nearly all confined to the northern hemisphere, and occur in temperate or cold regions of both worlds. See TITMOUSE. F. A. L.

Pari'etal Bones [*parietal* is from Lat. *pa'ries*, wall, partition]: in vertebrates, the two bones which close in the skull above. They are never preformed in cartilage, but arise from the ossification of membranes, ossification in each proceeding from a single center.

Parietal Eye: a vestigial organ peculiar to vertebrates. In the brain of all vertebrates there has long been known a structure of unknown functions, called the pineal gland. It arises from the roof of the brain, between the cerebrum and mid-brain, and in the human being, where it is a structure about the size of a pea, it is completely covered by the cerebrum as it folds back over the cerebellum. In the lower vertebrates, where the cerebrum is less developed, it is exposed upon cutting into the cranial cavity. One of the most brilliant discoveries of recent years was Spencer's demonstration that this problematical organ was a vestigial eye, and that in certain lizards it reached nearly to the surface of the head, retaining in its most complete development lens, retina, pigment, and traces of a nerve. In these forms its presence can be recognized from the exterior in a small spot between the parietal bones, whence the name. Since Spencer's paper numerous investigators have studied the structure, and they recognize in it a compound organ, the anterior part of which alone develops the eye, while the posterior (for which the name epiphysis is retained) is more lymphoid in nature. It would, however, appear probable from the recent investigations of Klinckomstrow and Locy (1894) that the parietal eye is paired in origin, and that the epiphysis may be a second eye, behind the first, which has become more degenerated than its fellow. So far as is known this eye is no longer functional, but in some of the fossil vertebrates a cavity exists in the skull in the right position and of proper size to accommodate a third eye with its appropriate muscles. One of the most interesting features connected with the parietal eye is that it is built upon the invertebrate type; that is, the retinal layer is not inverted as it is in the functional vertebrate eye. See Spencer, *Quarterly Journal Micros. Science* (xviii., 1887); Leydig, Senckenberg. *Abhandl.* (1889); Ritter, *Bulletin Mus. Comparative Zoölogy* (xx., 1891). J. S. KINGSLEY.

Parima, Sp. pron. păă-ree'măă, **Serra**, or **Sierra de**: a line of highlands forming the divide between the headwaters of the Orinoco on the W. and the Rio Branco, a secondary affluent of the Amazon, on the E.; marking part of the boundary between Venezuela and Brazil. According to Codazzi, some points are over 7,000 feet high. On the side of the Orinoco the general trend appears to be from N. W. to S. E. The name is often extended to all the central highlands of GUIANA (*q. v.*). Originally it was given to a mythical lake of large size supposed to exist in this region and connected with the story of El Dorado. H. H. S.

Parini, GIUSEPPE: poet; b. at Bosisio (Brianza), May 23, 1729; d. at Milan, Aug. 15, 1799. Of humble family, he made his way by pure ability into the best society of Milan, and thus acquired the knowledge of its manners necessary for his satiric purposes. His actual career was that of a teacher, though he was also a priest; and from 1773 to his death he was Professor of Belles-lettres in the Academy of the Brera at Milan. He was a member of several of the literary academies so popular in Italy in his time, notably of the Trasformati of Milan and of the Milanese offshoot of the Roman Arcadia. His life was not an eventful one, though at its end he endured some unhappiness through unfortunate mingling in public affairs, and consequent retirement into something like actual poverty. His fame as a poet chiefly rests on his satiric poem, *Il Giorno*, begun by him in 1760. This appeared in four parts—*Il Mattino* (1763), *Il Mezzogiorno* (1765), *Il Vespro* and *La Notte* (the last incomplete, both published after Parini's death in the Reina edition of his *Works*, 6 vols., Milan, 1801). The work is an ironic description of the daily occupations of the Milanese aristocracy, its effeminate and too often corrupt customs, its idleness, its vanity. Pretty episodes are interwoven, and at times the author finds opportunity for noble and sincere protests against social injustices. Besides this poem we have from Parini's pen a number of odes (1st ed. Milan, 1791) and several occasional poems. In these the

neo-classicism of the Arcadia is everywhere to be seen—modified, however, by a certain intentional roughness, which is the poet's protest against the too soft and delicate manner of his contemporaries. A good edition of *Il Giorno* is that by A. Borgognoni (Verona, 1892); of the *Odi*, that of F. Salveraglio (Bologna, 1882). See also A. Giannini, *La vita e le opere di G. Parini* (Salerno, 1891); G. Carducci, *Storia del Giorno di G. Parini* (Bologna, 1892); C. Cantù, *L'abbate Parini e la Lombardia nel secolo passato* (Milan, 1854).

A. R. Marsh.

Paris [< Late Lat. *Pari'sii* (Lat. *Lute'tia Parisio'rum*, Lutetia of the *Pari'sii*, a people of Celtic Gaul, bordering on the Senones]: the capital of France; on both sides of the Seine, 110 miles by rail from the river's mouth; in lat. 48° 50′ N. and lon. 2° 20′ E. of Greenwich (see map of France, ref. 3–F). It has a mean elevation of 120 feet, and lies in a basin between lines of heights, which reach 404 feet on the north side and 190 feet on the south side. The Seine enters Paris on the west and leaves it on the southeast side, forming in its passage the islands of St.-Louis and La Cité. The granitic substratum is covered by Jurassic, Cretaceous, and Tertiary formations, and at several points a light-colored limestone is quarried, which has been used in constructing most of the buildings of the city.

Area and Population.—The present boundary coincides with a line of ramparts, 22⅓ miles in length; it includes an area of 78 sq. km. (a little over 30 sq. miles), of which one-fifth is occupied by the streets, 458 acres by squares and gardens, and 642½ acres by the river and canals. In 1896 the population was 2,536,834. Barely a third were born in Paris, and of the remainder more than 11 per cent. were foreigners. At the end of the thirteenth century the population was 200,000; in 1675, under Louis XIV., 540,000; in 1789, at the outbreak of the Revolution, 600,000; in 1851, at the beginning of the Second Empire, about 1,000,000; ten years later, 1,500,000, an increase chiefly due to the extension of the boundary; in 1871, on the advent of the Third Republic, nearly 2,000,000. The increase is now at the rate of about 25,000 a year. The population is denser than in any other great European city. Marriages average annually 26,500; births, 75,000; deaths, 70,000.

Climate.—The climate is fairly uniform, but liable to changes at all seasons, and on the whole is healthful and agreeable. The average temperature is 51° F. The highest temperature recorded in the nineteenth century was in July, 1881, when it was over 100°; the lowest was in Dec., 1879, when it sank to about −7°. From 1804 to 1876 the average temperature for each season was as follows: winter, 39°; spring, 51°; summer, 64°; autumn, 52°. January is the coldest and July the warmest month. The Seine seldom freezes; generally there is skating for a few days only each year, and the snowfall is slight. The average height of the barometer is 29·55 inches. During an average year there are about 143 rainy days, divided about equally among the four seasons.

Fortifications.—Paris is entirely surrounded by a fortified wall, which, with the first line of detached forts, was constructed between 1840 and 1860. This first line of forts, eighteen in number, is situated at a distance of about 1,600 yards from the city walls. The second line of forts, built since the war of 1870–71, is several miles distant from the city and consists of eighteen forts, placed on the various heights which surround Paris. The capital is now believed to be impregnable from a military point of view.

Streets.—The streets of no city in the world are so fascinating as those of Paris. They are well paved with stone, wood, or asphalt, or are macadamized; they are well lighted with electricity or gas, many of the lamp-posts being in bronze, and some of them being real objects of art. The sidewalks, though rather narrow in the small and old streets, are extremely wide in the boulevards and many of the avenues, and are in all cases smooth and neat. The streets are cleaned daily, and sprinkled frequently, while the gutters are washed out with running water once or twice every twenty-four hours. Trees, shrubs, and flower-beds abound. Comfortable benches are scattered along all the boulevards and avenues. Paper-stands, fruit-stands, etc., are generally neat, and all are constructed on the same models. A system of pneumatic tube telegraphy supplements the postal service. The means of conveyance are chiefly by cabs, omnibuses, and horse-cars, and an underground railway is being constructed. There are also steamboats plying up the river to Charenton and down to Suresnes; and a circular railway, the Chemin de Fer de Ceinture, runs round the city just within the walls. The names of the streets are at all the street-corners, and the numbers on the houses are large and conspicuous. The dwellings and public edifices, almost always built of limestone, are well constructed, and for the most part are of about the same height and same style of architecture. On their fronts, in scores of cases, are tablets bearing historic inscriptions, informing the public that on this or that site or in this or that house some famous man lived or died, or some great event happened. No two streets bear the same name. Most of the names are given to perpetuate the memory of famous men or women of all ages and nations, or to recall celebrated historical and political events. Among the citizens of the U. S. who are thus remembered are Washington, Lincoln, Franklin, and Fulton.

From the Madeleine to the Bastille the line of boulevards, 3 miles in length, forms the busiest and most fashionable thoroughfare in the world. The thoroughfare of the boulevards of Sébastopol and Strasbourg stretches N. and S. between the Gare de l'Est and the Seine, and then by the Boulevard du Palais and Boulevard St.-Michel reaches the observatory, the total length being 2½ miles. The Rue Royale, the Malesherbes and Haussmann boulevards, and the Avenue de l'Opéra are among the finest quarters of the town. The Rue de la Paix, Rue Auber, and Rue 4 Septembre are remarkable for their shops. The Place de l'Étoile is the center of twelve avenues issuing from it like the spokes of a wheel. On the south side the main thoroughfare is the Boulevard St.-Germain.

Bridges.—The Seine is of the proper width to favor the construction of graceful bridges, which are among the most attractive ornaments of the city. The oldest are Notre Dame, occupying the site of a Roman bridge; the Pont Marie, constructed between 1614 and 1628; the Pont d'Austerlitz, begun under the first Napoleon, rebuilt during the Second Empire, and enlarged during the Third Republic. The names of the principal officers killed at the battle of Austerlitz are inscribed on the ornamental portion of this structure. The present Pont au Double, which dates from 1880, supplanted a bridge of the seventeenth century, where a toll of a *double*, an old piece of money worth the sixth of a sou, was collected. The Pont St.-Michel, rebuilt several times since the fourteenth century, is one of the widest and most frequented. The famous Pont Neuf is now the oldest of the Paris bridges. It was begun in 1578 under Henry III. and finished under Henry IV., whose statue adorns it. Mansart was the architect of the Pont Royal, which was constructed between 1685 and 1689. The Pont de Solférino commemorates the chief French victories during the Italian campaign of 1859. The Pont d'Iéna dates from the closing years of the First Empire. The bridge and viaduct of Auteuil, one of the finest of the kind in existence, was built in 1866. It serves for railway, vehicle, and foot traffic.

Parks and Gardens.—The public garden of the Tuileries covers about 70 acres, and was laid out in 1665 by Le Nôtre, the landscape-gardener of Louis XIV.; but the original plan has been much altered. The garden contains many fine, large trees and numerous pieces of sculpture by famous French artists. The Luxembourg Garden is a little smaller than the Tuileries. The hothouses, sixteen in number, contain more than 25,000 plants. Besides other statuary there is a series of portraits of famous French women, erected during the reign of Louis Philippe (1830–48). The Palais Royal garden, in the form of a large parallelogram, is much smaller than the two gardens already mentioned. It is surrounded on all four sides by buildings and an arcade, where are many fine jewelry-shops.

The Jardin des Plantes, which is a little larger than the Tuileries, was designed by Guy la Brosse, Louis XIII.'s physician, and was first opened to the public in 1650. At that time it contained only medicinal herbs. To-day the botanical school has a reserve of nearly 5 acres filled with some 13,000 kinds of plants. Most foreign trees and shrubs which can live out of doors in the climate of Paris are found here, and are labeled. There are nearly 2,000 varieties of fruit-trees and many hothouses. A zoölogical collection forms a part of the garden. The Monceau Park was laid out in 1778 by the father of Louis Philippe, but did not become public property till the Second Empire. It contains several bits of historical ruins, notable modern statues, and is surrounded by some of the most fashionable streets and magnificent private residences of Paris. The Trocadéro Park dates from the Exhibition of 1878. After the foun-

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VERSAILLES RAILWAY
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I. DE LA GRANDE JATTE
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Courcelles
Levallois
Villiers
Champerret
LES BATIGNOLLES
Monceaux
Parc de Neuilly
Sablonville
Porte Maillot
Les Ternes
St. James
Madrid
ILE DE PUTEAUX
Bagatelle
BOIS DE BOULOGNE
Hippodrome de Longchamp
Grand Stand
Windmill
Pré Catelan
Lac Inferieur
Lac Superieur
La Muette
PASSY
Trocadero
Trocadero Palace
CHAMP DE MARS
Ecole Militaire
Invalides
Esplanade des Invalides
Palais de l'Industrie
Corps Legislatif
Place de la Concorde
Jardin Mabille
Av. de la Grande Armée
Av. de Friedland
American Ch.
Russian Church
Quai d'Orsay
Manuf. des Tabacs
Av. de Suffren
Rue Dupleix
Boulevard de Grenelle
AUTEUIL
Grand Rue d'Auteuil
BOULOGNE
Porte de St. Cloud
Route de St. Cloud
Route de Versailles
GRENELLE
Station de Grenelle
VAUGIRARD
Station de Vaugirard
Rue de Vaugirard
Rue Lecourbe
Rue de la Croix Nivert
Rue de Sèvres
Rue de Babylone
Pte. de Sèvres
Pte. d'Issy
Pte. de Versailles
BILLANCOURT
Billancourt Sta.
ILE SEGUIN
ILE DE BILLANCOURT OR ST. GERMAIN
Steamboat Sta.
Bas Meudon
Meudon Sta.
Fort de Meudon
ISSY
Hospice
Lycee
VANVES
VERSAILLES RAILWAY (LEFT BANK)
Nouvelle Californie
CEINTURE RY.
PLAISANCE
Petite Montrouge
MONTE ROUGE
Station de l'Ouest
Western Station
Station de Clichy
Station Batignolles
Pal. Elysees
English Embassy


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STRASBOURG RAILWAY
Canal de l'Ourcq
PANTIN
LA VILLETTE
Pont de Flandre Station
LA CHAPELLE
MONTMARTRE
Cattle Market
Abattoir
Pte. de Pantin
LE PRE ST. GERVAIS
Porte des Pres St. Gervais
Porte de Romainville
Montfaucon
Butte Chaumont
BELLEVILLE
Hospice St. Louis
Napoleon Docks
Theatre
Station Meilmontant
Meilmontant
Porte de Baynolet
Pere la Chaise Cemetery
CHARONNE
Station de Charonne
Fontarable
Petit Charonne
Pte. de Montreuil
Place de la Nation
Cours de Vincennes
Porte de Vincennes
Porte de St. Mande
Abattoir
Prison
National Printing Office
Palais Royal
Opera
Grand Hotel
North Ry. Sta.
Strasburg Ry. Sta.
Bank
Post Off.
Rue de Rivoli
Rue St. Honore
Quai du Louvre
Louvre
Tuileries
Institut
ISLE PALAIS
Notre Dame
Morgue
ILE ST. LOUIS
Pl. de la Bastille
Vincennes Ry. Sta.
Lyons Railway Station
Jardin des Plantes
Orleans Ry. Sta.
Hopital de la Salpetriere
Pantheon
Palais du Senat
Jardin du Luxembourg
Mont Parnasse Cemetery
Hopital du Val de Grace
Observatory
Market
Place d'Italie
La Glaciere
Parc Mont Souris
Station de Montrouge
Le Deux Moulins
La Maison Blanche
La Gare
Station d'Orleans
BERCY
Sta. de la Rapee
La Grande Pinte
Pte. de Picpus
Pte. de Charenton
BOIS DE VINCENNES
LYONS RAILWAY
Conflans
Les Carrieres
CHARENTON
IVRY
ORLEANS & CORBEIL RY.
GENTILLY
SEINE

tain and palace the most interesting object is the aquarium. The Buttes-Chaumont Park is in the extreme northeast part of Paris on the Belleville hill. Till the end of the Second Empire what is now a beautiful park of over 55 acres was a waste quarry-ground. A fine view of Paris may be had from the heights of this park. The Montsouris Park (nearly 40 acres) is on the southern outskirts of the city, and contains the meteorological observatory.

The Champ de Mars, which used to be a sandy field for military manœuvering, is now laid out as a public garden. It is surrounded by the principal buildings of the Exhibition of 1889, and in the center is the Eiffel Tower (*q. v.*). At the southeast end is the military school. The Champs Élysées is the most frequented garden of Paris.

Outside of the walls are the two great parks, the Bois de Boulogne and the Bois de Vincennes. The first, of about 2,000 acres, contains two large lakes, many beautiful drives and walks, and a race-course—Longchamps—where the Grand Prix is run for and where the grand annual military review takes place. A fashionable skating-rink is opened here in winter. The aristocratic drive is the Allée des Acacias. The Garden of Acclimatation, situated here, embraces the finest zoölogical collection in Paris. The Bois de Vincennes contains over 2,075 acres. In the center is a large field for military manœuvers and also a race-course.

Public Monuments.—The streets, squares, and parks contain many groups of statuary by noted sculptors, and numerous monuments. The most remarkable monument is the Arc de Triomphe in the Place de l'Étoile, begun by Napoleon I. and completed by Louis Philippe. It is about 160 feet in height. Another triumphal arch stands in the Place du Carrousel, and commemorates the campaign of 1806. In the Place Vendôme is a shaft 143 feet in height, with bas-reliefs commemorating Napoleon's campaigns in 1805. *The Column of July*, a bronze pillar 154 feet in height, stands in the Place de la Bastille, and is dedicated to the citizens who fell in the Revolution of 1830. In the center of the Place de la Concorde, on the spot where stood the guillotine used during the Revolution, is the obelisk of Luxor, 75 feet in height. (See Obelisk.) It was removed from Egypt in 1833, and in 1836 was set up where it now stands. A colossal lion in the Place Denfert symbolizes the defense of Paris in 1871. A reduction of Bartholdi's *Liberty Enlightening the World*, a gift of citizens of the U. S., stands on one of the islands in the Seine. Among those to whose memory statues have been erected are Charlemagne, Joan of Arc, Louis XIV., Napoleon, Danton, Gambetta, Dante, Shakspeare, Béranger, Voltaire, and Dumas. The Medici fountain in the Luxembourg garden, the two fountains in the Place de la Concorde, copies of those at St. Peter's, Rome; the fountain in the Place Louvois, the Fountain of Victory in the Place du Châtelet, the Cuvier fountain near the Jardin des Plantes, the fountain at the north end of the Boulevard St.-Michel, the fountain at the north end of the Avenue de l'Observatoire, that in the Place de Notre Dame, that by Bouchardon in the Rue de Grenelle, and the colossal fountain in the Champ de Mars, are a few of the works of art of this kind that adorn the city. The great Trocadéro fountain may be termed a cascade.

Palaces.—Paris is rich in splendid palaces. The origin of the Louvre is almost coeval with the French monarchy, although the name first appears about the year 1204, during the reign of Philip Augustus, who entirely rebuilt it. The Louvre was then an exceedingly strong fortress. Catherine de Medicis was the first royal personage to take up a residence in the Louvre. Here in 1610 Henry IV. was laid out in state after his assassination. When Louis XIII. died the Louvre was abandoned as a royal residence, till occupied by the widow of Charles I. Louis XIV. held a *lit-de-justice* there, and during the same reign Molière's troop of actors played in one part of the palace. On the outbreak of the Revolution of 1789 the Louvre was in a semi-abandoned state; but the Convention made a complete change in its management by converting it into a grand picture gallery and museum.

The Tuileries (*q. v.*), on the right bank of the Seine, was begun in 1564, and was the scene of many historic events. The whole central portion and a part of the wing along the Rue de Rivoli were burned by the Communists in 1871. This wing was rebuilt during 1875–76, while a few years later, the ruins of the historic central part were leveled to the ground and a garden laid out on the site.

The Élysée Palace was built in 1718. Among its early occupants were Mme. de Pompadour and, later, Murat. Napoleon retired thither after his defeat at Waterloo, and there signed his abdication. It was Louis Napoleon's official residence when he was president of the Second Republic, and there he prepared the *coup d'état* of Dec. 2, 1851. Since the establishment of the Third Republic the Élysée has been the residence of the president.

On the site of the Palais Royal once stood the *hôtels* of Mercœur and Rambouillet, celebrated in literary history. Cardinal Richelieu bought these two *hôtels*, tore them down, and constructed on the ground a palace which was completed in 1634. Here he died eight years later. In 1643 Anne of Austria took possession of the palace with her two sons, one of whom afterward came to the throne as Louis XIV. It was Philippe Égalité, father of King Louis Philippe, who surrounded the garden with the shops which still stand, and whose rentage enabled him to keep up his expensive establishment. It was in the garden of the Palais Royal that Camille Desmoulins gave the first popular impulse to the Revolution. Between 1872 and 1876 it was reconstructed and restored, having been partially burned during the Commune, and is now occupied by state bodies.

The Luxembourg Palace is an ancient royal residence, built by Marie de Médicis in the beginning of the seventeenth century. Among other famous personages who have lived there are Mlle. de Montpensier, Louis XIV., and Louis XVIII. The Revolution converted the palace into a prison, and here were confined the future Empress Josephine, Danton, Camille Desmoulins, Thomas Paine, and others. Toward the end of the eighteenth century it became the seat of executive or legislative bodies, and has continued to be used for this purpose down to the present day, the Senate now occupying it. Here in 1815 Ney, in 1830 the ministers of Charles X., and in 1840 Prince Louis Napoleon after his landing at Boulogne, were imprisoned and tried; and here, during the republic of 1848, Louis Blanc established a sort of official labor bureau. The interior of the palace is rich and spacious, and contains many objects of historic and artistic value. A large public garden is connected with the palace, and a gallery of modern pictures and sculptures is established in an annex. The historic Petit Luxembourg, a wing of the larger palace, is now the official residence of the president of the Senate.

The Palais Bourbon was built in 1722, but has been much enlarged since that time. Here sat the Council of Five Hundred, and here, under different names, the Chamber of Deputies has met, with slight interruptions, since the Restoration down to the present day. In this hall the greatest parliamentary orators of France have been heard, and here occurred several of the most famous scenes in the political history of France during the nineteenth century. The palace occupied by the president of the Chamber of Deputies is connected with the Palais Bourbon. Here Gambetta once resided.

The palace of the Legion of Honor was built in 1786 for the Prince of Salm; but during the Revolution it was put up at lottery and won by a baker. In 1803 the offices of the Legion of Honor were established here. The edifice was burned by the Commune, but was restored.

The Palace of the Institute is due to Cardinal Mazarin, and was finished in 1662. It was at first used as the College of the Four Nations. During the early days of the Revolution it became a jail, and later the meeting place of the Committee of Public Safety. The First Empire established the Institute of France in this edifice, and there it has since remained. The famous French Academy, which forms a part of the Institute, meets here.

Museums and Picture Galleries.—Paris is remarkably rich in museums and picture galleries, there being nearly fifty in all. The most important is that of the Louvre, whose origin was a private collection of pictures which belonged to Francis I. Louis XIV., Louis XV., and Louis XVI. increased the collection, and on the eve of the Revolution the Louvre Gallery was one of the finest in the world. Additions were made during the Revolution, and during the wars which followed Napoleon sent to Paris the most famous works of art of all Europe, many of which became the permanent property of the Louvre. Its most noted piece of ancient sculpture is the Venus of Milo, discovered in 1820, and bought by the French Government. Since 1870 valuable gifts and the results of artistic and scientific expeditions under Government authority have considerably increased the value and extent of the collections.

Among the other important museums and galleries are the Carnavalet, specially devoted to the history of Paris and

the Revolution; the Cluny, mediæval art, containing over 10,000 objects; the natural history collections in the Jardin des Plantes, one of the largest of its kind in the world; the Luxembourg, a gallery of living painters and sculptors; the Artillery Museum in the Hôtel des Invalides, embracing some 4,000 specimens of military weapons of all kinds and of all countries and ages; the Trocadéro, comparative sculpture, architecture, and ethnology; the Guimet, devoted to the religions of the far East; the Galliera, a miscellaneous art collection housed in a magnificent stone structure which was ten years (1878–88) in building; the mint, containing a large collection of coins and other curiosities; the National Archives, a great mass of original documents, some of which may be seen by the general public, autographs, the keys of the Bastille, etc.; the Dupuytren, at the School of Medicine, a valuable collection bearing on pathological anatomy, formed in 1835; the art collection at the School of Fine Arts; and the scientific collections at the School of Mines.

Libraries.—There are many great book collections in Paris. The National Library, the largest in the world, contains some 3,000,000 volumes. It was begun by Charles V. (1364–80), and went on increasing steadily, but it was the suppression of the convents and the confiscation of their libraries, during the Revolution, that placed it, with one bound, at the head of the list. Besides its books the library contains some 300,000 maps from all parts of the world, over 90,000 volumes of manuscripts, ancient and modern, many volumes of rare autographs, more than 200,000 coins and medals, and 14,500 volumes and 4,000 portfolios of engravings.

The Ste.-Geneviève Library, near the Panthéon, is of ecclesiastical origin, and contains some 196,000 volumes, 4,000 manuscripts, and 25,000 engravings. Its books are mostly of an encyclopædic nature. Nearly 150,000 persons enter this library every year. The Mazarin Library, at the Institute, begun by Cardinal Mazarin, has 250,000 volumes, 6,000 manuscripts, and 1,700 incunabula, and is one of the leading libraries in France in bibliographical rarities. It is, furthermore, a museum, containing many scientific curiosities and objects of art. The Arsenal Library has 200,000 volumes and 8,000 manuscripts, and is notable for its works of the early minor French poets and for documents relating to the theater. The Library of the Opéra, kept in the Opera-house, is devoted principally to the history of the theater and music. It contains 15,000 bound volumes and pamphlets, 60,000 engravings, and the original drawings for the costumes of 200 operas or ballets.

Theaters.—The drama being one of the chief sources of amusement in Paris, there are many theaters. Four of them —the Opéra, Théâtre Français, Opéra Comique, and Odéon —receive state aid. The Opéra is one of the finest theatrical edifices in the world. It cost some 30,000,000 francs, covers an area of about 11,000 sq. yards, and can seat 2,156 spectators. It took over ten years to build the edifice, which was first thrown open to the public in 1875. The architect was Charles Garnier. The grand staircase and the *foyer* are the most admired portions of the structure. The annual subvention is 800,000 francs.

The leading theater of France and of the world is the Théâtre Français, or Comédie Française. It has a large and talented stock company, which enjoys many privileges. The present edifice was built in 1782, and contains, besides a large auditorium and handsome *foyer*, numerous busts and portraits in oil of celebrated dramatists and actors, and other interesting histrionic objects; also a curious collection of autographs and objects associated with famous actors. The Théâtre Français was created in 1680, and receives an annual subvention of 240,000 francs. Among its most famous actors have been Talma, Mars, Rachel, Coquelin, and Sarah Bernhardt.

The Opéra Comique was burned in 1887, but a new building is being erected. The Odéon, opened in 1782, was burned in 1799, rebuilt in 1808, and again burned in 1818, but immediately rebuilt. It contains one of the best auditoriums in Paris, and enjoys a subvention of 100,000 francs.

Among the non-subventioned theaters are the Gymnase, founded in 1820, which owed its early prosperity to Scribe, whose pieces were first brought out on its stage; the Palais Royal, whose troupe has contained many celebrated actors; the Porte St.-Martin; the Château d'Eau, which has the largest auditorium of all Paris theaters; the Vaudeville, Variétés, Renaissance, Gaîté, Châtelet, Nouveautés, etc. Several circuses, concerts, *cafés-chantants*, etc., complete the list of places of amusement.

Restaurants and Cafés.—In no other city is restaurant and *café* life so highly developed as in Paris. At the Café Américain congregate literary men and painters; bankers and brokers predominate at the Café Riche; at the Café du Helder are found army and navy officers and St.-Cyr cadets; rich foreigners frequent the Café de la Paix; the Café de Madrid is the headquarters of journalists; actors are numerous at the Café de Suède and the Café des Variétés; the Café Vachette, in the Quartier Latin, is patronized by students; the Café de la Régence is the meeting-place of Scandinavians and chess-players. The principal Montmartre quarter *cafés* were the Rochefoucauld and the Nouvelle Athènes, but the famous *café* of the Chat Noir has eclipsed them and has become one of the curiosities of Paris. There are fashionable restaurants in the Champs Élysées, where one may dine and watch at the same time the performances of the *cafés-chantants*. In the Bois de Boulogne are some *cafés* and restaurants, the Cascade restaurant being very popular in summer, when it is used as a resting-place after an evening drive.

Educational Institutions.—The Panthéon may be considered the center of the Quartier Latin, the students' part of Paris. Here, within five minutes' walk of one another, are the Sorbonne, the heart of the UNIVERSITY (*q. v.*); the Collège de France, which might be called the Post-graduate University; the special schools of law, medicine, mines, pharmacy, fine arts, Oriental languages, etc., the historic École Polytechnique, the École Normale Supérieure, etc. In the faculties are over 325 professors, and more than 100 lectures are delivered every day. The thousands of students in attendance come from almost all the nations of the earth; there are over 5,000 at the medical school alone.

Churches.—There are seventy parish churches, of which Notre Dame, the metropolitan cathedral, is the largest and most famous. Its corner-stone was laid in 1163 by Pope Alexander III., then a refugee in France, but the edifice was not completed till nearly a century later. In 1845 a thorough restoration of the church was begun. Notre Dame is one of the finest specimens in France of the ogival style of architecture. The interior is 132 yards long, 53 wide, and 37 high, and contains thirty-seven chapels. There are three grand rose windows, whose stained glass dates from the thirteenth century. The large bell in the south tower was cast in 1686, and weighs about 30,000 lb. The Sainte Chapelle is perhaps the most beautiful structure in Paris. It was built by St. Louis to house the supposed crown of thorns and a portion of the true cross. It was finished in 1247, and restored at the end of Louis Philippe's reign. The Chapelle Expiatoire, on the Boulevard Haussmann, was built by order of Louis XVIII. (1814–24), and finished in 1826. It is consecrated to the memory of his brother and sister-in-law, Louis XVI. and Marie Antoinette, who were buried on this spot, and to the memory of the victims of the Revolution. The first church bearing the name St. Étienne-du-Mont dates from the thirteenth century, but was reconstructed in 1517 under Francis I. The jube, or rood-loft, the work of the sculptor Biard, senior, was made at the beginning of the seventeenth century, and is considered a masterpiece. The stained-glass windows of this church are also notable, representing the work of the best artists from the middle of the sixteenth to the end of the seventeenth centuries.

St.-Germain-des-Prés is a remnant of the ancient abbey of that name. It was begun in 1001, but was not completed till the twelfth century. Near by was the prison of the abbey, which was the scene of much bloodshed during the Reign of Terror. It disappeared in 1860.

There was a church on the site of St.-Germain-l'Auxerrois as early as 560. Some portions of the present edifice date from the twelfth century. A cloister once surrounded the church, and was in the days of Charlemagne the seat of a famous school. On Aug. 24, 1572, its bell rang out the signal for the massacre of St. Bartholomew.

The Madeleine was begun by Louis XV., but was not opened till 1842. Napoleon I. intended it to be a Greek temple, dedicated to the soldiers of the Grand Army. It is now one of the most richly ornamented and fashionable churches of Paris. The corner-stone of St.-Roch was laid by Louis XIV. in 1653. On the top of the flight of steps leading up to the doors of this church, Bonaparte placed the cannon which checked the uprising against the Convention Oct. 5, 1795. Corneille, the dramatist, is buried here. The Church of the Sacred Heart on the heights of Montmartre is a large and conspicuous basilica in Byzantine

style, whose construction was decreed in 1874 by the National Assembly. A fine view of Paris can be obtained here.

St.-Sulpice was begun in 1646. During the Convention it was known as the Temple of Victory. Val-de-Grâce was raised by Anne of Austria as a thank-offering to God for the birth of the future Louis XIV. The cupola, which is considered to be the best imitation in France of the cupola of St. Peter's, Rome, is decorated with a large composition by Pierre Mignard—*Gloire des Bienheureux*—containing over 200 figures. Henrietta, queen of Charles I. of England, and daughter of Henry IV. of France, is buried here.

Among the other churches may be mentioned St.-Vincent de Paul, with its frieze over 170 yards long and 3 high, by Hippolyte Flandrin; Ste.-Élisabeth, Rue du Temple, whose cornerstone was laid in 1628 by Marie de Medicis; St.-Eustache (1532–1642), where Colbert is buried; Notre Dame de Lorette, in imitation of a Roman basilica; Notre Dame des Victoires, remarkable for the large number of *ex-votos* which cover the interior walls; and the Chapel of the Sorbonne, now the center of the immense parallelogram of new university buildings, and noted for its tomb of Richelieu. Of the forty-five or more Protestant churches the Oratoire is the most conspicuous.

Cemeteries.—Paris has nineteen cemeteries, thirteen of which are inside the walls. Of the latter, only three are of historic interest: Père Lachaise, Montmartre, and Montparnasse. The largest and most notable is the first named. It covers about 100 acres, and here are the tombs, among those of other celebrities, of Arago, Thiers, Rachel, Cuvier, Béranger, Molière, Ingres, and Balzac. It is also provided with a crematory, the first and only one established in Paris. In the Montmartre Cemetery are buried Delaroche, Gautier, Comte and the heart of Marshal Lannes, whose body is in the Panthéon. At Montparnasse are the graves of Henri Martin, Rude, Le Verrier, Malte-Brun, and Sainte-Beuve. La Fayette is buried in the little cemetery of Picpus, near the eastern extremity of Paris, and in the Passy Cemetery is the conspicuous tomb of Marie Bashkirtseff.

Reviews and Journals.—The oldest of the reviews published in Paris is the *Revue Britannique*, founded in 1825; the most important, which has a worldwide reputation, is the *Revue des Deux Mondes*, founded in 1829; and among the others may be mentioned Mme. Adam's *Nouvelle Revue*, the *Revue Historique*, Ribot's *Revue Philosophique*, *Revue Bleue*, which enjoyed considerable popularity during the life of its founder, Eugène Yung, the recently established *Revue de Paris*, and Richet's *Revue Scientifique*. Among the illustrated and artistic journals are *L'Illustration*, founded in 1843, the *Journal Amusant*, the *Journal Illustré*, the *Magasin Pittoresque*, founded in 1833, the *Monde Illustré*, the *Univers Illustré*, *La Vie Parisienne*, *L'Art*, one of the high art publications, the *Gazette des Beaux-Arts*, and the *Revue des Beaux-Arts*. Among the daily papers of note are *Figaro*, *Le Temps*, the leading evening newspaper; the *République Française*, founded by Gambetta; the venerable *Journal des Débats*; the *Rappel*, which used to be Victor Hugo's organ; the *Univers* and *Monde*, the two Roman Catholic organs; the *Petit Journal*, a one-sou morning paper with over 1,000,000 readers, the largest circulation in France; the *Gaulois*, which circulates largely in the fashionable world; and the *Journal Officiel*, the official organ of the Government.

Hospitals.—The oldest of the Paris hospitals is the Hôtel-Dieu, founded about 660 and rebuilt between 1868 and 1878. It contains nearly 600 beds. La Charité, founded in 1602 by Marie de Médicis, is the chief lying-in hospital. The Lariboisière takes its name from the Comtesse de Lariboisière, who left nearly 3,000,000 francs to the Paris poor. The hospital contains 690 beds. The Necker is named from the mother of Mme. de Staël, who used to found it a sum given her for charitable purposes by Louis XVI. La Pitié was built by Louis XIII., and has 729 beds. St.-Antoine is another of the early hospitals. It is surrounded by large gardens and has 647 beds. St.-Louis dates from 1607, during the reign of Henry IV., and is given up to patients suffering from skin diseases. The Midi is confined to the venereal diseases of men and the Lourcine to those of women. The Maternité occupies the old abbey of Port-Royal, which was used as a prison during the Revolution. There is attached to it a school of midwifery for female pupils. The hospital of the *accouchement* clinic, 89 Rue d'Assas, possesses a fine obstetric museum. The hospital for sick children in the Rue de Sèvres contains over 650 beds. The Trousseau, founded in 1660, is also devoted to children.

Prisons.—The Dépôt is a temporary lock-up at the prefecture of police, where prisoners are first sent when arrested. Mazas is filled chiefly with prisoners awaiting trial. The Conciergeric is the most famous, politically and historically. There Marie Antoinette passed the last days of her life, and was succeeded by Danton, Mme. Roland, Camille Desmoulins, Robespierre, etc. In Sept., 1792, 288 prisoners were murdered there. Georges Cadoudal, during the First Empire, and Prince Napoleon and the Duke of Orleans during the Third Republic, were confined there. The Roquette can accommodate nearly 450 convicts. Those condemned to suffer capital punishment are held here. In the street in front of the central door is the spot where the guillotine is put up. Ste.-Pélagie is the lock-up of journalists and writers who violate the press laws. Béranger, Lamennais, Proudhon, and a host of other French literary celebrities have been confined there. La Santé is another of the large prisons. St.-Lazare receives only women; during the Convention it was used as a political prison.

Government and Administration.—The city is divided into twenty *arrondissements*, each of which is subdivided into four quarters. Each of the latter elects, by universal suffrage, a member of the municipal council. The functionaries of the *arrondissement* are a mayor and three deputies, nominated by the prefect, or governor, of the department of the Seine, who act as registrars and take charge of the poor relief, and a justice of the peace nominated by the Government. The municipal council discusses and votes upon the budget of the city. The prefect of the Seine and the prefect of police, both government officials, represent the executive central authority as opposed to the municipal council. The prefecture of the Seine comprises a departmental service and a municipal service, the latter much the more important. Elections, taxes, the municipal debt, city schools, public lands, markets, cemeteries, etc., are under the control of the prefecture of the Seine. The prefecture of police includes the whole department of the Seine and part of Seine-et-Oise. It consists of three sections, the political police, the police of public safety, and the administrative police; but the two former are rather national than municipal.

Markets.—Wholesale trade in foodstuffs is carried on in the central markets—Les Halles. These comprise ten pavilions of glass and iron, each about half an acre in size, and separated from each other by covered streets. Butcher's meat is also sold in the market attached to the La Villette abattoir. The Chemin de Fer de Ceinture brings the cattle-trucks into this market, which, with the abattoirs, extends over an area of 111 acres. The places of sale are capable of holding 4,600 horned cattle, 4,000 calves, 22,000 sheep, and 7,000 pigs. Close to Les Halles is the corn-market; but the greater part of the grain arriving in Paris does not pass through this building; it is either stored at the stations or taken directly to the warehouses or the bakers. There are three great markets for wine and spirits at Bercy, Quai St.-Bernard and Pont de Flandre. There are also important markets for skins and hides, horses, charcoal, etc. The curious Marché du Temple, rebuilt in 1864, is devoted to the sale of second-hand articles of all kinds.

Water-supply and Drainage.—Paris derives its water-supply chiefly from (1) the Seine, whose water is pumped up and stored in reservoirs at the highest points in Passy, Montmartre, Charonne, and Gentilly. (2) The Marne, a loop of which, closed by a canal at St.-Maur, supplies several districts by means of the head of water and the application of steam-pressure. (3) The Ourcq Canal, also used as a waterway, which comes from the department of Aisne and terminates at the La Villette basin. (4) The Dhuis and the Vanne, two streams of La Champagne. The former is diverted near Château-Thierry and conveyed by an aqueduct 81 miles long to the Ménilmontant reservoirs. The aqueduct from the Vanne ends in reservoirs at Montrouge. (5) The Aure, a tributary of the Eure. The water is diverted near the junction with the Vigne and brought by an aqueduct 63 miles long, by turns under and above the ground, to the Montretout reservoirs at St.-Cloud (opened Mar. 30, 1893). The last is calculated to have raised the daily water supply from 150,000 to 270,000 cubic meters, so that Seine water is no longer used for drinking purposes.

The drainage on both sides of the river is collected in a great sewer terminating in the Seine at Clichy. The two main sewers on both sides are connected by a siphon which passes under the Seine by a tunnel near the Pont de l'Alma. A departmental sewer receiving the drainage of the higher districts on the north side ends at St.-Denis. The sewers in

general are also used as passages for water-pipes, gas-pipes, telegraph wires and pneumatic tubes. (See PNEUMATIC TRANSMISSION.) The largest class have a height of 17½ feet at the keystone and a width of 17 feet at the spring of the arch.

Financial Institutions.—After the Bank of France (see BANK) the chief financial establishments are the Caisse des Dépôts et des Consignations, which receives voluntary deposits and those obligatory in cases fixed by law; the Crédit Foncier de France, which makes advances on real estate; and the Comptoir National d'Escompte. There are also numerous private joint-stock banks. The Bourse is open from noon to 3 P. M. for dealings in stocks and shares, and from 3 P. M. to 6 P. M. for commercial transactions. The former are effected by means of *agents de change*, named by ministerial decree and possessing nominally the exclusive right to act as brokers; but a large business is done by the unauthorized brokers called *coulissiers*.

Manufactures and Commerce.—In proportion to its population Paris can not be regarded as pre-eminently a manufacturing or commercial city. It contains a great number of officials, on account of the highly centralized government of France. It is a great financial center; and as it offers a variety of attractions appealing to the appetites, the senses, the æsthetic feeling, and the intellect, it is the residence of wealthy men from all parts of the world, as well as of numerous authors, artists, and scientific men. The chief industries are the production of articles not depending upon the cost of material, but upon the skill and taste of intelligent workmen, such as bronzes, jewelry, decorative furniture, and *articles de Paris*. The publishing business of France has been almost monopolized by Paris, and has reached a very high state of development, especially in the production of engravings and illustrated books. The larger manufacturing establishments include engineering works, chiefly in connection with the railways, foundries, and sugar-refineries. Among Government works are two tobacco-factories, the national printing establishment, the mint, and the Gobelins tapestry-factory and dye-works. Next come the chemical-factories, printing-offices, cabinet-makers' workshops, tailoring establishments, and hat-factories. Several plans have been discussed with the object of making Paris a seaport in the modern sense, and it has at length been decided to open up the port by the canalization of the Seine. In 1891 the plans were completed, the final estimates being: length of canal, 112 miles; depth, 20½ feet; cost, $27,000,000. The goods arriving by the Seine are chiefly building materials, timber, grain, coal, coke, charcoal, and wines; building materials and flour are brought by the Canal de l'Ourcq, and coal and coke from the north of France, Belgium, and England by the Canal St.-Denis. By the Seine, Paris dispatches manure, pyrites, and refined sugars. To the traffic of the river should be added that of the canals, especially of La Villette, on the Canals St.-Denis and Ourcq, which is the third port in France, measured by its traffic.

History.—The generally accepted opinion is that the city was primitively one of those many fishing villages which the early Gauls established on the islets scattered along the course of the Seine, for the heart of the city is even to-day known as the Île de la Cité and the Île St.-Louis. The first historic mention of Paris and its inhabitants occurs in the year 52 B. C., when Cæsar says in his *Commentaries*, book vii.: "Labienus leaves for Lutetia with four legions. This is the fortress of the Parisii, situated on an island in the river Seine." At the end of the fourth century Lutetia, *Lutèce* in French, had become the seat of a bishop and was called Paris, from the name of the little nation whose capital it was. The Roman emperor Constantius Chlorus is said to have fixed his residence there (292–306), and Julian was there proclaimed emperor by his soldiers (360). In 506 Paris became the residence of Clovis, and later Charlemagne sometimes visited it, though in his time it ceased to be the capital. The growing town suffered from the devastations of the Normans. In 885–886 30,000 of them encamped in front of the Île de la Cité, which was besieged, but in vain, during thirteen months. "By this heroic siege," says the French historian Henri Martin, "Paris took the first step toward its grand destiny; thenceforth it was the head and heart of France." In 987 Hugh Capet, the first of the dynasty, made Paris the capital of his kingdom, and his successors resided there. During the reign of Philip Augustus (1180–1223) the city's growth was great. The streets were then first paved with stone, the two wooden bridges which connected the Île de la Cité with the mainland were rebuilt in stone, three colleges were founded, and soon 20,000 students flocked to the city from all parts of France and foreign countries. This was the foundation of the university, which did much to increase the population and importance of the city. Under Louis IX. (1215–70) was founded a theological college, which became the celebrated Sorbonne. Philip the Fair added greatly to the importance of the city by making it the seat of the highest court in the kingdom—the *Parlement*, which he organized in the opening years of the fourteenth century. During the reign of Charles IX. (1560–74) religious and civil wars checked the development of the city, and Henry III. in the closing years of his reign found himself excluded from his own capital, which fell completely under the control of the League. Both he and his successor, Henry IV., were obliged to lay siege to it, the second siege lasting four years, and bringing terrible sufferings upon the inhabitants (1590–94). During the minority of Louis XIV. the city sustained another siege, and suffered from frequent riots in the streets. (See FRONDE.) During the reign of Louis XIV. (1643–1715) the streets began to be lighted at night with lanterns containing candles, but only when there was no moon. Colbert was put in charge of public works, and he effected great improvements. He was ably seconded by Perrault and Mansart, the architects, and by the great sculptors and painters of the age. The centralizing policy of Louis XIV. and his opposition to the residence of the nobility on their estates drew to Paris the most brilliant and distinguished men of France. From his time the history of the city becomes in a sense the history of France, and for an account of the principal events see that title. Paris suffered severely from the excesses of the Revolution, whose worst crimes were committed within its limits. It was the scene of the Revolutions of 1830 and 1848, and it suffered from siege in the FRANCO-GERMAN WAR (*q. v.*) and from the violence of the Commune. See COMMUNE OF PARIS and FRANCE, HISTORY OF.

BIBLIOGRAPHY.—Among the vast number of works on Paris only a few of the modern ones can be mentioned. See Baedeker's and Murray's guides; Dickens's *Dictionary of Paris*; the official *Annuaire Statistique*; *Guide de Paris par les principaux écrivains et artistes de la France* (1867–68); A. Joanne, *Paris illustré* (1881); Philip G. Hamerton, *Paris in Old and Present Times* (1884); *Histoire Générale de la ville de Paris*, published by the municipality since 1866; Lacomb, *Bibliographie de Paris* (1886).

THEODORE STANTON.

Paris: a port of entry of Brant co., Ontario, Canada; on the Grand river; at the junction of two branches of the Grand Trunk Railway; 61 miles S. W. of Toronto (see map of Ontario, ref. 5–D). It has valuable beds of gypsum, great water-power, many mills, foundries, knitting-works, and other industries, and two weekly newspapers. Pop. (1891) 3,094.

Paris: city; capital of Edgar co., Ill. (for location, see map of Illinois, ref. 7–G); on the Cleve., Cin., Chi. and St. L. and the Vandalia line railways; 170 miles S. of Chicago, 200 miles E. of St. Louis. It is the center of a rich agricultural region, and is an important grain, produce, and stock market. There are 2 national banks with combined capital of $208,000, a private bank, a new court-house, and a monthly, 3 daily, and 4 weekly periodicals. Pop. (1880) 4,373; (1890) 4,996; (1900) 6,105. EDITOR OF "BEACON."

Paris: city; capital of Bourbon co., Ky.; on Stoner creek, and the Louisv. and Nashv. and the Ky. Midland railways; 19 miles N. E. of Lexington, 80 miles S. by E. of Covington (for location, see map of Kentucky, ref. 3–I). It is the principal place of manufacture of Bourbon whisky, has large live-stock and tobacco interests, and contains five State banks with combined capital of $800,000, several classical and female institutes, and a semi-weekly and a weekly newspaper. Pop. (1880) 3,204; (1890) 4,218; (1900) 4,603.

Paris: city (founded in 1823); capital of Henry co., Tenn. (for location, see map of Tennessee, ref. 6–C); on the Louisv. and Nashv. and the Paducah, Tenn. and Ala. railways; 110 miles W. of Nashville, 130 miles N. E. of Memphis. It is in a wheat and tobacco growing region, and contains 5 churches, high school, university training-school, public school for colored youth, 2 cotton-factories, 2 grist-mills, a roller-mill, 2 tobacco-factories, a pottery, a barrel-factory, headquarters of the Henry County Fair and Trotting-horse Association, and 2 weekly newspapers. Pop. (1880) 1,767; (1890) 1,917; (1900) 2,018.

EDITOR OF "POST-INTELLIGENCER."

Paris: city; capital of Lamar co., Tex. (for location, see map of Texas, ref. 2–J); on the Gulf, Col. and S. Fé, the St. L. and San Fran., and the Tex. and Pac. railways; 15 miles S. of the Red river, 64 miles E. of Sherman. It is in a wheat and cotton growing region and is the trade center of a large territory. There are 15 churches, 3 public-school buildings, public-school property valued at over $65,000, the North Texas University, 4 banks, cottonseed-oil mill, canning-factory, and 2 daily and 2 weekly newspapers. Pop. (1890) 8,254; (1900) 9,358. EDITOR OF "NEWS."

Par'is, or **Alexander** (in Gr. Πάρις, Ἀλέξανδρος): a son of Priam, the King of Troy, and Hecuba. He carried off Helen, the wife of Menelaus, King of Sparta, thereby bringing on the war between the Greeks and Trojans. By Homer he is described as shrewd, but cowardly; in art he is represented as a youthful and handsome man, though somewhat effeminate in appearance. Being wounded during the siege by a poisoned arrow, he died before the capture of the city. For Paris in art, see the article *Paris und Parisurtheil* in Baumeister's *Denkmäler*; Overbeck, *Die Bildwerke zum Thebischen und Troischen Heldenkreis* (Stuttgart, 1857), pp. 206–263. J. R. S. STERRETT.

Paris, ALEXIS PAULIN: French author; b. at Avenay, Marne, France, Mar. 25, 1800; studied at the *lycée* at Reims and afterward in Paris, where he began the study of law, but soon devoted himself to literature and history, and became distinguished for his knowledge of mediæval French literature. He became connected with the great library, now the Bibliothèque Nationale, in 1828, and was attached to the department of manuscripts in it. In 1837 he was made a member of the Académie des Inscriptions et Belles-Lettres. He was Professor of the French Language and Literature at the Collège de France from 1853 to 1872, when he retired with the title of honorary professor, leaving at the same time his position at the Bibliothèque Nationale. His writings deal mostly with the mediæval literature of France, including text editions, modernizations, and studies, but are not limited to that field. Among them are *Apologie de l'école romantique* (1826); a translation of Byron's *Don Juan* (1827); *Li romans de Berte aus grans piés* (1832); *Li romans de Garin le Loherain*, 1833 (the same *en nouveau langage*, etc., 1862); *Le romancero français* (1833); *Les grandes chroniques de France* (6 vols., 1836–38); *De la conqueste de Constantinoble par Joffroi de Villehardouin et Henri de Valenciennes* (1838); *Les manuscrits français de la bibliothèque du roi* (7 vols., 1836–48); *La chanson d'Antioche* (1848); *Les aventures de Maître Renart*, etc. (1861); *Les romans de la Table Ronde mis en nouveau langage* (5 vols., 1868–77); *Étude sur François I.*, etc. (2 vols., 1885); further a large part of the contents of vols. xx.–xxiii., xxv.–xxviii. of the *Histoire littéraire de la France*, notably the articles on the *Chansons de geste* in vols. xxii., xxv., xxvi. D. in Paris, Feb. 13, 1881. E. S. SHELDON.

Paris, GASTON BRUNO PAULIN: philologist; b. at Avenay, France, Aug. 9, 1839. Graduating at the Collège Rollin, he studied Romance philology at Göttingen and Bonn. Returning to Paris, he became in 1865 instructor in Romance languages in the École Pratique des Hautes Études, and in 1866 and 1869 lectured at the Collège de France in place of his father, Paulin Paris (1800–81), whom he succeeded in 1872. He was an untiring contributor to the early history of French language and literature, and the flourishing young school of Romance philologists in France is largely due to his influence and composed of his pupils. He was one of the founders of the *Revue Critique* (1865) and of the *Romania* (1872), which he continues to direct, and in which many of his studies have appeared. Among his more considerable works are: *Étude sur le rôle de l'accent latin dans la langue française* (1862); *Histoire poétique de Charlemagne* (1866); *Les contes orientaux dans la littérature française du moyen âge* (1875); *La vie de saint Alexis* (1872); *La Poésie du moyen âge* (1885); *La Littérature française du moyen âge* (1888). A. G. CANFIELD.

Paris, paa'ris, JOHN AYRTON, M. D., D. C. L.: therapeutist; b. at Cambridge, England, Aug. 7, 1785; graduated in medicine at Cambridge University 1808; resided some time in London, and several years at Penzance, Cornwall, where he founded the Royal Geological Society of Cornwall; returned to London 1817; lectured on *materia medica* and the philosophy of medicine at the Royal College of Physicians, of which body he was president from 1854 until his death; invented the tamping-bar, an implement coated with copper for the protection of miners from the perils caused by the sparks emitted from iron bars; published, among other works, a *Memoir* of Sir H. Davy (1810); *Pharmacologia, or the History of Medical Substances* (1819); *A Treatise on Diet* (1826); *Philosophy in Sport made Science in Earnest* (3 vols., 1827); *Elements of Medical Chemistry* (1833); and *Medical Jurisprudence* (3 vols., 1823), in which he was aided by J. S. M. Fonblanque. D. Dec. 24, 1856.
Revised by S. T. ARMSTRONG.

Paris, pāā'ree', LOUIS PHILIPPE ALBERT D'ORLÉANS, Comte de: claimant to the French throne; son of the Duc d'Orléans and grandson of King Louis Philippe; b. in Paris, Aug. 24, 1838; appeared with his mother in the French Chamber of Deputies in the Revolution of 1848, but his claims to the throne were not recognized, and he was taken to England and lived at Claremont, where he received his education. After traveling in Greece, Egypt, and the East, the prince and his brother, the Duc de Chartres, accompanied their uncle, the Prince de Joinville, to the U. S., Aug., 1861, and offering their services to the Federal Government, were attached to the personal staff of Gen. McClellan with rank of captain, but free at any moment to relinquish the service and return to Europe. They remained with the army for several months, serving with bravery and efficiency, especially in the battle of Gaines's Mill. In 1864 the count married his cousin, the Princess Isabella, eldest daughter of the Duc de Montpensier. In 1871 he was admitted as a member of the National Assembly, and in the following year that body voted the restitution of the property of his family. In 1873 he acknowledged the Comte de Chambord as the head of the royal house of France, but after the latter's death in 1883 the Comte de Paris united in his person the claims of both branches of the Bourbons, and was accepted by most of the legitimists as the successor of Chambord. He was again forced to leave France in 1886, in consequence of the Expulsion Act, which forbade the heirs of former reigning families to live in France. After this he lived in England, and in spite of occasional manifestoes calling upon his compatriots to restore the monarchy he did not receive a large share of public notice till 1890, when the escapade of his son, the Duc d'Orléans, who tried to enlist in the French army in violation of the law of exile, caused considerable excitement among the royalists, and revived for a time the popular interest in their cause. D. in Stowe House, Buckinghamshire, England, Sept. 8, 1894. The Comte de Paris won some fame as a writer, especially by his *Histoire de la guerre civile en Amérique* (1874–89). He also wrote *Situations des ouvriers en Angleterre*, and various articles in periodicals.

Paris, MATTHEW OF: See MATTHEW OF PARIS.

Paris, Declaration of: See DECLARATION OF PARIS.

Paris Green: See SCHWEINFURTH GREEN and INSECTICIDES.

Paris, Plaster-of-: See GYPSUM.

Paris Yellow: See CHROMIUM.

Park: in the usual sense of the term, a considerable extent of ground laid out and maintained as a public pleasure-ground. In the course of its development first comes the glade and meadow with woods and waters where the hunter seeks his game. Inclosed by wall or fence this becomes the *chace*, and is still mainly devoted to the preservation of game. Finally the desire for open-air pleasures felt by the home-dweller asserts itself, and walks and resting-places are made for the quiet enjoyment of outdoor features. In this way at last came the gentleman's country-place of to-day. Notwithstanding this increasing desire for the peaceful enjoyment of woods and waters, paths and resting-places, there still remained the green or common. This continued to exist, but beside it grew up the park modeled on the gentleman's country-place, and comprising certain other features, such as roads and open spaces, required for public use.

History.—The Egyptians doubtless had parks earlier than the earliest records on their monuments. Their parks were formal, rectangular, little more than promenades full of architectural features, colonnades, and sculptured objects of diverse form and significance. Parks to them meant little more than a cluster of gardens. In the mountainous regions of Assyria glimpses of the modern idea of a park began to appear. Idealized conceptions of the mountain idea have been ascribed to the "hanging gardens of Nebuchadnezzar," and the paradises of the Assyrian Semiramis and the later Persians with wild animals and birds, trees and flowers, approached still nearer the park of modern Europe.

The Greeks derived much of their science and art from Egypt, and their landscape architecture apparently came in large part from the same source. There is little evidence that they comprehended the true park idea in design. The Romans, however, developed a great love for parks, and Rome became in the time of the Cæsars one great pleasure-ground. Lanciani says that there were at this time eight campi or commons for foot-races and thirty parks or gardens belonging to the city. The largest common was the Campus Martius, a vast level space with buildings, playgrounds, and water-works on an extraordinary scale, surrounded by miles of sumptuous colonnaded porticoes inclosing beautiful gardens. The Golden House of Nero included miles of gardens in the very heart of Rome. In every direction the architectural masses were broken and enframed by the green of gardens and parks, while the water was used in canals, fountain-basins, and cascades to an extent unknown before or since.

During the Middle Ages little attention was paid to gardening as an art. (See LANDSCAPE-GARDENING.) In the days of the Renaissance, however, the taste for public works of this sort gradually increased, and in France during the reign of Louis XIV. the great parks and gardens by Le Nôtre and others appeared, and the kings of Spain, Germany, and Poland sought to signalize their reigns in the same manner. Paris and two or three other great cities remained for a long time the only seats of these public enterprises.

In the nineteenth century, as a consequence of the revival among poets and painters of a love for natural effects, public parks have sprung up all over Europe and North America.

Different Styles of Park-making.—The different styles of park-making have been divided into the regular, mixed, and irregular or natural. The division is arbitrary, and in some of the finest public parks the different styles mingle. There is a quality about the formal style that suits it to the immediate surroundings of great public buildings like those of Paris or Rome. The mixed style enables the designer to preserve valuable formal features, such as ruins, straight promenades, and regularly laid-out flower-gardens. This system has been adopted in many of the parks of Europe. The natural style lends itself better to all the requirements of a public park than any other. The essentials of a public park, whether regular or irregular and natural, are public ways laid out in conjunction with greensward and planted with shade trees. Climate, topography, and surroundings must determine which style is to be used, and if both styles are employed the one should be isolated from the other and one predominant character given to the entire park. A ruin, a formal old-fashioned flower-garden, a system of gay parterres and regular walks, may all be retained, but they must be masked and isolated by trees and shrubbery.

The keynote of the composition of natural park landscape is peace and restfulness, the pastoral idea. Meadows, hedgerows, shaded lanes are the types for the study of the park-maker. There should be as much open meadow, with bordering shrub and tree plantation, as possible, and the rugged effects of rock and hillside should be toned down to the semblance of somewhat cultivated or not unkempt mountain scenery. All violent contrasts of form and coloring are to be carefully avoided in the composition of the general mass of natural park landscape as well as in the arrangement of the smallest details.

The Selection of Park Lands.—A level site or a slightly undulating one is preferable to one that is hilly or rocky, and great variety of effect may be secured on the level site by means of planting and other landscape-gardening devices. Among hills, ravines, and rocks, drainage and roads are difficult to design and construct, and the open lawn effect characteristic of the true park idea may be almost impossible of attainment. An excellent selection of park lands has been made in the Prince's Street Gardens site in Edinburgh. Here a steep hillside slopes down from the castle to a valley that borders on Prince's Street. It is not a large territory, but gains greatly in its appearance of size from the hollowing contour lines of its valley and the picturesque and artistic disposition of its shrubbery and trees. Wherever rough land is selected for a park its peculiar features should be intensified rather than obliterated.

The Making of a Park.—In the preparation of the plan of a park various landscape pictures must be secured by the arrangement of plantations and other devices, and at the same time the necessary convenience of the public must be considered. There must be also unity of idea governing the entire design. In the execution of the plan a landscape architect, a constructing engineer, and a superintendent of labor are needed to carry it out on the ground. The landscape architect or park-maker should control the execution of the plan, and decide whether the lines are laid out correctly and what changes should be made. No map can be worked out so precisely on paper as to prevent the necessity of frequent changes that have been indicated by the experience of actual execution.

Drainage, grades, road and building construction, and all engineering problems should be under the control of the engineer of construction, but on the superintendent of labor, more than on any one else, depends the successful execution of the architect's plans. The offices of landscape architect and constructing engineer can be hardly held successfully by the same person, for the reason that the engineer is trained to use mathematical straight lines or segments of a circle, while the landscape architect, except in strictly formal designs, never uses them; but one person may serve well as both landscape architect and superintendent. It is also important that the landscape architect should continue to control the execution of the design until, after years, it has reached its full development.

Walks.—Primarily, parks should be laid out with special reference to the needs of the pedestrian who seeks open air, skies, stretches of greensward, and shady trees. The walks should never run parallel with anything, or be of uniform width, unless the entire design is strictly formal. They should run above or below the road or lawn they border, and should widen or narrow as the designer sees fit. In no case should they run nearer the road than 10 feet, that space being needed for trees and groups of shrubs. They should be constructed with broken-stone foundation and covered with asphalt or cement for comfort, and with gravel if the most harmonious effect be desired.

Roads.—Roads should be laid out with a view of reaching the landscapes and other attractive features of the park. The masses of the park, the open meadows, and large groves should be determined by the course of the roads. Sometimes, as in Central Park, New York, the arrangement of a road that comes in at a corner and bends off diagonally increases the apparent size of the park greatly, or, in the case of the English Garden at Berlin, a narrow park will have its roads forced close together to the diminution of the apparent size of the park. This has been overcome in the English Garden by skillfully devised masking plantations. Park roads should be laid out on long and easy curves for the safety of the driving public and to avoid abruptness, and should be built 45 to 50 feet wide. A greater width tends to dwarf the lawns and diminish the appearance of breadth throughout the park. All roads should have a foundation of a foot or more of broken stone and a surface of gravel or fine broken stone, and should be bordered with low graded edgings of turf.

Lawns.—A bit of greensward is the most essential and characteristic feature of a park. The pictorial element of park-making is found to a large extent in the greensward or meadow. Trees and shrubs frame and develop the lawn, and thus serve a purpose more important than the exhibition of their own attractions. The comparatively level line of the meadow inspires a sense of serenity, and produces far-reaching sky effects. No path should traverse the main parts of a meadow, or tree or shrub mar the restfulness of its surface. There should be a recognition of the original topography of the region, a smoothing out and blending of minor inequalities which will leave a play of long lines of slightly undulating surface.

Treatment of Water.—The employment of the level line in park-making may be much extended by designing various water effects, and this is one of the most difficult problems of park-making. An abundant supply of pure water should be always at hand. Natural positions where watercourses or pools already exist are preferred to purely artificial ones. Every landscape feature in park-making should be suggested by actual conditions of the original surface. The charm of water lies chiefly in its broad, level, glass-like reflecting surface, and in the play of ripples, but of almost equal importance is the picturesque treatment of the shore by means of small promontories, bays, creeks, inlets, and islets. By this means the whole extent of the water is not seen at once, and the sense of size and distance is greatly increased. Rustic buildings, rocks, or some fine tree or bush may also be so arranged as to be reflected in the water, and seats

may be placed that will command the best views. The most attractive reflections are those of water-plants, lilies, lotuses, flags, and rushes. Grass should be encouraged to grow to the surface of the water, except where an actual beach has been constructed. Drooping trees and shrubs should also be permitted to dip their branches in the water.

Employment of Rocks in Parks.—A desire for natural effects in park-making leads to the employment of groups of rocks at certain points, but they should be used only where neighboring rocks create a reason for their presence. They should peep out of the earth on some curved surface or mound and along the borders of walks and steps and pools and streams of water. They should have rounded or weather-beaten surfaces, and should be so buried as to give no adequate conception of their size. Rocks should not be planted irregularly in a mass, to support a bank of earth. The bank should be, if possible, so graded as to support itself, and a regular dry wall of stone should be constructed if this is not possible.

Park Plantations.—Shade trees are the most important park plantations. Along all drives and walks shade trees should be set at intervals of 50 or 60 feet. The masking plantations of the park, the framework that with the greensward produces the vistas and landscape pictures, should be made up of a series of groups of trees and shrubs. There should be groves of trees and entire groups of low shrubs, but both trees and shrubs should be skirted by a border of drooping bushes. Outlying specimens of both trees and shrubs may stand on the flanks of the main shrub group. The sky-line of these groups should be waving with emphatic points, and the outlines of the base should be varied into bays and points of foliage. Groups and single specimens of trees and shrubs planted near them should be disposed around the lawns and down the hillsides and along the water-courses, so as to secure the greatest possible apparent length of vista and breadth of greensward, and at the same time most surprising, varied, and mysterious effects.

Plantations of trees and shrubs should mask all roads and paths as far as the opening of vistas and broad stretches of greensward will permit. It is important especially that they should mask completely the junction of different roads and paths. The sense of variety, surprise, and mystery, and the rural effect are thereby greatly increased.

Trees and shrubs may be used effectively at the top of steep hills, where the presence of such trees as the Lombardy poplar and the birch tend to intensify the suggestion of mountain scenery. A few of the trees valuable for shade and mixed groups are the American elm, the sugar, Norway, and scarlet maple, the linden, the tulip, poplar, the honey locust, the horse-chestnut, the birch and the beech, and the white-oak and pin-oak. Vigorous hardy shrubs are *Spiræa opulifolia*, privet, snowball, viburnum, mock-orange, bush honeysuckle (*Lonicera fragrantissima*), golden bell (*Forsythia*), weigela, red-twigged dogwood (*Cornus sanguinea*), *Rhodotypus kerrioides*, Japan quince (*Cydonia japonica*), *Spiræa thunbergii*, and *Berberis thunbergii*. The best coniferous evergreen trees are the white pine (*Pinus strobus*), blue Colorado spruce (*Abies pungens*), Mugho pine (*Pinus mughus*), hemlock (*Abies canadensis*), atlas cedar (*Cedrus atlantica*), Nordman fir (*Abies nordimanniana*), Japan yew (*Taxus cuspidata*), and Japanese cypress (*Retinospora obtusa*).

Good broad-leaved evergreens are the American laurel (*Kalmia latifolia*), the rhododendron, the Japanese azalea (*Azalea amœna*), and the tree-box (*Buxus arborescens*). Overcrowding these trees and shrubs should be carefully avoided. The large-growing trees, such as the elm or maple, should all be planted 50 feet apart, and the smaller 25 feet. Large shrubs, such as privet, should be 10 feet apart, and smaller ones, as the Japan quince, 6 to 8 feet; even the smallest should be allowed from 3 to 4 feet.

Along the borders of many shrub groups and rocky places should be planted hardy herbaceous plants, i. e. perennials, or wild flowers, such as larkspurs, daisies, phloxes, asters, sedums, irises. These perennials should stray out over the turf in irregular belts, and should constitute an intermediate gradation between the lower-sized shrubs and the grass.

Bedding-plants, cannas, coleuses, geraniums, etc., should be planted as a framework around buildings and other architectural structures in the park, and nowhere else. Their treatment must be somewhat formal and should be considered as an ornamentation of the building and not an integral part of the park itself; but since the outer portions of these beds must connect with the grass and make a part of the lawn, the same principles of design should apply to them as to the tree and shrub group.

Generally high plants should be in the middle or at the back, and low plants in front or on the borders, but this rule should be frequently broken in the interest of true art by thrusting high plants directly over the border-line, and in the case of single specimens by setting them outside near points of the bed in the greensward.

The outline of the border, like that of shrub groups, should be wavering, running in and out in promontories and smooth slopes and bays, and the curves should never be segments of a circle. Form combinations of the most artistic design can be thus contrived, and the blending and the contrast of both form and color made more subtle and brilliant than any carpet bed plants where the contrasts of color are nearly always strong and not artistic and the form flat and ill proportioned.

Plants suitable for bedding are musas, cannas, achalyphas, geraniums, begonias, coleuses, alternantheras, salvias, bouvardias, castor-oil plants, solanums, and achyranthus and periwinkles. Groups of lilies, lotuses, and other water plants should be treated in the same artistic way.

Climbing vines should be used over rocks, banks, walls, bridges, and buildings. Wherever they appear they add to the variety and picturesqueness of the landscape. Useful vines are the honeysuckle, Virginia creeper, Japan ivy (*Ampelopsis tricuspidata*), clematis, Dutchman's pipe (*Aristolochia sipho*), wistaria, trumpet creeper, climbing rose, and akebia.

Architectural Structures.—All architectural structures in a park should be of simple, unobtrusive design and thoroughly masked by trees, shrubs, and vines. No statues should be allowed in a rural park, except at the entrances and adjoining buildings. Stone bridges should be rough-faced and rustic in character, with as small amount of wall effect as possible. Bridges over walks and roads for the safety of the public should not be multiplied to the detriment of the general rural effect of the park. All entrances to bridges should be masked by planting. Stone steps should be made of rough-faced blue or neutral-tinted stone, and the borders protected by narrow strips or curbs of the same material. The earth all about the steps should be mounded up until from most directions only slight glimpses of the stonework can be obtained.

On the higher parts a few single rocks may be buried with good effect, provided there are other rocks in the neighborhood. Stone walls suit the outer boundaries of parks better than any other fence. They should be made of neutral-tinted, gray, or brown stone.

Arbors, summer-houses, and seats may be built successfully of knotty and crooked gnarled wood. All bark should be peeled off, and the most durable kinds of material employed, such as locust, red cedar, and sassafras.

Rights of the Public in Parks.—Much confusion often arises as to the rights of the public in parks, and great injury comes in this way from people who wish to secure fair-grounds, grounds for military parades, speeding-tracks, and for shows of all kinds. Parks are for the use of the public, and occupation of ground by one set of people to the exclusion of others is an infringement of personal rights. Games of all kinds may be played on the lawns, provided every one who desires is allowed to take part in them. An exception is made in the case of children, who, it is conceded, should have their ball-ground, swings, merry-go-round, and arbor. Music should be isolated in some spot arranged for the purpose, where the crowds will not mar the restful effect of the remainder of the park.

City Squares and Places.—City squares are hardly recognized as parks in the usual sense of the term. They must be somewhat more formal in effect on account of the proximity of city buildings, but the principles on which they are constructed should be the same as those of the largest parks. The boundaries should be planted with a series of masking trees and shrubs, and as much open lawn secured as the general design will permit. Architectural structures, statues, and fountain-basins find an appropriate home in the small squares of the city. Around these structures brilliant beds of cannas, geraniums, and begonias may be arranged in an effective manner. Children's playgrounds may be also devised after the manner of some Paris parks, by making a special widening of the walk in one of the angles of the territory, and there planting one or more shade trees.

Noted Parks.—Among the best-known parks of the pres-

ent day are Hyde Park (with Kensington Gardens), 598 acres, Regent's Park, 472 acres, Victoria Park, 300, Battersea Park, 250 acres, all in London; Princes Street Gardens, Edinburgh; Phœnix Park, nearly 2,000 acres, Dublin; Central Park, 862 acres, New York; Prospect Park, 515 acres, Brooklyn; Thier Garten, 200 acres, Berlin; the Bois de la Cambre, 124 acres, Brussels; the Garden La Flora, Cologne; the English Garden, 500 acres, Munich; the Prater Gardens, 1,500 acres, Vienna; Paulovsk Park, near St. Petersburg; the Bois de Boulogne, 2,000 acres, and Bois de Vincennes, 2,075 acres, Paris. SAMUEL PARSONS, Jr.

Park, EDWARDS AMASA, D. D., LL. D.: theologian; b. at Providence, R. I., Dec. 29, 1808; graduated at Brown University 1826 and at Andover Seminary 1831; became in 1831 Congregational pastor at Braintree, Mass.; was 1835–36 Professor of Moral and Intellectual Philosophy in Amherst College; held the Bartlet professorship of Sacred Rhetoric in Andover Theological Seminary 1836–47, and in the latter year became Abbot Professor of Sacred Theology in the same institution, resigning in 1881. He was one of the editors and translators of *Selections from German Literature* (1839). In 1869–70 he traveled extensively in Europe and the East; was one of the founders and (1844–83) one of the principal editors of the *Bibliotheca Sacra*; author of *Lives* of Hopkins (1852), Emmons (1861), D. B. Edwards (1853), and W. B. Homer (1849), prefixed respectively to editions of their writings; a *Life* of S. H. Taylor; edition of *Discourses and Treatises on the Atonement* (1859); *Discourses on some Theological Doctrines as related to the Religious Character* (1885); author of numerous published discourses, sermons, essays, etc.; a preacher and theological teacher of great ability. Revised by G. P. FISHER.

Park, MUNGO: traveler; b. at Fowlshiels, Scotland, Sept. 10, 1771; studied surgery at Edinburgh, and was 1792–93 assistant surgeon in India. Under the auspices of the African Association, London, he was the pioneer in the modern exploration of Africa. He journeyed up the Gambia (1795), suffering extreme hardships, and being a prisoner for some time in the hands of a Moorish king. Escaping on July 1, 1796, he reached the upper Niger, the great object of his search, at Segu, and followed the river toward Timbuctoo as far as Silla, where he was compelled to turn back. After seven months' illness and great hardships he reached the mouth of the Gambia, having been nineteen months in the interior. This journey was described in his book *Travels in the Interior of Africa*. The British Government sent him (1805) to descend the Niger from the upper river, and trace its entire course. Most of his party died of fever, and before the Niger was reached only five white men were left out of forty-four. The party set sail down the river, at first in two canoes, but soon built a little schooner, with which they descended the Niger some 1,500 miles, when they were treacherously attacked by a large party of natives, and Park and all his company perished in the attempt to escape by swimming. The journals he sent home and information collected by Clapperton and Lander have given all the facts that are known of his last expedition. Revised by C. C. ADAMS.

Park, ROSWELL, M. D.: surgeon; b. at Pomfret, Conn., May 4, 1852; educated at Racine College and Chicago Medical College; demonstrator and Adjunct Professor of Anatomy, Chicago Medical College, 1877–82; lecturer on surgery, Rush Medical College, 1882–83; Professor of Surgery, Medical Department, University of Buffalo, since 1883; author of *The Mütter Lectures on Surgical Pathology* (1892); of numerous encyclopædia articles and surgical monographs; and one of the joint authors of *An American Text-book of Surgery* (1892). He was editor of the Chicago *Weekly Medical Review*; then of *The Medical Press of Western New York*; and associate editor of the *Annals of Surgery*.

Park City: city; Summit co., Utah; on the Union Pac. and the Utah Cent. railways; 30 miles E. of Salt Lake City, the Territorial capital (for location, see map of Utah, ref. 4–M). It is in a mining region, and contains a valuable silver mine, sampling-works, several quartz-mills, sawmills, a national bank with capital of $50,000, and a weekly newspaper. Pop. (1880) 1,542; (1890) 2,850; (1900) 3,759.

Parke, JOHN GRUBB: soldier; b. near Coatesville, Pa., Sept. 22, 1827; graduated at the U. S. Military Academy July 1, 1849, when he was appointed brevet second lieutenant, topographical engineers (first lieutenant July, 1856; captain Sept. 9, 1861), being engaged in various surveys in the Western States, as secretary of the lighthouse board, and for many years as chief astronomer and surveyor in locating the northwestern boundary of the U. S. Appointed brigadier-general of volunteers Nov., 1861, he accompanied Burnside to North Carolina, and commanded at the capture of Fort Macon; promoted to be major-general Aug., 1862, he served as chief of staff of the Ninth Corps in the battles of South Mountain and Antietam, and on Gen. Burnside's succeeding to the command of the Army of the Potomac was retained by the latter as his chief of staff, participating in the battle of Fredericksburg; was in command of the Ninth Corps during its march to Vicksburg, and for a time of the left wing of Gen. Sherman's army; in command of a division of the Ninth Corps on Gen. Burnside's reassuming command, and engaged in Tennessee in siege of Knoxville, etc.; and in Richmond campaign of 1864, again attaining command of the Ninth Corps before Petersburg (Aug., 1864), which he retained till the end of the war. He received the brevets of colonel for gallantry at Jackson, of brigadier-general at Knoxville, and major-general at Fort Steadman, Virginia. Mustered out of volunteer service July, 1866, he resumed the duties of his corps. In 1864 he became a major of the Corps of Engineers, lieutenant-colonel in 1879, and colonel in 1884. During these years he was engaged upon boundary surveys, improvements of rivers and harbors, and works of fortification. From 1868 to 1887 he was senior assistant in the office of the chief of engineers, frequently acting as chief. He became superintendent of U. S. Military Academy July 1, 1887, and was retired from active service at his own request July 2, 1889. D. Dec. 16, 1900.
Revised by JAMES MERCUR.

Parker, AMASA JUNIUS, LL. D. (of Hobart College): b. at Sharon, Conn., June 2, 1807; removed in 1816 to Greenville, N. Y., and graduated from Union College in 1825. He held many positions of public and private trust during his life; was a member of the Legislature in 1833; chosen a regent of the university in 1835; in Congress 1837–39; vice-chancellor and circuit judge 1844–47; and (under the new Constitution) judge of the Supreme Court 1847–55. He was one of the founders of the Albany Law School, and for twenty years one of its professors. His chief literary work was the publication of reports of criminal cases (6 vols., 1855–69), work in the preparation of the revised statutes of 1859, and editorial work upon the third edition of Reeve's *Law of Baron and Femme*. D. at Albany, May 13, 1890.
F. STURGES ALLEN.

Parker, EDWIN POND, D. D.: clergyman; b. at Castine, Me., Jan. 13, 1836; graduated at Bowdoin College 1856, and at Bangor Theological Seminary; has been pastor of the South Congregational church in Hartford, Conn., since 1860. Dr. Parker is the author of *Book of Praise*; *Sunday-school Songs*; *Christian Hymnal*; *Memorial of Horace Bushnell*; *The Ministry of Natural Beauty*. He has composed many hymn-tunes and several hymns, which have found acceptance. It was at his ordination that the question of continued probation after death first came into public discussion in the Congregational churches of New England. G. P. FISHER.

Parker, FOXHALL ALEXANDER: commodore; b. in New York city, Aug. 5, 1821; was appointed a midshipman in the navy Mar. 11, 1837; graduated from the Naval School at Philadelphia June 3, 1843; was commissioned lieutenant Sept. 21, 1850; served at the Washington navy-yard as executive officer 1861–62; appointed commander July 16, 1862; commanded the steam gunboat Mahaska (1862–63) in active service off Wilmington and Yorktown; commanded the Wabash off Charleston June to Sept., 1863; commanded the Potomac flotilla from Dec., 1863, until the close of the civil war; was promoted to a captaincy July, 1866; was chief of staff to the North Atlantic fleet 1872; appointed chief signal-officer of the navy July 1, 1873. Published *Fleet Tactics under Steam* and *Squadron Tactics under Steam* (1863); *The Naval Howitzer Afloat* (1865); and *The Naval Howitzer Ashore* (1866); also *Elia, or Spain Fifty Years Ago* (translated from the Spanish, 1866). He was one of the founders of the Naval Institute at Annapolis. In Dec., 1874, he was appointed chief of staff of the united fleets in Florida waters; commanded navy-yard, Boston, 1877; superintendent Naval Academy from 1878 till his death, June 10, 1879.

Parker, FRANCIS WAYLAND: See the Appendix.

Parker, HORATIO GILBERT: See the Appendix.

Parker, HORATIO WILLIAM: composer and organist; b. at Auburndale, Mass., Sept. 15, 1863; studied in Boston and

Munich. His first important composition was the cantata *King Trojan* (1885), produced in Munich. He has also composed *The Kobolds*, a short cantata, and *Hora Novissima*, a sacred cantata (1892) for the Church Choral Association of New York, besides much other music, sacred and secular. From 1885 to 1893 he was Professor of Music at the Cathedral School of St. Paul, Garden City, L. I., and organist of Holy Trinity church, New York; then became organist of Trinity church, Boston; was elected Professor of the Theory of Music at Yale University in 1894. D. E. Hervey.

Parker, Joel, LL. D.: lawyer; b. at Monmouth, N. J., Nov. 24, 1816; graduated at Princeton in 1839; admitted to the bar in 1842; elected to the State Legislature in 1847; subsequently county attorney. On the breaking out of the civil war he was made major-general of volunteers; in 1862 was elected Governor of New Jersey, and again in 1871. He was an associate justice of the Supreme Court of New Jersey. D. in Philadelphia, Pa., Jan. 2, 1888.

Parker, John Adams: See the Appendix.

Parker, Joseph, D. D.: preacher and author; b. in Hexham, England, Apr. 9, 1830; educated privately and at University College, London; settled at Banbury in 1858; was pastor of Cavendish Chapel (Congregational), Manchester, 1858–69; of Poultry Chapel, London, 1869–93; and is now (1894) in charge of City Temple, High Holborn; visited the U. S. in 1888, and received the degree of D. D. from Chicago University. Author of *Ecce Deus* (1868); *The People's Bible* (vol. i., 1885); and other works, most of which have been reprinted in the U. S. Revised by G. P. Fisher.

Parker, Matthew, D. D.: archbishop; b. at Norwich, England, Aug. 6, 1504; educated at Corpus Christi College, Cambridge; took priests' orders 1527, the same year became M. A. and fellow of his college; chaplain to Anne Boleyn 1533; dean of Stoke Clare College, Suffolk, 1535; chaplain to Henry VIII. 1537; prebendary of Ely 1541; master of Corpus Christi College 1544; dean of Lincoln 1552; was deprived by Queen Mary 1553 for having married; appointed Archbishop of Canterbury in 1559 through the influence of Nicholas Bacon and Cecil, for Queen Elizabeth was at that time violently opposed to the marriage of the clergy. The Bishops' Bible was printed at his expense. Later he became an enemy of conventicles and of the nonconforming spirit. He published Anglo-Saxon and other early English chronicles, and collected a valuable library, which he bequeathed to Corpus Christi College, Cambridge. D. May 17, 1575. The Parker Society, named in his honor, published from 1841 to 1855 a series of fifty-five volumes of English ecclesiastical writings of the Elizabethan age.

Parker, Peter, M. D.: missionary and diplomat; b. at Framingham, Mass., June 18, 1804; graduated at Yale College 1831; studied theology and medicine at New Haven; went to Canton, China, as a missionary 1834; established a hospital; had great success both in surgery and medicine, and trained many Chinese students; returned to the U. S. 1840–42; became interpreter and secretary of legation to the American mission in China 1845, retaining charge of the hospital; again visited the U. S. 1855, but went to China the same year as commissioner with power to revise the treaty; finally returned to America in 1857, after which he resided at Washington, D. C.; was a regent of Smithsonian Institution, and filled other honorable scientific posts. D. at Washington, Jan. 10, 1888.

Parker, Samuel, D. D.: bishop; b. at Portsmouth, N. H., Aug. 28, 1744; graduated at Harvard 1764; was an instructor for nine years; ordained to the Anglican ministry 1774 by the Bishop of London; until 1779 assistant minister, and then rector, of Trinity church, Boston; conformed the Prayer-book services to the changed condition of civil affairs directly on the receipt in Boston of news of the signing of the Declaration of Independence; was an active promoter of a union between Bishop Seabury and the New England churches, and Bishops White and Provoost and the churches of the Middle and Southern States, which in 1789 united the Episcopal Church in the U. S.; in 1804 consecrated bishop of the Protestant Episcopal Church for the diocese of Massachusetts. D. at Boston, Dec. 6, 1804.

Parker, Theodore: theological leader; b. at Lexington, Mass., Aug. 24, 1810; was a grandson of Capt. John Parker, who commanded the company of minutemen fired on by British troops at Lexington Apr. 19, 1775; studied Latin, Greek, and mental philosophy while working on the farm or in the tool-shop; taught school at the age of seventeen; studied at Lexington Academy; entered Harvard College 1830, but did not pursue the regular course, being obliged to carry on his studies at home and teach private classes at Boston and Watertown; became proficient in many languages; entered the Cambridge Divinity School 1834, graduating 1836; was settled at West Roxbury as pastor of the Second (Unitarian) church June, 1837; soon arrived at religious views widely differing from those of conservative Unitarians, and became the leader of a school of theology which rejected as unhistorical many portions of the canonical Scriptures, renounced all belief in the supernatural, and exercised great freedom in the definition of the Christianity which he continued to profess; laid down the principles of his new transcendental system in a series of five lectures delivered at Boston in the autumn of 1841, published under the title *A Discourse of Matters Pertaining to Religion* (1842); followed in the autumn of 1842 by a series of six *Sermons for the Times*; wrote articles in *The Dial*; published a volume of *Critical and Miscellaneous Writings* (1843), and a translation of De Wette's *Introduction to the Old Testament* (2 vols., 1843); spent nearly two years (1843–44) traveling in Europe; returned to Boston in the autumn of 1844, when a controversy grew warm within the Unitarian denomination, arising from the act of several pastors of churches at Boston, who admitted him to their pulpits. As the result, Mr. Parker established an organization at Boston known as the Twenty-eighth Congregational Society (1846), which worshiped at the Melodeon, and subsequently for many years at the Music Hall, where his audiences were large and his teachings embraced a wide scope of subjects; founded and edited for three years the *Massachusetts Quarterly*; was earnestly opposed to the Mexican war, to slavery, and intemperance; was indicted in the U. S. court (June, 1854) for resistance to the Fugitive Slave Law in the case of Anthony Burns, the offense being an address at Faneuil Hall, but was never brought to trial; Jan., 1859, he was prostrated by an attack of bleeding at the lungs; visited the West Indies, where he wrote a small work entitled *Theodore Parker's Experience as a Minister*; proceeded thence to Europe; resided successively in Switzerland and at Rome 1860, obtaining no relief. He died at Florence, Italy, May 10, 1860, and was buried in the Protestant cemetery outside the walls. He bequeathed 13,000 volumes to the Boston Public Library. His complete works were edited by Frances Power Cobbe (12 vols., London, 1863–65) and by H. B. Fuller (10 vols., Boston, 1870); his *Life and Correspondence* was published by Rev. John Weiss (2 vols., New York, 1864); and his *Life* by Rev. O. B. Frothingham (New York, 1874). A French compendium, entitled *Théodore Parker, sa Vie et ses Œuvres* (1865), was prepared by Rev. Albert Réville. This has been translated (London, 1865). See *West Roxbury Sermons* (1892), with an introduction by Rev. S. J. Barrows and a biographical sketch by Frank B. Sanborn. Revised by J. W. Chadwick.

Parker, Willard, M. D., LL. D.: surgeon; b. at Lyndeborough, Hillsborough co., N. H., Sept. 2, 1800; graduated at Harvard 1826; studied medicine and surgery under Prof. John C. Warren; became Professor of Anatomy in the Vermont Medical College, and also in that of Berkshire 1830; Professor of Surgery in the latter institution 1833, and at Cincinnati 1836; spent some time in the hospitals of Paris and London; was for thirty years (1839–69) Professor of Surgery in the New York College of Physicians and Surgeons, after which he exchanged into the chair of Clinical Surgery, which he held for many years. In 1854 he first described and reported cases of what is now known as malignant pustule. Dr. Parker became president of the New York State Inebriate Asylum at Binghamton in 1865; was the first to call attention to the phenomena of concussion of the nerves as distinguished from that of the nerve-centers, formerly erroneously considered identical with a state of inflammation, and made several important discoveries in practical surgery, including the operation of cystotomy for the relief of chronic cystitis, and that for the cure of abscess of the appendix vermiformis. D. in New York city, Apr. 25, 1884.

Parker, William Kitchen, F. R. S., F. Z. S., F. L. S.: anatomist; b. at Dogsthorpe, near Peterborough, England, June 23, 1823; d. July 3, 1890. He was educated at Charing Cross and King's College Hospitals, and from 1873 to 1883 was Hunterian professor at the Royal College of Surgeons, London. His attention was early given to the Foraminifera, concerning which he published about thirty-six

papers, mostly in conjunction with Prof. T. Rupert Jones and Dr. H. B. Brady. He subsequently devoted himself to the study of the vertebrate skeleton, and particularly to the development and morphology of the skull, and on these subjects published about sixty papers, many of them monographic in their character. He was a skilled dissecter, an accurate observer, and a good draughtsman. Among Dr. Parker's principal papers are those *On the Osteology and Systematic Position of Balæniceps* (1860); *Palamedea* (1863); *Gallinaceous Birds and Tinamous* (1862–66); published in the *Transactions* of the Zöological Society of London a *Monograph on the Structure and Development of the Shoulder Girdle and Sternum in the Vertebrata* (1868); *The Skull of Batrachia* (1878); *Sturgeon* (1882); *Edentata* (1886); and *Insectivora* (1886), in the *Transactions* of the Royal Society of London. F. A. Lucas.

Parkersburg: city; capital of Wood co., W. Va. (for location, see map of West Virginia, ref. 6–E); at the confluence of the Ohio and the Little Kanawha rivers; on the Balt. and O., the Balt. and O. S. W., and the Ohio River railways; 96 miles S. by W. of Wheeling. It is in a rich oil and natural-gas region; contains 12 churches, 6 public-school buildings, high school, a seminary, the Academy of the Visitation, U. S. Government building, 4 national banks with combined capital of $636,000, and a monthly, 2 daily, and 2 weekly periodicals; and has the shops of the Ohio River Railroad, 5 oil-refineries, 5 machine-shops, 3 iron-foundries, 2 boiler-shops, lumber-mills, furniture-factory, and acid-works. The city has a water-system with sufficient pressure to render fire-engines unnecessary. The Ohio river is here crossed by a railway bridge over 1¼ miles long, excluding approaches, which cost over $1,000,000. Pop. (1880) 6,582; (1890) 8,408; (1900) 11,703. The suburbs have a population of about 4,000.

Proprietors of "State Journal."

Parkes, Sir Harry Smith: diplomatist; b. near Walsall, Staffordshire, England, Feb. 28, 1828. Left an orphan in 1833 he became a charge of his kinsman, Rev. Charles Gutzlaff, Chinese missionary and scholar. He was a student-interpreter on the staff of Sir Henry Pottinger in the China war of 1842, served in various grades of the British consular service in the far East, and was commissioner when the British troops occupied Canton. Captured treacherously by the Chinese in 1860 when under a flag of truce, he was thrown into a dungeon and tortured. His indomitable resolution carried him safely through this cruel experience, and finally he was released, most of his companions having meanwhile perished. From 1865 to 1883 he occupied the post of minister at the Japanese court, and was much dreaded by that nation, whose history he helped to mould, his sympathies being entirely with the imperialists. Sir Harry was a diplomatist of the Palmerston school, and very popular with his fellow countrymen; he enjoys the reputation of being the "only foreigner whom the Japanese could not twist round their little finger." He was transferred to Peking in 1883; d. there, Mar. 22, 1885. See his *Life*, by Stanley Lane-Poole (1894). J. M. Dixon.

Parkes, Sir Henry: See the Appendix.

Parkesburg: borough; Chester co., Pa. (for location, see map of Pennsylvania, ref. 6–I); on the Penn. Railroad; 45 miles W. of Philadelphia. It is in an agricultural region, and contains 5 churches, 6 public schools, an academy, rolling-mill, steam flour and planing mills, and a weekly and a monthly periodical. Pop. (1890) 1,514; (1900) 1,788.

Parkhurst, Charles Henry, D. D.: clergyman; b. at Framingham, Mass., Apr. 17, 1842; graduated at Amherst 1866; studied theology at Halle (1869–70) and Leipzig (1872–73), in Germany, having meanwhile taught (1870–71) in Williston Seminary, Easthampton, Mass.; was settled over the Congregational church in Lenox, Mass., 1874–80; in 1880 became pastor of the Madison Square Presbyterian church in New York city. In 1891 he became president of the Society for the Prevention of Crime, and soon after made the assertion that as the result of his own investigations he could prove that the New York police were the accomplices of the criminal classes, and that the corruption permeated the department of public justice. This led to an investigation by a committee of the State Legislature, a reorganization of the police department, and many reforms. He has published *Forms of the Latin Verb Illustrated by the Sanskrit* (Boston, 1870), and volumes of sermons under the titles *The Blind Man's Creed* (New York, 1883); *The Pattern in the Mount* (1885); and *Three Gates on a Side* (1891).

Parkinson, John, known by the fantastic name of **Paradi'sus in So'le** (Park-in-sun): botanist; b. in London in 1567; was apothecary to James I. and *botanicus regius primarius* to Charles I. Author of *Paradisus Terrestris* (1629–56) and *Theatrum Botanicum* (1640). He is one of the best of the old herbalists, and is commemorated by Plumier's genus *Parkinsonia*, order *Leguminosæ*. The year of his death is not known.

Parkinson-Fortescue, Chichester Samuel: statesman; b. in 1823; graduated B. A. at Christ Church, Oxford University, in 1844; was elected a Liberal member of Parliament for the county of Louth in 1847; was a Lord of the Treasury 1854–55; Under-Secretary of State for the Colonies 1857–58 and 1859–65; was made Chief Secretary for Ireland Nov. 20, 1865, and again in Dec., 1868, having been sworn a privy councilor in 1864. In Dec., 1868, he was a member of Gladstone's cabinet, and Jan., 1871, president of the Board of Trade. He was created Baron Carlingford 1874; Lord Privy Seal in Gladstone's cabinet 1881–85; Lord President of the Council 1883–85.

Parkman, Francis: historian; b. at Boston, Mass., Sept. 16, 1823; graduated at Harvard College in 1844, and from the Dane Law School in 1846; and in May, 1846, set out on a tour in the far West. The fruit of his travels was *The Oregon Trail*, which appeared in *The Knickerbocker Magazine* in 1847, and was republished in book form in 1849. His first historical work, *The Conspiracy of Pontiac*, appeared in 1851. This was followed by *Vassall Morton*, a novel (1856), published at a time when the author was suffering from a severe chronic disease, which postponed further literary work for several years. His principal work is *France and England in North America*, consisting of the following parts: *Pioneers of France in the New World* (1865); *The Jesuits of North America in the Seventeenth Century* (1867); *La Salle and the Discovery of the Great West* (1869); *The Old Régime in Canada* (1874); *Count Frontenac and New France under Louis XIV.* (1877); *Montcalm and Wolfe* (1884); and *A Half Century of Conflict* (1892). The whole work is one of immense research, perfect candor, and very rare ability. D. at Boston, Nov. 8, 1893.

Revised by F. M. Colby.

Parley, Peter: See Goodrich, Samuel Griswold.

Parliament [(with spelling adapted to Mediæv. Lat.) from O. Fr. *parlement*, liter., a speaking, deriv. of *parler*, speak]: a deliberative assembly or legislative body. The term is chiefly restricted to the legislatures of Great Britain, the Dominion of Canada, New South Wales, and other British self-governing colonies. The constitution of the colonial governments is treated in the articles on the various colonies; only the British Parliament is discussed here. The origin of parliamentary government in England, like that of many other British institutions, is involved in much obscurity. There can, however, be no doubt that alike in Saxon and Norman times the English people had always some share in making the laws whereby they were governed. The Witenagemote (or assembly of the wise) of the Saxon period, and the Parliament (or free-speaking council), which is traceable both in etymology and function to Norman influence, were at once the outgrowth and the guardians of popular rights and liberties. It is true that the earlier councils and assemblies have left no record of their proceedings, and probably they met at irregular intervals, being in some measure dependent on the caprice or necessities of the monarch. The taxes and crown levies could only be raised through the sanction of the people themselves; and it is one of the oldest as well as one of the most imperishable traditions of British government that there ought to be no taxation without representation. Successive sovereigns after the Conquest (1066) had encroached upon popular prerogative, until, in the reign of King John, the evil culminated in practical absolutism on the part of the crown. The result was a violent recoil and a resolute demand for the restoration of baronial and popular rights, which led to the signing of the Great Charter (Magna Charta, *q. v.*) on the field of Runnymede (1215). The Great Charter contained no new idea touching rights and liberties, every one of its clauses embodying an English tradition. In truth, it was only a revival of the English constitution; and the provision for calling a parliament whenever money was wanted was one of the first principles of ancient English politics. Little is known of the manner in which the pledges of the sovereign were kept for half a century after the signing of Magna Charta, but writs are still extant which were issued in the

reign of Henry III. (1265) summoning the knights, citizens, and burgesses to meet in Parliament. The government was even more democratic during the Middle Ages than it subsequently became, for the nobles and commons met in the same chamber, debating and voting promiscuously. Historians have failed to discover the date at which the legislature was separated into two chambers, but the present arrangement was in force during the fifteenth century. Numerous changes, sometimes violent and at other times mild and gradual, have been made in the machinery of British parliamentary government, but certain great principles have survived all these transmutations. Parliament can best be considered under three heads: (I.) its constituents, (II.) its powers, and (III.) its forms.

I. *Of what does Parliament consist?*—The imperial Parliament consists of the monarch, the lords, and the commons. The three estates of the realm are the lords spiritual, the lords temporal, and the commons. The sovereign is the executive authority, and is charged with the duty of enforcing the will of Parliament; but in the matter of legislation the sovereign is no more than a constituent part of Parliament, acting in conjunction with the three estates of the realm. In ordinary times there can be no meeting of Parliament unless the monarch is present at the opening of it, either in person or by commissioners. We say "in ordinary times," for there have been exceptions to this rule. The Convention Parliament which restored Charles II. could not, in the nature of things, satisfy the above condition, but proceeded to do a supreme parliamentary act without any summons or sanction from the sovereign. Though Charles held himself to be king *de jure* before Parliament restored him, still he was sagacious enough not to insist upon his sovereign rights, which at the time a majority of the English people would have questioned. The self-constituted Parliament sat several months after the Restoration, and enacted laws which are still recognized as binding by English tribunals. Lest, however, the authority of this assembly should be questioned by the judges, an act was passed after the return of Charles, and signed by that monarch, confirming all that it had done. Such a precaution was generally held by lawyers to be superfluous, as the convention acted *ex necessitate rei*. Another departure from the rule laid down above occurred in 1688, when the two houses of Parliament met on the summons of the Prince of Orange and proceeded to dispose of the crown itself; but the events of that period constitute, by universal consent, a revolution. At the same time it is worthy of observation that even in disposing of the crown and kingdom by revolutionary force the English people have always kept as close to constitutional tradition as circumstances would permit.

The House of Lords in 1900 was constituted as follows:

Lords Spiritual.

Archbishops (Canterbury and York)	2
English bishops	24

Lords Temporal.

Peers of the blood royal	5
Dukes	22
Marquises	22
Earls	123
Viscounts	30
Barons	320
Scotch representative peers	16
Irish representative peers	28
Total	592

Four Irish prelates sat in the House of Lords until 1869, when, under the provisions of the act for disestablishing the Irish Church, they became disqualified to sit. The last consecrated of the twenty-five diocesan English prelates, provided he holds one of the inferior sees, has no seat in the House of Lords, and the same disability applies to suffragan and coadjutor bishops. A bishop is not a peer, but is only a lord of Parliament in virtue of holding an imaginary barony under the Queen. In latter days there has been a steady diminution in the number of marquises, earls, and viscounts, but more than a corresponding increase in the number of barons. The creation of peerages is vested unreservedly in the crown, and it is well known that the House of Lords consented to the passing of the Reform Bill in 1832 because the king had given his consent to the creation of as many new peers as would have served to outvote the opponents of the bill. All peerages are hereditary, the House of Lords having decided that a life-peer can not, as one of their number, discharge any legislative functions. The question was raised in 1858, when the Queen conferred on Sir James Parke a peerage "for and during the term of his natural life," under the title of Baron Wensleydale. Acting on the report of a committee, the House of Lords decided that it was not competent for him to take his seat in Parliament with such a patent of nobility. The Scottish representative peers are elected for one Parliament, the electors being those Scottish peers whose titles are older than the union of England and Scotland. The Irish representative peers sit for life, and are elected by the whole body of Irish peers, no matter from what period their titles date. The Queen can create only one Irish peerage for every three which become extinct. As there is a feeling that an Irish peer who is not a lord of Parliament is a political anomaly, the House of Lords has requested her Majesty to forego her right to issue patents of nobility of this class, and the Queen has signified her willingness to hold in abeyance that part of her prerogative. Provision was made in 1876 and modified in 1887 for four Lords of Appeal to be appointed for life on account of their eminent judicial attainments, and to sit in judicial cases appealed to the House of Lords.

The House of Commons has varied much in number of members. Under Edward I. there were two representatives for each of 37 counties and 166 boroughs, and under the Stuarts the house numbered usually about 500 members. The Reform Acts of 1832 and 1867–68 made extensive changes in the constituencies, the latter giving England and Wales 493 members, Scotland 60, and Ireland 103. By the Reform Act of 1884 and the Redistribution of Seats Act of 1885 the total number was raised to 670, as follows:

England and Wales.

Members for counties	253	
" " boroughs	237	
" " universities	5	495

Scotland.

Members for counties	39	
" " boroughs	31	
" " universities	2	72

Ireland.

Members for counties	85	
" " boroughs	16	
" " universities	2	103
United Kingdom. Total		670

Certain persons are disqualified to become members of Parliament. Minors, lunatics, outlaws, and aliens are excluded; so also are the common-law judges, the clergy of the Established churches of England and Scotland, and Roman Catholic priests; likewise pensioners under the crown during pleasure or for a term of years, contractors with Government, members of the India Council, and peers of Parliament. By the act of 1858 property qualification was abolished. Prior to that date an estate of £600 a year was requisite in England and Ireland to qualify for a county, and £300 a year for a borough, except in the case of the eldest sons of peers and bishops. In Scotland and for the universities no property qualification was ever necessary. A member of the House of Commons can not resign his seat; but if he accept any office of profit under the crown, his seat is vacated *ipso facto*. When a member wishes to be relieved from parliamentary duties, he accepts the stewardship of the Chiltern Hundreds (*q. v.*), or some one of certain other similar sinecures. Being, however, a place of *profit*, it furnishes a convenient back-door for wearied members to make their escape into the retirement of private life. Members of the House of Commons are now elected by secret ballot in all the constituencies of the United Kingdom, with the exception of the universities. No religious test whatsoever is imposed upon members, the only oath taken by them being the oath of allegiance. Previous to 1858, Jews were incapacitated to sit on account of the oath including the words "on the true faith of a Christian."

II. *The Powers of Parliament.*—The House of Lords has two functions, the legislative and the judicial. In legislation it acts in concert with the Queen and the Commons, the assent of all three being necessary to give validity to a bill, which then becomes an act of Parliament. Practically, the law lords alone sit in a judicial capacity, though every peer has a legal right to take part in trying appeals. The crimi-

nal cases which come before the House of Lords are those in which a person is impeached by the Commons, or those in which a true bill has been found by a grand jury against a peer of the realm. Peers can no longer vote by proxy in any case. Every peer, when dissatisfied with a decision of the House, has a right, with leave, to enter a protest on the journals. When sitting in his judicial capacity, he gives judgment on his honor and not on his oath; but when summoned as a witness in any cause, he must be sworn. All bills affecting the rights and privileges of peers must originate with the House of Lords, and they may not be amended, but may be rejected by the Commons. The House of Commons is vested with the right of imposing taxes and voting money for the public service. Until 1867 the Commons decided for themselves all questions touching the election of members, but since that date election petitions are tried by the common-law judges. Both branches of the legislature have certain privileges and powers for the protection of their own dignity, independence, and honor. At the beginning of every Parliament the Speaker of the House of Commons claims for the members, in presence of the Queen or her commissioners, freedom of speech and that the best construction shall be placed on all their words. To publish the debates of the House is a breach of privilege, but this rule has long been disregarded, though peccant publishers may still be summoned to the bar of the House to answer for their contumacy. Strangers are admitted to the House, but are not "seen" by the Speaker. For a long time, whenever a member called the Speaker's attention to the presence of strangers he immediately ordered the sergeant-at-arms to clear the House. During one session of Parliament strangers were thus "espied" in the gallery, the Prince of Wales being one of the number. The Speaker's attention being called to the fact, he had no alternative but to eject all, including the heir to the throne. The incident led to a modification in the rules of procedure, and the law now is, when strangers are "seen," a vote is taken at once, without debate, whether they shall be ordered to withdraw or not. Ladies are not admitted within the House, but a clumsy evasion of this rule is effected by permitting them to sit in a gallery behind a grating, whence they can see and hear without being seen themselves. These regulations, however, are of small account when compared with the vast prerogatives which Parliament claims as a legislature and as the grand inquest of the nation. It makes and unmakes laws, and is, in fact, superior to all human law; for in the constitution of the United Kingdom despotic power lies in Parliament, there being no remedy for that which Parliament does wrong except in the same or another Parliament, summoned by the crown and elected by the people. Any grievance which defies the ordinary remedies of law can be redressed by Parliament. It can determine the succession to the throne, and has done it. It can alter the established religion of the country, and can abolish an established Church altogether, as it has done in the case of Ireland. It can amend its own constitution, and can say how long a Parliament shall last. At present members are elected for seven years, but there was a time when each Parliament lasted only three years. It was a saying of Cecil that "England could only be ruined by a Parliament." That ruin could be brought about if it violated the fundamental maxims of its own constitution. One of these is that the people, whom it professes to represent, can be taxed only with their own consent. By attempting to defy this maxim in the case of the American colonies in the reign of George III. a rupture of the empire was brought about, and English colonies became independent commonwealths.

III. *The Forms of Parliament.*—Parliament assembles on the summons of the sovereign; and although the law provides that not more than an interval of three years shall elapse from the dissolution of one Parliament to the assembling of the next, the practice of voting money for the public service annually has rendered this statute superfluous, as the Government could not be carried on without an annual meeting of the House of Commons. Should the sovereign die between the dissolution of a Parliament and the issuing of writs for a new election, the old Parliament revives, and may continue to sit for a period not exceeding six months. At the beginning of each session the Queen states her reasons for convening the Lords and Commons, and gives an outline of the legislation contemplated by her ministers. This statement is known as "the speech from the throne," and is either delivered personally or by commissioners. Adjournment is decided by each House for itself, but prorogation and dissolution are the sole acts of the sovereign. Prior to the reign of William and Mary the sovereign determined the duration of a Parliament. By the triennial act (William and Mary) the duration was limited to three years, and by the septennial act (George I.), still in force, a Parliament expires at the end of seven years. The sovereign, however, usually puts an end to it by dissolution, and does not allow it to expire by efflux of time. When the estimates are laid before the House of Commons, a member may move and carry the reduction of a vote, but no additional grant of public money can be made without a recommendation from the Queen. A member of either House can not be questioned outside of Parliament for anything he has said in his place; but if he afterward publish his speech, he is liable to an action for libelous imputations, and is not protected by the privilege of his position as a member of Parliament. The persons of members are free from arrest in civil causes, but they may be adjudged bankrupts, and their goods are liable to distress on legal process, like those of private citizens. Every bill before it becomes an act must be read three times in each House, and also be reviewed clause by clause in a committee of the whole House or by a select committee. When a bill has passed both Houses, the sovereign's assent is given, usually by commission, the Commons being summoned to the bar of the House of Lords, with the Speaker at their head, to hear the announcement of the Queen's will. In the case of a public bill, the clerk of the Parliament reads its title and pronounces these words: "*La reigne le vaut.*" When it is a private bill, the words are, "*Soit fait comme il est desiré.*" There are numerous forms and details touching the election of Speaker, mode of addressing the House, putting the question in the two Houses respectively, divisions, presenting of petitions, right of putting questions to cabinet ministers, conferences of the two Houses, powers of committees, and various other matters of procedure, of which the reader will find ample information in the works enumerated below. The power of the House of Commons has steadily increased during the nineteenth century, and in any serious conflict between the two Houses of Parliament the Lords invariably deem it prudent to give way. The House of Lords frequently rejects bills which have passed the Commons, such as the burial bills, the marriage with a deceased wife's sister bill, and the Home Rule Bill of 1893, but in no case does the upper chamber reject a measure which has obtained the unmistakable approval of the nation at a general election. The will of the people is paramount, in the long run, in all the departments of British legislation, and the friends of freedom desire that it should remain so for the future. The House of Lords acts as a conservative element of great power to prevent precipitate or imperfectly considered action; but, if the opinion of the people is clearly expressed, that opinion at once is decisive.

LITERATURE.—The following works are recommended to the reader as books of reference: *Rules, Orders, and Forms of Proceeding of the House of Commons relating to Public Business* (1874); *History of the House of Commons*, by W. C. Townsend (2 vols.); *How We are Governed*, by A. Fonblanque; *Constitutional History of England*, by Henry Hallam; *A Treatise upon the Law, Privileges, Proceedings, and Usage of Parliament*, by Sir Thomas Erskine May; *Essay on the Practice of the British Government*, by G. F. Leckie; *Essay on British Government*, by Francis Jeffrey; *History of the Anglo-Saxons*, by Sharon Turner; *The English Constitution*, by J. L. de Lolme, William Stubbs, and Thomas Erskine May. Of recent authorities the most important are Creasy, *Rise and Progress of the English Constitution*; Bagehot, *English Constitution*; Todd, *Parliamentary Government in England*; Taswell-Langmead, *English Constitutional History*; Hearn, *Government of England*; Cox, *Institutions of the English Government*; Ewald, *The Crown and its Advisers*; Palgrave, *The House of Commons*; and Gneist's *English Parliament*.

Revised by C. K. ADAMS.

Parliamentary Law: the law governing the proceedings of deliberative assemblies. Among English-speaking people it is derived from the practice of the English Parliament, which gradually solved the problem of how to conduct its proceedings so as to obtain the deliberate sense of the assembly with the least restraint and inconvenience to individual members—the object of all parliamentary rules. In the U. S. the old English parliamentary law has been gradually modified in practice, so as to be better adapted to

the people. New motions have been introduced and others so changed as to preserve only their old name; thus to *reconsider* is purely a new motion designed to counteract partially the evil incident to hasty action; while the previous question has so completely changed that in the U. S. it is demanded by those who intend to vote for it, while in Great Britain it is demanded by those who vote against it. As a result of this growth of parliamentary law there is a certain amount of confusion, the growth being more rapid in certain sections than in others. Thus in certain parts of the U. S. many still hold to the ruling that ordering the previous question cuts off pending amendments and brings the assembly to an immediate vote on the pending resolution. This was once sound parliamentary law, but has long ceased to be, the previous question in the U. S. being now merely a motion to stop debate and proceed to vote on the pending question, even though it be an amendment. The practice is not the same even in the two houses of Congress, motions being allowed in one that are prohibited in the other, and the order of precedence of other motions being different. To avoid confusion, every deliberative assembly should adopt some published work as its authority on all points of parliamentary law not covered by its own special rules. It will generally be found best to supplement the adopted authority by some rules adapted to meet the special wants of each separate organization. A large political convention, a small debating society, and a city council would need different rules to supplement the ordinary parliamentary law. If the U. S. House of Representatives had continued to be essentially a deliberative assembly, like the English House of Commons, with its presiding officer abstaining from partisanship, so as to retain the chair notwithstanding the change in the party in power, then the practice of Congress would determine the parliamentary law of the republic in all matters common to all deliberative bodies; but the lower house of Congress has almost ceased to be a deliberative assembly, placing in the chair the leader of the majority, and allowing him to appoint some sixty committees to whom are referred, without reading, the bills that are presented. Practically, legislation is done by committees, Congress, with few exceptions, merely formally adopting, without any real deliberation, what the committees recommend. As a general rule, however, parliamentary law in the U. S. is based upon the rules and practice of Congress, except where they are evidently not adapted to a *bona fide* deliberative assembly, when recourse must be had to the old common parliamentary law and the best practice of the numerous deliberative assemblies throughout the country. A careful examination of the following outline of parliamentary law as practiced in the U. S. will show that such law is not arbitrary, but is based upon well-defined principles, from which it varies only for good reasons.

Officers.—The necessary officers of a deliberative assembly are a presiding officer or chairman (variously called president, speaker, moderator, etc.), and a recording officer, usually known as secretary or clerk. It is the duty of the chairman to call the assembly to order; preside over the meetings; state every question coming properly before the assembly previous to recognizing a member to speak or make another motion; put to vote the questions before the assembly in their proper order; announce the business before the assembly in its order; enforce the rules; preserve order and decorum in the meeting; and decide all questions of order and practice, subject to an appeal by any two members. The chairman should rarely participate in the debate, as it diminishes the confidence of the assembly in his impartiality. He can vote whenever his vote would affect the result and whenever the vote is by ballot. It is the duty of the secretary to keep a record of the proceedings of the assembly, the extent of which record depends upon circumstances, but it should always include every resolution adopted, and the names of every member of every committee appointed. The official records and other documents of the assembly are in the custody of the secretary, but they are open to inspection by members, and the chairman may even direct certain ones to be turned over to a committee that needs them. The record of the proceedings, which is also known as the minutes of the meeting, should always be signed by the secretary, or, in his absence, by the secretary *pro tem.*

The Resolution or Motion.—Business is usually brought before the assembly originally in the form of a resolution which is offered by a member, who moves its adoption, or that it be agreed to. The question on its adoption is called the main or principal question. A resolution should always begin with the words "*Resolved*, That." When it is desired to give a reason for the resolution this reason should be placed in a paragraph preceding the resolution, called the preamble, which should begin with "Whereas" and end with "therefore," or "therefore, be it." The preamble, as well as the resolution proper, is included in the term resolution. Where a resolution can not be well expressed in one sentence, each sentence should be placed in a separate paragraph beginning "*Resolved*, That," or the paragraphs after the first may begin thus: "1. That," "2. That." In order to offer a resolution it is necessary for the member to rise in his place and address the presiding officer by his proper title, preceded by Mr., if a man, and Madame, Mrs., or Miss, if a woman. The chairman then recognizes him, preferably by announcing his name, but commonly by merely bowing to him; in legislative bodies a member is recognized or referred to as the member from such and such a district. No member is entitled to make a motion or speak until recognized. It is customary to require important motions to be seconded in order to prevent wasting the time of the assembly on questions favored by only one member. It is not necessary to obtain the floor for this purpose, but any member in his seat can say, "I second the motion." In Congress such seconds are not required. The chair now clearly states the question before the assembly, after which he recognizes the mover of the motion as having the floor, if he claims it, and otherwise the member who first rises and addresses the chair.

Precedence.—During the consideration of a question it is not in order to introduce any other principal question, but it is allowable to make other motions that will aid in disposing of the main question, or that arise incidentally during the proceedings, or that relate to the enforcement of the rules, or to the privileges of the assembly or its members, or to closing the meeting, or to the time of the next meeting. The most common of these have the following order of precedence, any one being in order (except to amend) when one of lower rank is pending, and every one being out of order when one of higher rank is pending: To fix the time to which to adjourn, adjourn, orders of the day, lay on the table, previous question, postpone to a certain time, commit or refer, amend, and postpone indefinitely. Questions incidental to those before the assembly take precedence and must be decided first.

Debate.—Every motion is debatable, except such as from their nature or privilege can not be debated without injury to the business before the assembly. Debate can not be allowed on highly privileged motions, as to adjourn, or they could be used to prevent the assembly from transacting any business. A motion to close debate must necessarily be undebatable, or its very object could be defeated. The following motions can not be debated: Fix the time to which to adjourn; adjourn; for the orders of the day and questions relating to priority of business; appeal when previous question is pending or when relating to indecorum or to transgression of rules of speaking or to priority of business; objection to consideration of question; lay on the table or take from the table; previous question, and all motions extending, limiting, or closing debate or allowing one to continue speaking after being guilty of indecorum in debate; reconsider an undebatable question; question relating to suspending the rules, withdrawing a motion, or reading papers. Debate must be confined to the one question before the assembly at the time, other questions being discussed only so far as they have a bearing on the question immediately before the assembly, except that when the decision of the pending question finally disposes of the main question, then the latter is open to debate also. Thus the motion to postpone indefinitely, having the effect of rejecting the question, if carried, opens to debate the merits of the question it is proposed to postpone; but the motion to postpone to a certain time, if carried, does not finally dispose of the question, and therefore debate is limited to the propriety of the postponement. The common parliamentary law, and the rules of Congress till quite recently, made one exception to this principle, by making the motion to refer to a committee open the main question to debate, evidently on the ground that the discussion would aid the committee in understanding the views of the assembly. Under the House rules, however, it is rare that there is a motion or vote on referring anything to a committee, the reference being made by the chair without a vote as provided for by the rules, or as requested by the member introducing it; if a motion to refer is made it is now very properly undebat-

able. The common parliamentary law rule is better adapted to ordinary deliberative assemblies, for, if the motion to refer were undebatable, it would enable a bare majority immediately to suppress a question without debate by moving to refer it to an unfriendly committee. A motion to reconsider a debatable question or to rescind a vote opens for discussion the merits of the main question.

Debate can be closed or its limits diminished or increased by a two-thirds vote. The motions for these purposes are as follows: (*a*) The previous question, which cuts off debate and brings the assembly at once to a vote on the pending question, which, in case of the motions to commit or to amend, includes the question to be committed or amended, unless it is demanded simply on the motion to commit, or on the amendment, or on an amendment to the amendment; (*b*) a motion limiting debate as to the number and length of speeches, or specifying the time at which debate upon the question shall close; (*c*) a motion extending these limits in general or for a single speaker. Any of these motions may be applied to a single amendment, and, after it is voted on, the main question is still open for amendment and debate.

Amendments.—The assembly can modify the main question by adopting amendments, or it may be referred to a committee who can report amendments for adoption by the assembly. An amendment may be by adding or inserting, by striking out, by striking out and inserting, by substituting, or by dividing the question. An amendment may itself be amended, but not so as to alter its form, nor can any parliamentary motion be amended so as to become a motion of another form. Thus a motion to strike out can not be amended so as to become a motion to strike out and insert, nor can to postpone to a certain time be amended so as to become a motion to postpone indefinitely. An amendment of an amendment can not be amended. While an amendment is pending it is not in order to make another motion to amend the resolution, but after one amendment is disposed of another can be offered and so on without limit. In legislative bodies it is found best in addition to an amendment of the second order to permit an amendment in the nature of a substitute and one amendment to the latter, all to be pending at the same time. While this is useful in legislative and analogous bodies, it would merely produce confusion in ordinary deliberative assemblies. The following motions can not be amended: Adjourn (when unqualified), for the orders of the day, all incidental questions, lay on the table, the previous question, an amendment of an amendment, postpone indefinitely, and reconsider.

Postponing and Suppressing Questions.—Action upon a question may be deferred by postponing it to a certain time; or, if it is intended to reserve the power to take it up at any time, it should be laid on the table; or, if it is desired to set apart a particular time when it shall have special right of way, it should be made a special order for a certain time, which motion requires a two-thirds vote for its adoption. The assembly may suppress the question as follows: (*a*) When first introduced, before debate or action thereon, any member may, even while the mover has the floor, object to the introduction of the question, and if the objection is sustained by a two-thirds vote, the question is dismissed for that session, thus enabling the assembly to avoid having its time taken up with irrelevant or profitless questions. (*b*) After the question has been debated, the proper way to suppress the question is to vote it down or postpone it indefinitely, which has the same effect, except that if it fails the original question is not adopted as it would have been had the vote been taken on adopting the main question. Since to postpone indefinitely opens the main question to debate, when this motion is made with a view to suppressing the question immediately, it is necessary also to demand the previous question, just as it is when it is desired to bring the assembly to an immediate vote on the main question. (*c*) While the fundamental principles of parliamentary law require a two-thirds vote to suppress the question without free debate, yet in most cases it can be practically accomplished by a majority vote on the motion to lay the question on the table. In the U. S. Congress, where the calendar is so full and party lines strictly drawn, the most common method of killing a question is to lay it on the table. In voluntary organizations, where mutual good feeling and co-operation are desired, questions should not be suppressed without debate unless by a two-thirds vote, as described above, and the motion to lay on the table should be confined to its strict parliamentary use of laying aside a question to be taken up at a more convenient time. Where it is desired to kill simply an amendment, it will not do to lay it on the table, as this carries with it the resolution also.

Reconsideration.—To protect the assembly from having questions reintroduced repeatedly at the same session, and yet to give reasonable freedom for correcting errors due to hasty action, parliamentary law in the U. S. provides that no principal question (resolution or report) or amendment that has been once acted upon shall be again taken up at that session except by a motion to reconsider or rescind; but the motion to adjourn can be renewed if there has been progress in debate or any business transacted, and, as a general rule, privileged, incidental, or subsidiary motions (excepting to suspend the rules for the same purpose, and for the orders of the day while the same principal question is pending) can be renewed if a motion has been made that alters the state of affairs. On the day a vote is taken, or on the next day if a meeting is held then, a member who voted on the prevailing side can move to reconsider the vote, and this motion can be made when any other question is before the assembly, or even when another member has the floor; but in such case it is only entered on the record to be called up afterward, as it can not interrupt pending business. After the motion has been made all action under the resolution is suspended until the reconsideration is disposed of. If the mover does not call up the motion within the time allowed for making it, then any one can call it up and have a vote taken. If the motion to reconsider is carried the question is in the same condition as immediately before the vote was taken, and therefore must be disposed of in the same way. Where the assembly regrets action that it has taken and it is too late to reconsider the vote, the proper way is to rescind the objectionable vote, which a majority can do.

Adoption of Motions.—A majority of the votes cast when a quorum is present is all that is necessary, in the absence of a special rule to the contrary, for the adoption of any motion (except those stated below) that does not suspend or change any rule or custom of deliberative bodies or of the assembly. A quorum, or the number that must be present in order that business may be transacted, is a majority of all the members of the organization where there is no number specified by rule, which should always be done. It is sometimes less than 1 per cent. of the members, as in the British House of Lords, where it is 3 out of about 450 members. The following motions come under the above exception, and require a two-thirds vote for their adoption: To amend or suspend the rules; to make a special order or take up a question out of its proper order; to object to the consideration of a question; to close or limit or extend the limits of debate; and the previous question. The right to introduce questions germane to the objects of the assembly, and discuss them before their final disposition, is inherent to the fundamental idea of a deliberative assembly; but these rights, like that of having the rules enforced, must yield to the convenience of an overwhelming majority. A two-thirds vote can not, however, suspend any article of the constitution or by-laws (unless they provide for such suspension of a specified by-law), nor can it suspend any right or privilege given to less than one-third of the members present, as otherwise the privilege would be of little value.

Committees.—If an assemblage is large, or even when small, if it has much business to transact, its work can be greatly expedited by having all questions first considered by committees, which may be standing (appointed for a term, as a year or session), or select (one for a special purpose), or committee of the whole (i. e. the whole assembly). The first member named on a standing or select committee, and in his absence the next, should act as chairman, unless the committee elect some one else, which it can do, if the chairman has not been appointed by the assembly. If the committee is one for action, it should be small and contain only friends of the object for which it was appointed: if for deliberation or investigation, it should be larger, and all sides should be fairly represented. In committee the chairman usually takes the most active part, members do not rise to speak, motions are not seconded, and in small committees they are not always made, but they should be voted upon; the chairman usually votes. A paper referred to a committee must be returned to the assembly intact, its amendments being written on another sheet. In such case the only report of the committee is a verbal one that the committee has instructed the members to submit certain amendments and move their adoption. The member who submits a written report from a committee should always move its

adoption. If the report is adopted, or accepted, or agreed to, the opinions and doings of the committee become the opinions and doings of the assembly. If the committee wishes action taken, it should close its report with recommending the adoption of certain resolutions, which should either accompany or form a part of the report. In the latter case the adoption of the report carries the resolution with it; in the former, instead of a motion to adopt the report, one is made to adopt the resolutions, and no further action is taken on the report. The committee is discharged without any formal vote when it has completed its work. When the assembly desires to consider a question with all the freedom of a committee, it resolves itself into a committee of the whole, to consider the particular question. The chairman calls some member to the chair, takes his place as a member of the committee, and the assembly proceeds to discuss and amend the resolution or matter before it. Every member can speak as many times as he can obtain the floor. No motions are in order except to amend and to adopt, and to rise and report, which is used instead of to adjourn. When the committee has risen and the presiding officer has resumed the chair, the chairman of the committee reports to the assembly as instructed by the committee. The assembly then acts upon this report as in the case of the report of any other committee. HENRY M. ROBERT.

Par'ma: town, in the province of Parma, Italy; on the river Parma; about 12 miles S. of the Po and 79 miles S. E. by rail of Milan (see map of Italy, ref. 3-C). The town is circular in form, is surrounded by ramparts and bastions, and has a citadel built in 1591. The Via Emilia crosses it from E. to W. The streets are broad and in good condition, the squares large, and there is a public promenade near the citadel on the south side of the town, and a public park in the northwest angle. Among the public buildings is the Cathedral of the Assumption (Roman Byzantine, begun in 1060 and consecrated by Paschal II., 1106), which contains, among other superior works of art, many frescoes by Correggio, but much restored; the baptistery (begun in 1196), a fine specimen of Lombard architecture; the Church of S. Giovanni Evangelista, with frescoes by Correggio; the Madonna della Steccata, a church of the Renaissance, containing sepulchral monuments of the Farnese and Bourbon rulers of Parma and a celebrated picture by Mazzuoli. The municipal museum, the academy of fine arts, the school of design, and the Farnese theater are in the great building known as the Pilotta, which was intended to form a part of a colossal ducal palace never completed. The national theater was erected by Maria Louisa; the communal palace is a fine but unfinished structure. There is also a university founded in 1521, with (1891) 41 teachers and 276 students, and a royal public library with 213,995 volumes and 4,500 MSS. Parma, however, owes its chief attraction to the masterpieces of Correggio in the academy of fine arts, and to his well-preserved frescoes in the Camera di San Paolo. There are manufactures of pianos, silk, linen and cotton stuffs, leather, glass, crystal, earthenware, and cast-iron wares; and there is a considerable trade in grain, cattle, and dairy produce. The cheese called Parmesan is, however, now better made elsewhere. Parma, though lying in the old Etruscan territory, does not appear in history until the time of the Roman republic. Being nearly destroyed by Mark Antony, it was partially rebuilt by the first Cæsars, who gave it successively the names of *Julia* and *Augusta*. After suffering cruelly from the barbarians, it was again restored and rewalled by Theodoric. Narses took it and gave it the name of *Chrysopolis*, or the Golden City. Charlemagne made a bishop (it has been an episcopal see from very early Christian times) its temporal lord, with the title of count. After the death of Frederick Barbarossa (1190) Parma declared itself a republic; but in 1303 it became the prey of feudal lords. At last it fell into the hands of the popes, who retained possession of it (except during a short occupation by the French) until 1545, when Paul III. included it in the duchy which he conferred on his son Pier-Luigi Farnese. (See FARNESE.) The government of the Farnese dukes was generally popular with the middle and lower classes, but was not acceptable to the nobility, who conspired frequently against them. In 1701, the direct Farnese line being extinct, the duchy passed to the royal family of Spain. In 1802 the French took possession of it, and in 1814 it was conferred (Spain protesting) as a sovereign duchy on the ex-empress Maria Louisa. In 1817 this arrangement was confirmed, with the stipulation, however, that the succession should fall on the Duke of Lucca, the rightful heir in the Spanish line. The duke was supported in a reactionary policy by Austria, and in 1848 he was compelled to fly from his dominions. In 1849 he was succeeded by his son Charles III., who was assassinated in 1854; and finally in 1860 the territory was annexed to the new kingdom of Italy. Pop. (1892) 51,500. The province has an area of 1,250 sq. miles. Pop. (1892) 272,040.

Revised by R. A. ROBERTS.

Parma, DUKES OF: See FARNESE.

Parma, Duchy of: one of the political divisions of Italy previous to the formation of the Italian kingdom in 1860, embracing the present provinces of Parma and Piacenza.

Parmen'ides (in Gr. Παρμενίδης): son of Pyrrhes; the most notable of the philosophers of the Eleatic School; b. at Elea, a Phocæan colony situated in Lucania, about the year 519 B. C. (cf. Grote, *Hist. of Greece*, chap. lxvii.). He is said to have been the pupil of Xenophanes, founder of the Eleatic School (Aristotle, *Metaph.*, i., 5), and to have to a considerable extent adopted the mode of living of the Pythagoreans, with two of whom, Ameinias and Diochætes, he was very intimate. He took an active part in the government of his native city and drew up a code of laws, to which the Eleans annually swore to conform. He disseminated his philosophy both by teaching and writing. He appears to have attained a ripe old age, and, if we may believe Plato (*Parmenides*, 127 B.), to have become personally acquainted with Socrates.

Writings.—The only work of Parmenides known to the ancients was that bearing the general and oft-imitated title *On Nature* (Περὶ Φύσεως), written, according to the custom of the time, in dactylic hexameters. It was divided into three parts: 1, An introduction, describing in highly figurative language the manner in which the philosopher reached the citadel of truth: 2, a treatise *On Truth* (τὰ πρὸς Ἀληθείην); and 3, a treatise *On Opinion* (τὰ πρὸς Δόξαν). The doctrines put in the mouth of Parmenides in the Platonic dialogue bearing his name are mostly the property of Plato, or of whoever was its author. The known extant fragments of Parmenides are comprised in something less than 160 hexameters. They are collected mainly from the writings of Plato, Aristotle, Clemens Alexandrinus, Sextus Empiricus, Plotinus, and Simplicius. There are editions of them by Brandis (1813), Karsten (1835), Mullach (1845; reprinted in the Didot *Fragmenta Philosophorum Græcorum*, Paris, 1860), and by Stein in *Symbola Philologorum Bonnensium* (1864–67), pp. 763–806. The best are those of Karsten and Stein. There is a translation into English hexameters of all the extant fragments, in the *Journal of Speculative Philosophy*, vol. vi. For bibliography, see Ueberweg, *History of Philosophy* (Eng. trans.), vol. i., p. 50.

Philosophy.—Parmenides was, with the exception perhaps of Heraclitus, the greatest of the pre-Socratic thinkers. The kernel of his thought is the notion of pure Being, which he identifies with pure Thinking, and labors to define by every means afforded by the undeveloped philosophic diction of his day. Pure Being, the common basis of finite existence and finite Thought, alone *is*. Non-Being and all the array of finite thoughts and things which its assumption entails are delusions, unavoidable perhaps for the uncultured mind, but transparent enough to the true thinker. Being is

> . . . Birthless and deathless,
> Whole and only-begotten, and moveless and ever-enduring:
> Never it was or shall be: but the *all* simultaneously now is,
> One continuous one.

The philosophy of Parmenides largely affected all subsequent thought, and even so powerful a thinker as Aristotle could not shake off his cosmological ideas. Nowhere else have the rational and the sensuous been more clearly opposed. This is so true that some writers, notably Gladisch (*Die Eleaten und die Inder*), have endeavored to connect it with the Hindu philosophy. Cf. Aristotle, *Metaph.*, A. 5; Plotinus, *Enneads*, v., 1, 8; Buroni, *Dell' Essere e del Conoscere*; *Studii su Parmenide, Platone e Rosmini*; Hegel, *Gesch. der Philos.*, vol. i.; Zeller, *Philos. der Griechen*, vol. i.; and Ueberweg and Schwegler. THOMAS DAVIDSON.

Parmigianino and **Parmigiano**: See MAZZUOLI.

Parnahyba, pär-nä-ee'bä (also written *Parnahiba*, *Parnaiba*, or *Paranahyba*): the name of two considerable rivers in Brazil: (1) One of the head streams of the PARANÁ (*q. v.*), separating Minas Geraes from Goyaz. (2) A river of Northern Brazil, separating the states of Piauhy and Ma-

ranhão; flowing N. E. and entering the Atlantic near lat. 3° 15′ S.; length about 850 miles (according to Pompeu, 1,000 miles). Its basin of 135,000 sq. miles embraces the whole of Piauhy, in which it has many affluents, and about 20,000 sq. miles in Maranhão. It has few rapids, and during the annual floods canoes can ascend nearly to the head of the main river and tributaries; small steamers ascend regularly to São Pedro de Alcantara, about half way to the head, and most of the commerce of Piauhy is by this route. Vessels drawing 11½ feet ascend to the town of Parnahyba, near the mouth of the river; it is the commercial center of Piauhy. HERBERT H. SMITH.

Parnassiens: name given to a group of French poets of the Second Empire, from the name of the volume, *Parnasse contemporain*, in which their first poems were collected in 1866. Their common qualities are a great and almost exclusive cultivation of the metrical form and the rejection of emotion in favor of plastic or pictorial subjects as poetic material. A. G. C.

Parnas'sus (in Gr. *Παρνασσός*): a mountain of Greece in the district of Phocis, rising 8,068 feet above the level of the sea. Its three peaks are covered with snow for the greatest part of the year; its sides are covered with beautiful forests and abound in crags and caverns. In ancient times it was consecrated to Apollo and the Muses. Delphi, with its famous oracle and the Castalian fountain, was situated on its southwestern slope. The Corycian cavern, the abode of Pan and the Muses, was on its western slope, and on its highest top were celebrated the wild orgies of Dionysus. Revised by J. R. S. STERRETT.

Par'nell: See CONGLETON, LORD.

Parnell, CHARLES STEWART: Irish party leader; b. at Avondale, County Wicklow, Ireland, in 1846; was educated at Cambridge, and entered Parliament in 1875 as a member for Meath. In 1877 he brought in the Irish Church Act Amendment Bill, the object of which was to facilitate the purchase of their holdings by the tenantry of the disestablished Irish Church; but the bill was thrown out by 150 to 110 votes. He then became the leader of the obstructionists in Parliament, and in 1879 he founded the Irish National Land League, whose purposes were, first, to bring about a reduction of rack-rents; and, secondly, to facilitate the obtaining of the ownership of the soil by the occupiers. From this time his fortunes are identified with the history of the Home Rule party, and for an account of the principal events of his political career see the articles HOME RULE and LAND LEAGUE. In the same year he visited the U. S. and lectured in all the large cities in order to raise funds for the new organization. In 1880 he was returned for three constituencies, Meath, Mayo, and Cork city, and chose to sit for the last, but in the same year informations were laid against him by the Irish attorney-general. The trial resulted in a disagreement of the jury, but, the Land League having been declared by the Government an illegal association, he was arrested and conveyed to Kilmainham jail. He was soon released, however, and in the session of 1883 he took a very active part in procuring the passage of the Arrears Act and the Tramways and Laborers Acts. The Land League was revived under the name of the National League, with Mr. Parnell at its head. He led the Irish parliamentary party in 1884–85, and afterward supported Gladstone's proposed Home Rule. He was often charged by his enemies with favoring and even abetting acts of violence on the part of the Irish tenantry, and in 1887 these charges took definite shape in a series of articles published by *The Times*, accusing him of complicity in crime and supporting the charge by the publication of certain letters purporting to have been written by him. These Parnell declared to be forgeries, and he was sustained in this statement by the finding of the so-called Parnell commission, appointed to investigate the matter. Parnell then brought suit for libel against *The Times*, and was awarded £5,000 damages. With this victory he reached the height of his influence, but in 1890 he was named co-respondent in the divorce suit of his friend, Capt. O'Shea, and proved in court to have been guilty of adultery with O'Shea's wife. Gladstone declared him unfit for the leadership of the Irish party, and he was advised to withdraw. He refused, and the result was a breach in the party, the majority choosing Justin McCarthy as their chief, the others, known as the Parnellites, adhering to their old leader. The latter made several bitter speeches against the Liberals, and threw himself into the contest with the McCarthyites in the North Kilkenny election, but the hostility of the priesthood was added to the other opposing influences, and the Parnellites were defeated Dec. 22, 1890. In the following June he married Mrs. O'Shea. He continued to attend public meetings in Ireland, but his candidates were repeatedly defeated in the elections. At length his strength began to fail under these reverses and the constant attacks of his political opponents, and his death, which occurred at Brighton Oct. 6, 1891, was doubtless hastened by his misfortunes. F. M. COLBY.

Parnell, THOMAS: poet; b. at Dublin, Ireland, in 1679; educated at Trinity College, Dublin; took orders in the Church of England 1700; became archdeacon of Clogher 1705, prebendary in the cathedral of Dublin 1713, and vicar of Finglass 1716; resided chiefly in England; assisted Pope in his translation of Homer, and wrote the *Life* of Homer prefixed to the *Iliad*. D. at Chester, July, 1717. Pope published in 1722 a volume of posthumous poems attributed to Parnell, the best of which was the *Hermit*. See the *Life*, by Goldsmith, in the Globe edition of Goldsmith's works (1881). Revised by W. S. PERRY.

Parol, or **Parole** [from Fr. *parole*, word, promise: Ital. *parola*: O. Span. *paraula*: Portug. *palavra* (cf. Eng. *palaver*) < Lat. *para'bola*, parable, word = Gr. *παραβολή*, comparison]: literally, a word, word of mouth; in law, a term used generally to designate oral evidence as distinguished from written evidence (see EVIDENCE), but also to designate any contract or agreement, either oral or in writing, which is not under seal. Pleadings formerly when given *viva voce*, orally, in court were frequently termed the *parol*.

Paropam'isus, or the **Paropamisan Mountains**: in ancient geography, a name of somewhat uncertain signification, sometimes limited to the range which forms the northern boundary of Cabul, sometimes extended to the whole group connecting the Caucasus with the Himalaya, but generally corresponding to the modern Hindu-Kush.

Paroquet: See PARRAKEET.

Paros: island in the Ægean Sea, belonging to Greece; one of the Cyclades. It is a flattened mountain, about 36 miles in circumference and toward the center 2,450 feet in height. Well cultivated and naturally fertile, it suffers from scarcity of water. Some of its little harbors are deep and well sheltered. It exports honey and wax, but its most precious product by far is the Parian marble, famous from all antiquity for purity and whiteness. The Arundel or Oxford marbles, which give the Greek chronology from Cecrops to Alexander, were discovered here in 1627. Pop. (1890) 3,048. E. A. GROSVENOR.

Parot'id Gland [*parotid* is from Gr. *παρά*, beside + *οὖς*, *ὠτός*, ear]: the largest of the salivary glands, in man as well as in many other animals. In the human subject the parotid glands lie on the sides of the face, below and forward of the ear. Each gland weighs about 1 oz., and discharges its secretion by a duct 2½ inches long, called the duct of Steno, which opens on the inside of the cheek, opposite the second molar tooth of the upper jaw. The parotid secretion in man is less viscid than the saliva of the other glands, and differs somewhat in its composition, but its functional uses are essentially similar. The most important diseased condition of the parotid is MUMPS (*q. v.*).
Revised by W. PEPPER.

Parquet, JACQUES DIEL DU: See DIEL DU PARQUET.

Parr: the young of the salmon and trout, after it has passed the fry stage and before it has reached that of smolt. These stages appear to be of indefinite duration, varying according to the food-supply and other conditions. It was once thought that the parr (called also samlet, pisit, or brandling) was a distinct species of fish. All the salmon and trout pass through a parr stage, during which the body is marked by dark cross-bands. Revised by D. S. JORDAN.

Parr, CATHARINE: See CATHARINE PARR.

Parr, SAMUEL, LL. D.: clergyman and author; b. at Harrow-on-the-Hill, England, Jan. 15, 1747; studied two years at the University of Cambridge 1765–67; was assistant master of Harrow School 1767–72; kept a private school at Stanmore 1772–76; became head master of Colchester School 1776, of Norwich School 1778; took orders in the Church of England; became curate of Hythe 1778, rector of Asterby 1780, and perpetual curate of Hatton, Warwickshire, 1786, rector of Wadenhoe 1790, and of Graffnam 1802, and head chaplain to Queen Caroline 1820; prebendary of St. Paul's, London. Cambridge gave him an LL. D. in

1781. He resided from 1786 at Hatton, engaged in literary pursuits and the classical training of pupils; was a brilliant but overbearing and quarrelsome talker, an ardent Whig partisan, possessed an extensive knowledge of Latin literature, was regarded by many of his contemporaries as an intellectual prodigy, and came near receiving the bishopric of Gloucester. Posterity wonders at his contemporary fame, as he has left nothing to justify it. D. at Hatton, Mar. 6, 1825. See De Quincey's essay. Revised by S. M. Jackson.

Parr, Thomas, commonly known as **Old Parr**: said to have been born in the year 1483, at Winnington, Shropshire; was taken to London by the Earl of Arundel, Sept., 1635, and introduced at court as being 152 years old. A metrical narrative of his career was published at the same time by John Taylor, "the water poet," under the title *The Olde, Olde, Very Olde Man*, in which Parr was represented as having been born during the reign of Edward IV. and as having lived through the reigns of ten sovereigns. D. in London, Nov. 14, 1635. An autopsy was made by Dr. Harvey, and he was buried in Westminster Abbey, where a monument commemorates his alleged longevity. Thoms, in his *Human Longevity* (1873), tries to show that Parr was not more than 101 or 102 years old when he died. See Longevity.

Parrakeet, or **Paroquet** [from Fr. *perroquet*, a parrot]: a popular name for numerous small parrots with rather long, wedge-shaped tails. While the word has no exact scientific meaning, it is simply used to distinguish those birds with wedge-shaped tails from the parrot, macaw, lory, and Cockatoo (*q. v.*), which, as a rule, are names applied to larger birds, usually with square tails. The ground-parrakeet (*Pezoporus formosus*) and grass-parrakeet (*Melopsittacus undulatus*) of Australia are familiar examples, and the species of the genera *Palæornis*, *Platycercus*, and *Nymphicus* are typical parrakeets. F. A. Lucas.

Parrha'sius (in Gr. Παρράσιος): a Greek painter; b. in Ephesus; a contemporary and rival of Zeuxis. He flourished 400–380 B. C. While Zeuxis deceived the birds by his painted grapes, Parrhasius deceived Zeuxis himself by his painting of a curtain. See Reber, *History of Ancient Art* (New York, 1887, p. 373, ff.). J. R. S. S.

Par'ridæ [Mod. Lat., named from *Par'ra*, the typical genus, from Lat. *par'ra*, barn-owl]: a family of birds (also called *Jacanidæ*) containing the jacanas (see Jacana), distinguished by long legs and enormous toes. In form they resemble rails and coots; the bill is elongated, rather slender; the nostrils longitudinally oval, near the middle of the bill, and in long grooves; the wings large and pointed; the legs long and provided with transverse scales, which extend on the tibiæ as well as tarsi; claws very long, nearly straight, or even somewhat curved upward. The family is represented by a small number of tropical birds of doubtful affinities, some authors placing them near the plovers, and others with the *Rallidæ*. Species of *Parra* are found in South America, Africa, Asia, and Australia; the single representative of *Hydrophasianus* in India. Revised by F. A. Lucas.

Parris, Samuel: clergyman; b. in London, England, 1653; emigrated to Massachusetts in youth; studied at Harvard, but did not graduate; was for a time a merchant at Boston; became minister of a church in that part of Salem now called Danvers 1689; obtained notoriety through the great delusion called Salem witchcraft, which originated in his family, his daughter and niece having accused an Indian slave from the West Indies of bewitching them. He was active in prosecuting those who were apprehended, and afterward his church brought charges against him. He acknowledged his error, but in 1696 was dismissed and left the place. Subsequently he preached in Stow, Concord, and other towns. D. at Sudbury, Mass., Feb. 27, 1720.

Parrish, Stephen: See the Appendix.

Parrot: a common name for any member of the order *Psittaci*; in a restricted popular sense it is applied to the moderate-sized species with square tails, such as the gray African parrot (*Psittacus erithracus*) and the Mexican yellow-headed parrot (*Amazona levaillanti*). The large species, with long, pointed tails are termed macaws, the smaller *parrakeets* or *lories*, the large, crested, square-tailed species are known as cockatoos. Parrots are readily distinguished by their stout, hooked bills, which are hinged upon the cranium; by their short legs and rough feet, and by having the outer toe turned backward. They range in size from the great macaws to the little *Nasiterna*, scarcely larger than a sparrow. There are more than 350 species, found most abundantly in the tropics, but also, as in Australia and New Zealand, occurring in the temperate zone. One small species (*Cyanoramphus erythrotis*) inhabits Macquaries island in 50° S. lat. America has the most species, 150; Australia is richest in peculiar genera; no parrots are found in Europe, and they are not common in Africa or Asia. Many species are very gaudily colored, bright green being a common hue, while red, blue, and yellow are frequent. The most delicately colored forms are among the lories of the Australian region. Their food consists largely of fruit, but they also eat nuts, seeds, and buds, while a few eat insects and occasionally flesh. They breed in hollow trees, holes in rocks, and deserted buildings. The eggs are smooth, white, and rounded, most commonly two in number. Notwithstanding the fact that their voice is naturally loud and harsh, many can be taught to articulate words. The well-known African gray and Mexican "yellow head" are among the best talkers. A single species, the Carolina parrakeet (*Conurus carolinensis*), occurs within the limits of the U. S., and this is threatened with extermination. It is about 12 or 13 inches long, half of this being due to the long tail; the prevailing color is green; the head is yellow and the cheeks are red. The technical characters are given under Psittaci. See also Cockatoo, Macaw, Parrakeet, and Owl-parrot. F. A. Lucas.

Parrot-fish: a name applied to many fishes of the families Labridæ and Scaridæ (*q. v.*).

Parrott, Robert Parker: inventor; b. at Lee, N. H., Oct. 5, 1804; graduated at the U. S. Military Academy 1824; entered the army as second lieutenant of artillery, remaining, however, at the academy as assistant professor until 1829; was transferred to the ordnance corps in 1836, in which year he resigned and became superintendent of the West Point iron and cannon foundry, Cold Spring, N. Y.; was judge of court of common pleas, Putnam County, 1843–47; and was the inventor of the system of rifled guns bearing his name, and of their projectiles. (See Artillery.) D. at Cold Spring, N. Y., Dec. 24, 1877.
Revised by James Mercur.

Parry: See Fencing.

Parry, Charles Christopher, M. D.: botanist; b. at Admington, Worcestershire, England, Aug. 28, 1823; removed to the U. S. in 1832; graduated at Union College, and in 1846 removed to Davenport, Ia., where he practiced medicine for several years, and studied the flora of the adjacent region. He was botanist to David Dale Owen's geological survey of the Northwest (1848), botanist to the Mexican boundary survey (1849–52), botanist to the Pacific Railroad survey of the 35th parallel (1867), botanist of the Department of Agriculture (1869–71). In 1861, 1862, 1864, and again in 1872 and 1873 he collected extensively in the Rocky Mountains, and later in Utah, Texas, and California. Among his publications are *Botanical Observations in Western Wyoming, etc.* (1874); *Botanical Observations in Southern Utah* (1875); *Revision of the United States Pacific Coast Species of Arctostaphylos* (1883); *Revision of the Genus Chorizanthe* (1884); *The North American Genus Ceanothus* (1888). D. at Davenport, Ia., Feb. 20, 1890.
Charles E. Bessey.

Parry, Charles Hubert Hastings: composer; b. in England, Feb. 27, 1848; graduated at Oxford 1870; received Mus. Bac. degree from Oxford 1867, and Mus. Doc. from Cambridge in 1883 and from Oxford in 1884. He has composed largely for orchestral instruments, both solo and concerted; also *Judith*, *Job*, and *King Saul* oratorios; music to *The Birds* of Aristophanes, *Prometheus Unbound* of Shelley, *De Profundis* for a twelve-part chorus, *Ode on St. Cecilia's Day*, *Blest Pair of Sirens*, *Funeral Ode*, *The Glories of our Blood and State*, *L'Allegro*, *The Lotus-eaters*, and other odes and cantatas. Much of his music was composed for the various English musical festivals. D. E. H.

Parry, Sir William Edward: Arctic explorer; b. at Bath, England, Dec. 19, 1790; entered the navy 1803; was engaged in the naval service on the American coast during the war of 1812; was a member of Sir John Ross's Arctic expedition 1818; commanded another expedition 1819–20, with which he penetrated farther W. within the Arctic Circle than any previous explorer, thereby gaining a reward of £5,000 offered by Parliament; made other expeditions 1821–23, and in 1827 set out in boats that could be fitted to sledges from North Spitzbergen and attained the highest

north (82° 45′ N. lat.) ever reached until Markham (1876) beat it. He was knighted 1829; became rear-admiral 1852; governor of Greenwich Hospital 1853; and died at Ems, Germany, July 8, 1855. He wrote several volumes, the most important being his *Journal of a Second Voyage for the Discovery of the Northwest Passage* (1824), and *Narrative of the Attempt to reach the North Pole in Boats* (1828).

Revised by C. C. Adams.

Parry Sound: chief town of the provisional district of Parry Sound, Ontario, Canada; at the eastern extremity of Parry Sound, an inlet of Georgian Bay; 70 miles N. E. of Collingwood, and the western terminus of the Canada Atlantic Railway (for location, see map of Ontario, ref. 2–D). Pop. (1891) 1,982.

Parsees, or **Parsis** (plur. of *Par'see*, or *Parsi* = Hind. and Pers. *pārsī*, Persian, fire-worshiper; cf. Eng. *Persian*]: the name generally employed to designate the modern followers of Zoroaster. The Parsis form a small community, now living chiefly in Bombay, or still scattered here and there in Persia, their original home. They are the descendants of the early Persian race, and their name is derived from the province of Pars, or Fars, broadly employed for Persia in general. With the Arab invasion and conquest of Persia, and Caliph Omar's victory over Yazdegard in the battle of Nahavand (A. D. 641), the Sassanian monarchy fell, and the power of Zoroastrianism that had swayed Iran for centuries was crushed before the faith of Islam. Most of the Zoroastrians accepted the creed of Mohammed; only a small number clung to the national religion, and these were subjected to severe persecution. The Mohammedans called them *Guebres*, infidels, and allowed them to settle only in the poorest districts of the country around Yezd and Kirmān. A goodly number, in order to avoid persecution, sought refuge in exile, and emigrated to the west coast of India, settling among other places at Navsari, Surat, Ahmedabad, and especially in Bombay. Those who remained in Persia suffered much oppression at the hands of the fanatical Mohammedans; they sank into poverty and decreased in numbers. They number only 7,000 or 8,000, but they are much respected on account of their honesty. Those, on the contrary, who went to India prospered much, though at one time they, too, were exposed to persecution by the Mohammedans. They number about 90,000; among them are some of the wealthiest merchants of Bombay.

In consequence of their emigration from Persia and their contact with the Hindus, certain of the ideas and observances of the Parsis in India underwent some changes which gave rise to schismatic tendencies and to religious factions among themselves; but with the establishment of reform associations the Indian Parsis have remained in close touch with their persecuted Persian brethren, and do all that is possible to alleviate their oppressed condition. Among the numerous striking religious practices for which the Parsi faith is peculiar is the strange custom of exposing the dead to be devoured by vultures on the "towers of silence." The Parsis, it may be added, strenuously object to the misleading designation "fire-worship," which is sometimes given their religion. In their daily life they have an acknowledged reputation for uprightness, high-mindedness, and morality, for benevolence and generosity, and furthermore for exceedingly keen business instincts. They form in general a community which, though small, is highly respected, and which is especially well disposed to European civilization. See Avesta and Zoroaster, and consult Dosabhai Framji Karaka's *History of the Parsis* (2 vols., London, 1884).

Revised by A. V. Williams Jackson.

Parsley [M. Eng. *perseley*, *persil*, from O. Fr. *persil*: Span. *perejil* < Lat. *petroseli'num* = Gr. πετροσέλινον, rock-parsley; πέτρα, rock + σέλινον, parsley (whence Eng. *celery*)]: *Petroselinum sativum*, a biennial umbelliferous herb cultivated in gardens. There are several varieties. The leaves of most are used in garnishing meats. Others are sometimes cultivated for the rich white root, which resembles the parsnip. The root of common parsley has medicinal qualities.

Revised by L. H. Bailey.

Parsnip, formerly often written **Pastnip** [M. Eng. *parsnepe*, viâ O. Fr. from Lat. *pastina'ca*, parsnip, deriv. of *pasti'num*, a kind of dibble. The Eng. form has perhaps been influenced by *turnip*]: an umbelliferous plant (*Pastinaca sativa*), usually biennial, found wild in Southern and Central Europe, in England, and in the southern parts of Russian Asia. There is a considerable difference between the wild and the cultivated parsnip, the root of the latter being larger, without branches, softer, and more fleshy. It succeeds best in light rich soil. The Guernsey parsnip has a root 4 feet long; the Dutch, only from 20 to 30 inches. To many this root is a great relish; the Romans cultivated it carefully and appreciated it much. To others, however, it is distasteful on account of its sweetness. As fodder, though not much used, it possesses value for some kinds of stock. The wild parsnip has an acrid taste, and sometimes malignant consequences when eaten; the cultivated assumes the same acrid taste when it begins to grow in spring. There are only three or four important named varieties in cultivation in the U. S.

Revised by L. H. Bailey.

Parson, or **Rector** and **Vicar**: in English ecclesiastical law, strictly, a parish priest of the established church in England, who, in addition to his spiritual functions, has the legal ownership and possession of all the temporal rights belonging to the parochial church. He is called parson (a variant form of *person*, Lat. *persona*) because by his person the church is represented, and he is in himself a corporation sole, in order to protect the rights of the church, which he personates by a perpetual succession. The word parson, at first used only in the sense above noted, gradually came to signify any incumbent of a benefice who officiated in place of the parson (as noted below), and is now popularly used to signify any clergyman or person authorized by ecclesiastical authority to preach. In the technical sense, instead of the term *parson*, the word *rector* (that is the person who has the direction of the affairs of the church) is now more commonly used.

The parson or rector, as distinguished from other parish priests, is a kind of life-tenant, having a freehold ownership of the church, the parsonage, the glebe, the tithes, and all the parochial dues; and he may commit certain kinds of waste, and must repair and insure the property. In the early history of the English Church these temporalities were sometimes perpetually annexed to, and held by, some spiritual corporation, in which case they were said to be *appropriated*. The corporation then became the parson of the parochial church, and was bound to provide for the performance of the ecclesiastical services of the church. Later on these church temporalities were in some cases granted to laymen (*lay parsons*), in which cases they are (according to some authorities) properly said to be impropriated. This distinction between *impropriate* and *appropriate* is probably without basis, the words having probably been originally used, as often now, interchangeably. Probably, however, in the case of appropriated benefices, the parson appropriate, or appropriator, was required to depute or appoint some one to perform the ecclesiastical duties of the church. This deputy was called the vicar (i. e. agent or deputy), and originally was little more than the stipendary curate of the present day. His stipend was entirely in the discretion of the appropriator, and he was removable at pleasure. By statute, however (4 Henry IV., c. 12), it was required that a secular ecclesiastic should be appointed; that he should be canonically instituted and inducted; that his office should be perpetual; and that he should be sufficiently endowed. His endowment now consists generally of the small tithes, and of a portion of the glebe, or the land belonging to the parsonage. The principal distinction between a rector and a vicar now is that the rector has the sole right to all ecclesiastical dues within his parish. Where the incumbencies were not endowed under the statute above mentioned they were called *perpetual curacies*, and the incumbent appointed to perform the ecclesiastical duties a *perpetual curate*. Since 1868 (by virtue of 31 and 32 Vict., c. 117) the incumbent of the church of every parish, or parish for ecclesiastical purposes, not being a rectory, who is authorized to publish banns and to solemnize marriages, churchings, and baptism in such church, and receive the fees for his own use, is for the purpose of style and designation, but not for any other purpose, deemed and styled a vicar, and his benefice a vicarage.

In order that a person may become a parson or a vicar he must be in holy orders (that is, a consecrated priest in accordance with the rights of the established church), be presented to the living by its patron, be instituted into the spiritual cure by the bishop, and be inducted into the possession of the church and other temporalities of the parish. His principal duties are to care for the church property, answer the questions of the bishop, perform divine services, administer the sacraments, solemnize marriage, churchings, and baptism, and officiate at burials of the dead. He has

complete control over the organist, the choir, and the bell-ringer. He is responsible for all that his curate or that other clergymen may do in his church with his sanction or permission. For further information, see Phillimore's *Ecclesiastical Law*; Cripp's *Law of the Clergy*: Whitehead's *Church Law*; T. Eustace Smith's *Summary of the Law and Practice of the Ecclesiastical Courts.* F. STURGES ALLEN.

Parson-bird: a characteristic bird of New Zealand (*Prosthemadera nova-zelandica*). Its glossy black coat and a tuft of white feathers on either side of the throat suggest the garb of a clergyman.

Parsons: city; Labette co., Kan. (for location, see map of Kansas, ref. 8–J); on the Kan. City, Ft. Scott and Mem. and the Mo., Kan. and Tex. railways; 32 miles N. E. of Independence, 48 miles S. S. W. of Fort Scott. It is an agricultural and manufacturing center, contains general railway offices, railway works and shops, a foundry, and furniture and other factories, and has a national bank, a State bank, a public library, and 3 daily and 4 weekly newspapers. Pop. (1900) 7,682.

Parsons, ALBERT ROSS: See the Appendix.

Parsons, CHARLES: See the Appendix.

Parsons, or **Persons**, ROBERT: ecclesiastic; b. at Nether Stowey, Somersetshire, England, June 24, 1546; educated at St. Mary's Hall and at Baliol College, Oxford, where he graduated 1568, and became dean; left Oxford in 1574, in consequence of his conversion to Roman Catholicism; resided for a time in the Netherlands; studied medicine and law at the University of Padua; entered the Society of Jesuits at Rome July, 1575; studied divinity in the Jesuits' College at Rome; took orders as a priest; was sent by Pope Gregory XIII. to England, along with Edmund Campion and other Jesuits, July, 1580, to attempt the conversion of that kingdom to Roman Catholicism; traveled in disguise among his coreligionists; became the object of energetic measures on the part of the English Government; escaped to the Continent 1581; opened a seminary for English youth at Eu in Normandy 1584; became rector of the English college at Rome and provincial of the English missions; communicated with James VI. of Scotland in behalf of his mother, Mary, Queen of Scots, then awaiting execution, and visited in her behalf the courts of France, Spain, and Portugal; founded seminaries for English Roman Catholics at Valladolid, San Lucar, Seville, and Lisbon, and at St.-Omer, France, 1593; became a second time rector of the English College at Rome (1598–1610), and resisted all attempts to make him a cardinal after the death of Cardinal Allen. D. at Rome, Apr. 18, 1610. He was the author of several treatises in favor of the doctrines of the Church of Rome, which appeared in London under assumed names, among which were *A Brief Discourse* (1584); *The Christian Directory* (1583–91); *A Conference about the Next Succession to the Crown of England* (1594); and *A Treatise of the Three Conversions of England* (1603–04). For issuing the first and the third of these works the printers were hanged and quartered, and it was made high treason to own a copy of the latter book, which advocated the claims of the Infanta of Spain to the English throne. Gibbon attributed his youthful conversion to Roman Catholicism to the writings of Parsons, who was a man of brilliant talents and a vigorous writer, industrious, prudent, and zealous. He possessed much influence at the court of Spain, and was more dreaded by the English court than any other ecclesiastic. See Dodd's *Church History of England* and Foley's *Records of the English Province of the Society of Jesus.*

Revised by J. J. KEANE.

Parsons, SAMUEL HOLDEN: soldier and jurist; b. at Lyme, Conn., May 14, 1737; graduated at Harvard 1756; studied law at Lyme in the office of his uncle, Gov. Matthew Griswold; was admitted to the bar 1759; was representative in the Legislature many years in succession from 1762; became king's attorney 1774, when he removed to New London; was a member of the Connecticut committee of correspondence 1775, in which year he took command of the Sixth Connecticut Regiment at the siege of Boston; took part in the battle of Long Island; was chosen by Congress brigadier-general Aug. 9, 1776; succeeded Putnam in command of the Connecticut line 1779; became major-general Oct. 23, 1780; practiced law at Middletown after the peace; was commissioner to treat with the Miami Indians 1785; member of the Connecticut convention for the ratification of the Constitution of the U. S. Jan., 1788; was appointed by Washington first judge of the Northwest Territory; was commissioner of Connecticut to purchase from the Wyandot Indians the tract in Northeastern Ohio known as the Connecticut or Western Reserve 1789; settled near the Ohio river; published a paper on the antiquities of the Western States in the *Transactions* of the American Academy (vol. ii.); was drowned in the rapids of the Big Beaver river, Ohio, Nov. 17, 1789.

Parsons, THEOPHILUS, LL. D.: jurist; son of Rev. Moses Parsons; b. at Byfield, Mass., Feb. 24, 1750; graduated at Harvard 1769; taught school at Falmouth, Mass. (now Portland, Me.); was admitted to the bar there 1774; returned to Byfield in consequence of the destruction of Falmouth by a British squadron in Oct., 1775, and began legal practice at Newburyport in 1777. He was a member of the patriotic association called the "Essex Junto," and author of the famous pamphlet known as the *Essex Result* (1778), which contributed largely to the defeat of the State constitution then proposed by the Legislature, and the establishment of the prevailing New England conservative school of constitutional doctrine; was a member of the convention held in 1779 which framed a new constitution, and of the convention of 1788 for the ratification of the Federal Constitution. Although not active in public affairs, he was several times elected to the State Legislature. He removed to Boston in 1800, and became in 1806 chief justice of the Supreme Judicial Court, which post he held until his death, in Boston, Oct. 30, 1813. His decisions, which fill vols. ii. to x. of the Massachusetts *Reports*, have given him a vast legal reputation. He was a man of a remarkable memory, a versatile mind, an exact student, and exhibited a universal readiness in his practice of law. See *Memoir of Chief Justice Theophilus Parsons*, by his son, Theophilus Parsons (Boston, 1859). Revised by F. STURGES ALLEN.

Parsons, THEOPHILUS, LL. D.: jurist; son of the eminent jurist of the same name; b. at Newburyport, Mass., May 17, 1797; graduated at Harvard 1815: studied law in the office of Judge William Prescott; visited Europe; practiced some years at the bar at Taunton, and afterward at Boston; was a frequent contributor to *The North American Review* and other magazines and periodicals; founded the *United States Literary Gazette*; published three volumes of *Essays* in support of the doctrines of the Swedenborgian or New Jerusalem Church; became in 1847 Dane Professor of Law at Harvard Law School; was author of some fifteen volumes of legal treatises on the laws of contracts, mercantile business, shipping and admiralty, notes and bills of exchange, marine insurance; *Treatise on the Law of Contracts* (1853; 5th ed. 1864); *Elements of Mercantile Law* (1856); *The Laws of Business* (1857); *Treatise on Maritime Law* (1859); *Treatise on the Law of Promissory Notes and Bills of Exchange* (1860); *Laws of Partnership* (1867); *Treatise on Marine Insurance* (1875); *The Political, Personal, and Property Rights of a Citizen of the United States* (1875), etc. He also wrote a *Memoir of Chief Justice Theophilus Parsons* (1859); several theological works; *Essays* (1845); *Deus Homo* (1867); *The Infinite and the Finite* (1872); *Outlines of the Religion and Philosophy of Swedenborg*, and other religious works. D. at Cambridge, Mass., Jan. 26, 1882. Revised by F. STURGES ALLEN.

Partan'na: town of Italy; in the province of Trapani, Sicily; on a mountain-slope 1,250 feet above sea-level; 19 miles S. E. of Trapani (see map of Italy, ref. 9–E). It commands a fine view of the Mediterranean and of the beautiful plain between Cape Lilibeo and the promontory of Sciacca. The Chiesa Madre contains some noticeable works of art. This town was originally a Greek colony, and terra-cotta vases of Greek workmanship are frequently disinterred in the vicinity. The Saracens erected three castles here, the ruins of which still exist. In the revolution of 1860 Partanna furnished important assistance to Garibaldi. Pop. 13,144.

Parthe'nius: Greek elegiac poet of Nicæa in Bithynia; went to Rome about 72 B. C. and taught Vergil Greek at Naples. His poems, two of which were imitated in the extant Latin poems *Moretum* and *Ciris*, have perished, and the only production of his that has survived is a collection of doleful love stories (*περὶ ἐρωτικῶν παθημάτων*), a practical manual of themes for elegies prepared for the benefit of Cornelius Gallus, the Roman poet. Ed. by Westermann in his *Μυθογράφοι* (1843). B. L. G.

Parthenogen'esis [Gr. *παρθένος*, virgin + *γένεσις*, production]: that type of reproduction where unfertilized eggs de-

velop into adults. It occurs in various groups of invertebrates, especially in land and fresh-water forms which are exposed to seasonal changes. Instances are most numerous among the Rotifers, the lower Crustacea, and insects. In some Crustacea it is almost the rule, and in the Phyllopod *Apus* males are so rare that for many years they were not known to exist. Parthenogenesis may occur occasionally in forms like butterflies and silkworms, when sexual reproduction is the rule, or it may occur as a normal condition in the production of one sex, as among the honey-bees, where the drones are developed from non-fertilized eggs, the workers and queens being developed from impregnated ova. In some of the lower Crustacea (*Otracodes*, *Cladocera*) parthenogenetic and normal generations alternate according to the season. In these the two types of eggs differ considerably in appearance. Among the plant-lice (Aphides) parthenogenetic reproduction prevails during the warmer months, the females producing eggs which develop, without fertilization, inside the mother, the young being born alive. In the autumn true males and females appear, and fertilized eggs are laid which carry the species through the winter months. Here the normal females differ from the parthenogenetic ones, since the latter possess wings and lack those organs necessary for copulation. A last type to be mentioned are certain pædogenetic flies, in which not the adult but the larva or pupa produces parthenogenetic eggs.

An explanation of parthenogenesis which shall fulfill all conditions is yet to be given. The latest and most nearly satisfactory is that of Weismann. Normal eggs in their maturation throw off two polar globules (see EMBRYOLOGY), but apparently, in at least some instances, parthenogenetic eggs throw off but one. The second globule is hence assumed to be equivalent in some respects to the male element (spermatozoön), and since it is retained in the egg, no addition of outside material is necessary. The whole subject is, however, obscure. The reader is referred to von Siebold, *Parthenogenesis* (London, 1857), and Weismann, *Essays on Heredity*.

J. S. KINGSLEY.

Par'thenon [= Lat. = Gr. Παρθενών, deriv. of παρθένος, a virgin, an especial epithet of Athene]: a temple of Athena Parthenos at Athens. It was built by Pericles about 438 B. C. The architects were Ictinus and Callicrates, and a part of the sculptured decorations are thought to have been from the hand of Phidias. It stands upon the Acropolis. It is of the Doric order, built of Pentelic marble, is 228 feet long and 101 feet wide. It is generally believed that it was painted within and without. There were 46 columns in its peristyle, 8 at each end and 17 on each side, reckoning the corner columns twice. It stood almost entire until 1687, when, during a siege by the Venetians, a large part of the central portion was destroyed by the explosion of some gunpowder stored in it by the Turks. It is regarded as the finest production of Greek architecture. The statues from the pediments, so far as preserved, many of the metopes, and a large part of the frieze on the outer wall of the cella were taken by Lord Elgin, and are among the chief treasures of the British Museum. See ARCHITECTURE and ATHENS.

Revised by RUSSELL STURGIS.

Par'thia: an ancient territory of Western Asia; situated S. E. of the Caspian Sea, corresponding nearly to the modern Persian province of Khorassan. It was wholly mountainous and inhabited by a rough, wild, and warlike people of Scythian descent, famous for their horsemanship and skill with the bow. Agriculture and trade they despised; war was their only occupation. They belonged successively to the Assyrian, Persian, Macedonian, and Syrian empires, but in 250 B. C. they established an independent kingdom under Arsaces, whose dynasty, the Arsacidæ, ruled till 226 A. D. and formed a vast empire, extending from the Euphrates to the Indus. The Romans attacked them several times, but without success; but Artabanus IV. was killed in 226 A. D. in a rebellion, and the dynasty of the Arsacidæ was followed by that of the Sassanidæ, a Persian family. The Persian influence now became the ruling one in Asia till the Mohammedan conquest, 651 A. D.

Participle [through the Fr. *participe* from Lat. *participium*, a deriv. of *par'ticeps*, sharing, participating; *pars*, part + *ca'pere*, take. The Lat. word is merely a translation of the Gr. μετοχή, deriv. of μετέχειν, to share; μετά, among + ἔχω, have]: an adjective verbal; an adjective formation, closely attached to the verb, and sharing with it meaning, the government of cases, and tense. In the parent Indo-European the boundary-line between participles and adjectives was less clearly fixed than it appears in the separate languages. The participle had not become an established part of the mechanism of the parent speech. Indo-European adjective suffixes have therefore been employed to form participles in these languages; thus *-to-*, *-no-* (*-ono-*), *-io-*, *-teuo-*, *-lo-*, *-ent-*, *-meno-*. Of these the English uses three: (1) *-tó-*, which forms the past passive participle of the regular or weak verbs, as in *tamed*: Germ. *ge-zāhmt*: Goth. *ga-tamida-* < Indo-Europ. *domətó-s* > Sanskr. *damitá-*: Lat. *domitus*. Three forms of the suffix appear, as in *blesséd*, *loved*, *blest*. (2) *-ono-*, which forms the past passive participles of the irregular or strong verbs, as in *given*: Germ. *gegeben*: Goth. *gibans*; cf. Germ. *ge-worden*, Goth. *waúrþans*, Sanskr. *vavṛtāná-s*. The prefix *ga-* (*ge-*, *gi-*) which commonly attached itself as a characteristic of past participles in Teutonic survives in English only in traces in a few archaizing words, like *yclept*. In German the compound verbs with inseparable prefix omit the *ge*, as *erfunden*, *verschwunden*. Relics of old participles with omitted *ge-* are also found in *können*, *lassen*, etc., e. g. in *hat singen können*, *hat kommen lassen*. (3) *-ent-* (*-nt*), which forms the present active participles, like *loving*, *singing*. This ending (M. Eng. *singinge*) succeeded to O. Eng. *-ende* in late Middle English, and soon caused confusion with the substantives in *-ing* (O. Eng. *-ung*, *-ing*), like *learning* (O. Eng. *leornung*). The original ending appears in *bearing*: Germ. *gebärend*: Goth. *bairands*; Sanskr. *bhárant-*: Gr. φέρων (*-οντ-*): Lat. *ferens*. The present participle in English may be used passively, as in *The house was building*, but the necessity of avoiding the ambiguity involved in cases like *The boy was whipping*, for *being whipped*, is bringing into standard use the substitute *is being built*.

BENJ. IDE WHEELER.

Partinico, pär-tee'nĕe-ko, or **Partenico**: town; in the province of Palermo, Sicily; about 17 miles W. of the city of Palermo (see map of Italy, ref. 9–E). It is situated in a wide valley, and is surrounded by calcareous mountains rising in the form of isolated pyramids. The vine and the olive thrive in this region, and the inhabitants are chiefly occupied with the manufacture and sale of wine and oil. Pop. 21,000.

Partition: See JOINT OWNERSHIP.

Partnership [deriv. of *partner* (by anal. of *part*) for *parcener*, from O. Fr. *parsonnier*, liter., portioner, deriv. of *parson*, portion < Lat. *parti'tio*, division]: "the relation which subsists between persons carrying on a business in common with a view of profit." (British Partnership Act, 1890, § 1.) The English law of partnership is modern—the product mainly of the nineteenth century. Blackstone barely refers to it. The earliest treatise on the subject was published in 1794 by W. Watson, who asserts that "the true use of partnership was discovered" during Elizabeth's reign. In the early English digests partnership cases are presented under the titles *Merchants* or *Lex Mercatoria*; and very naturally, as the decisions are rested on the customs of merchants. (*Jeffreys* vs. *Small*, 1 Vernon 217, A. D. 1683.) Although our law of partnership had its origin in mercantile customs, its development has been seriously affected by common-law rules, which have been applied in some instances by the courts with unfortunate results.

Nature of Partnership.—The mercantile conception of a partnership is that of an entity distinct from the partners. This view has been championed by distinguished judges in England and the U. S. Chief Justice Hornblower, in *Curtis* vs. *Hollingshead* (2 Green, N. J. Law, at p. 410), declares, "A partnership is considered in law as an artificial person, or being, distinct from the individuals composing it." Master of the Rolls Jessell, in *Pooley* vs. *Driver* (5 Chancery Division, at p. 476), asserts: "Everybody knows that partnership is a sort of agency, but a very peculiar one. You can not grasp the notion of agency, properly speaking, unless you grasp the notion of the existence of the firm as a separate entity from the existence of the partners." Similar but more guarded statements of the same doctrine are found in *Bank of Buffalo* vs. *Thompson* (121 N. Y. 280) and in *Meehan* vs. *Valentine* (145 U. S. 611). On the other hand, the mercantile view has been expressly, almost contemptuously, repudiated by other judges. In *Hallowell* vs. *Blackstone Bank* (154 Mass. 359) Justice Holmes says: "Cory on accounts and Lindley on partnership have made it popular to refer to a mercantile distinction between the firm and its members; but we have no doubt that our merchants are perfectly aware that claims against their firms are claims against them." Lord Justice Kay (*In re* Beauchamp Brothers (1894), 1

Queen's Bench, at p. 7), referring to counsel's argument that a partnership is an entity, asserts, "It is no such thing, and the rules do not mean anything of the kind." Had the courts accepted and consistently enforced the mercantile conception of a partnership, this branch of the law would have been much simplified and improved. While they have not adopted it, they have established certain doctrines, as will appear from our subsequent discussion, which fully recognize its soundness. The Partnership Act of 1890 declares, "In Scotland a firm is a legal person distinct from the partners of whom it is composed."

At common law any number of persons may unite in a partnership. This is sometimes modified by statute, as by the Companies Act, 1862 (25 and 26 Vict., c. 89), which limits the members of a banking partnership to ten, and those of a partnership for any other purpose to twenty persons. In the absence of prohibitory legislation, a partnership may divide its capital into transferable shares (see JOINT-STOCK COMPANY), and thus enable any of its members to dispose of their interests to strangers without dissolving the firm. The shares in mining partnerships are thus transferable, by mercantile custom. In the normal partnership, however, *delectus personarum* is a fundamental rule; each partner has the right to choose his associates, and no one can become a member of the firm without the consent of every member. This relation is presumed to be founded on personal confidence between the partners, for the incapacity or dishonesty of any one may inflict irreparable injury upon his associates.

How Created.—A true partnership originates in an agreement of the partners. It follows that the members of a firm must possess contractual capacity (see ALIEN, CONTRACT, CORPORATION, INFANTS, and MARRIED WOMEN), and that if the partnership be illegal it has no legally enforceable rights against third persons, nor have its members any against each other. Persons may enter into an association by agreement without becoming partners. Their association, to be a partnership, must be organized to carry on a business with a view of profit. Hence a social club, or a charitable organization, or a political committee, or an association formed to open and grade a street, or to resist the claims of a particular patentee or to build a meeting-house which is to be the property of the associates in the proportion of their payments, or to buy and divide lands, or to cultivate a farm on shares, or to engage in the production of articles which are to be divided among the associates, is not a partnership. In neither of these cases is a business carried on in common with a view of profit. It must be admitted that the term business is somewhat vague, and that judicial definitions of it are not harmonious. The tendency of modern decisions, however, is fairly expressed in the Partnership Act, which defines the expression as including "every trade, occupation, or profession."

While an agreement between persons is necessary to institute the relation of partnership, such agreement need not declare expressly their intention to become partners. On the other hand, it may call them partners without creating a partnership. (*Livingston* vs. *Lynch*, 4 Johnson's Chancery, at pp. 592–593.) Whether this relationship has been instituted is in each case a question of intention, to be determined as a fact from all the language and acts of the parties. It is not essential that they should plan actually to become partners. They may have been ignorant of the law, and unconscious of the legal results of their conduct; or they may have tried to evade the law by giving to the transaction the appearance of a loan of money, or the use of property or personal services, on the part of one or more of the associates to his fellows, while securing to such one or more all of the advantages of a partnership; yet if they have carried on intentionally a business in common with a view of profit, they are partners. While the business must be carried on in common, it is not necessary that each partner engage in the management. It is enough that it be carried on in his behalf as a common proprietor. Nor is it essential that each partner should share in the losses of the business. One or more may be guaranteed against loss by his copartners.

That the intention of the contracting associates to carry on a business in common with a view of profit is the true test of a partnership, has not always been recognized by the courts. In England, until the decision of the House of Lords in *Cox* vs. *Hickman* (8 House of Lords Cases 268, A. D. 1860), it was generally understood that participation in the profits, or at least in the net profits of a business, constituted one a partner. "He who takes a moiety of all profits," it was said, "shall by operation of law be made liable to losses, if losses arise, upon the principle that by taking a part of the profits he takes from the creditors a part of the fund which is the proper security to them for the payment of their debts." (*Waugh* vs. *Carver*, 2 H. Blackstone 235, A. D. 1793.) Various exceptions were established from time to time, and in *Cox* vs. *Hickman* the House of Lords declared that this doctrine was not a part of the law of England: that "the real ground of the liability" of a partner "is that the trade has been carried on by persons on his behalf"; that in determining whether it so has been carried on, participation in the profits is an important but not a decisive fact; that the question is to be answered in accordance with the terms of the contract between the parties. The principles of this decision have been followed by the English courts in subsequent cases, and are now a part of the statute law of Britain. *Cox* vs. *Hickman* had been anticipated by several State decisions (e. g. *Loomis* vs. *Marshall*, 12 Conn. 69, and *Polk* vs. *Buchanan*, 5 Sneed (Tenn.) 721), and its doctrine is enforced by most of the courts in the U. S. Even the New York court of appeals, while professing still the form of the older English doctrine, has discarded its substance. In a recent decision, after restating the old rule and the grounds upon which it was based, the court said: "Exceptions to the rule are, however, found in cases where a share in profits is contracted to be paid as a measure of compensation to employees, for services rendered in the business, or for the use of moneys loaned in aid of the enterprise; but where the agreement extends beyond this, and provides for a proprietary interest in the profits as a compensation for moneys advanced and time and services bestowed as a principal in its prosecution, we think that the rule still requires such party to be held as a partner." *Hackett* vs. *Stanley*, 115 N. Y. 625.

The partnership contract sometimes provides that the interest of a partner in case of his death shall remain in the business until a certain date. Such a provision does not give to the executor a right to enter the firm, nor does it subject him to the liabilities of a partner. Where the contract provides that the executor shall be admitted to the firm, it does not compel him to enter the partnership; but if he does, he becomes personally liable for the firm debts, and is entitled to indemnity to the extent of the share of the estate embarked by the will in the business, and no further. *Wild* vs. *Davenport*, 48 N. J. Law 129.

Quasi-partnership.—There is some judicial authority and an abundance of judicial dicta for the proposition that a partnership may exist as to third persons, where there is none between the parties, but it has been rejected by the great majority of courts as indefensible. Its unsoundness was never exposed more clearly than by Baron Bramwell in *Bullen* vs. *Sharp* (Law Reports, 1 Common Pleas 86): "Partnership means a certain relation between two parties. How, then, can it be correct to say that A and B are not in partnership as between themselves; they have not held themselves out as being so, and yet a third person has a right to say they are so as relates to him? That must mean *inter se*; for partnership is a relation *inter se*, and the words can not be used except to signify that relation. A is not the agent of B; B has never held him out as such; yet C is entitled, as between himself and B, to say that A is the agent of B! Why is he so entitled if the fact is not so, and B has not so represented?" According to the prevailing view, then, there is no true partnership as to third persons where there is none between the parties; but the parties, by holding themselves out to third persons as partners, may subject themselves to a partnership liability to such persons. This holding out may be by express statement or by conduct. One who asserts that he is a member of a firm, or who knowingly suffers himself to be represented as a member, is liable as a partner to those who give credit to the firm on the strength of such assertion or representation. It is often said that one who holds himself out to the world as a partner is liable as such to every one who deals with the firm, whether the holding out was known to the third person or not; and there is some judicial authority for this doctrine based upon considerations of public policy. (*Poillon* vs. *Secor*, 61 N. Y. 456; *Bartlett* vs. *Raymond*, 139 Mass. 275, 277.) The better view, however, is that the liability of a "holding out" or quasi-partner rests upon the principle of estoppel, which is that one who has induced another to believe in and act upon the existence of a particular state of facts can not be heard, as against that other, to deny the truth of those facts. *Thompson* vs. *Bank*, 111 U. S. 530.

Title to Partnership Property.—In dealing with this branch of the subject the courts have been forced to accept, to a greater or less extent, the mercantile idea of a partnership. Personalty may be transferred to or by the firm in the firm name, and title thereto is in the firm and not in its members as individuals. A chattel mortgage on firm property by one partner to secure his separate debt, or the levy of an execution thereon, issued on a separate judgment, does not subject it to a lien as against the firm or its creditors. All that is encumbered in either case is the debtor partner's share. This is not the interest of a tenant in common, for the transferer of a partner's share gets no title to an undivided share of any chattel; he obtains only a chose in action, a right to an account, and to any surplus of proceeds which may belong to the debtor partner on account of the property mortgaged or levied on, after the payment of firm debts and the adjustment of the equities between the partners. It is not the interest of a joint tenant, for the full legal and equitable title does not survive as between partners.

The tendency of modern decisions is to treat firm real estate as partnership stock or personalty, so far as the rules of conveyancing and of the recording acts will permit. In Britain this doctrine has been carried to its logical conclusion. The Partnership Act provides: "Where land or any heritable interest therein has become partnership property, it shall, unless the contrary intention appears, be treated as between the partners (including the representatives of a deceased partner), and also as between the heirs of a deceased partner and his executors or administrators, as personal or movable and not real or heritable estate" (§ 22). Sir Frederick Pollock has expressed the belief that this rule was well settled before the statute, and may safely be accepted in other common-law jurisdictions. However, the doctrine which prevails in most of the U. S. does not sustain fully his view. It treats partnership realty as converted into personalty only for the purposes of paying partnership liabilities. The surplus retains all the incidents of real estate. For example, a deceased partner's share passes to the heir and not the personal representative, and is subject to dower.

The deed of real estate to a firm should contain the individual names of the partners and the firm name. If the firm name is employed as that of the grantee, the effect of the deed will vary with the jurisdiction. In some States it will operate not as a conveyance, but as a contract to convey. In others it will pass the legal title to any of the partners whose names appear in the firm appellation, but if this does not contain the name of a member, the deed will be inoperative, and the grantor will retain the legal title in trust for the firm. In still others it will pass the legal title to the persons composing the firm at the time of the transfer. Wherever firm real estate stands in the name of a partner, the equitable title is in the firm, and he may be compelled to deal with it as firm property. While he holds the legal title a purchaser for value from him without notice of the partnership's rights may get good title. In case he disposes of the property to such a purchaser, and reinvests the proceeds in other lands, these become firm property.

A Partner's Powers.—Each partner is a general agent of the firm, and therefore has full authority to do any act which is necessary to the transaction of the firm's business in the way in which it is usually carried on. Whether an act in question is within the scope of the partner's apparent authority is "to be determined by the nature of the business and by the practice of persons engaged in it." The authority of partners in a trading firm is much more extensive than that of non-trading partners. In case of the latter—such as lawyers, farmers, mine or quarry owners, hotelkeepers, theater-managers—a partner has apparent authority to sell any of the personal chattels of the firm, or to purchase for it any chattels ordinarily used in its business, or to receive payment and give receipts and releases of debts, or to engage servants for the business. A member of a trading firm has apparent authority to do any of these acts, and also to bind his firm by negotiable paper, by borrowing money on the firm's credit, and by pledging its property as security therefor. He has not apparent authority to bind his firm by a sealed instrument, for the firm has no seal; nor to make a general assignment of firm property for the benefit of creditors, since this necessarily puts an end to the firm's business; nor submit a firm claim to arbitration; nor to make the firm a surety for third persons, unless the usage of the firm or of others engaged in the like business warrants such an act; nor to change in any material respect the business of the partnership. The ordinary authority of a member in either a trading or non-trading firm may be limited by an agreement of the partners, which is communicated to those dealing with the firm. As a partner is the general agent of the firm, his admissions and declarations relating to the affairs of the partnership and in the ordinary course of its business are its admissions and declarations. His representations as to the existence of a firm, or as to his authority to bind it, are clearly not within this rule. Whether a partner's authority to bind the firm by admissions and declarations concerning partnership transactions continues after dissolution, is a question upon which the courts differ. One line of decisions, following a leading English case (*Wood* vs. *Braddick*, 1 Taunton 104, A. D. 1808), holds that it does, while the opposite doctrine is maintained by decisions as numerous and respectable which follow a leading New York case. (*Hackley* vs. *Patrick*, 3 Johnson 536, A. D. 1808.) The former seems to be the sounder view. The courts have also disagreed as to the power of a partner to waive the statute of limitations after dissolution; but the weight of argument and authority is against his possession of it. "Notice to any partner, who habitually acts in the partnership business, of any matter relating to partnership affairs, operates as notice to the firm, except in the case of a fraud on the firm committed by or with the consent of that partner." Partnership Act, § 16.

Liability of Partners.—The members of a firm are jointly liable for all its contract obligations. Such has been always the prevailing doctrine in the U. S., except as modified by statute; but in England, until the decision of *Kendall* vs. *Hamilton* (4 Appeal Cases 504, A. D. 1879), it was understood that the liability was joint and several in equity. Several liability is still the rule in Scotland (Partnership Act, § 9), and in the U. S., as well as in Britain, the estate of a deceased partner is severally liable for partnership obligations. In most of the U. S., however, a firm creditor is not allowed to proceed against the estate of a deceased partner, unless the firm and the surviving partner are insolvent. The liability of partners for the torts of one or more within the scope of a partner's apparent authority is joint and several.

Although, as a rule, the liability of partners is joint, a judgment in an action against all is enforceable at law against the property of the firm or against that of any member at the creditor's option, as the entire fortune of each partner is liable for firm debts.

Duties of Partners.—Because of the power which the law gives to each partner, it requires him to exercise it with the utmost good faith. He is bound to render true accounts and full information of all partnership affairs. If, without his partners' consent, he derives any benefit from any firm transaction, or from any use by him of the property, name, or business connection of the partnership, this belongs to the firm; and he is not allowed, without his partners' consent, to carry on any competing business. It is the duty of the minority of a firm to acquiesce in the decision of the majority where differences arise as to ordinary matters connected with the partnership business, but not in a decision which works any change in the nature of the business, or in the membership of the firm. Each member is bound to devote his time and energies to the affairs of the firm without special remuneration. Of course these duties may be, and often are, varied by the agreement of the parties.

Dissolution and its Consequences.—A partnership may be dissolved by the agreement of the parties, by the operation of law, or by the decree of a court. The dissolution may be expressly provided for in the partnership contract, or the agreement of the parties may be inferred from the circumstances of the case. If the partnership is for a single adventure, it terminates with the close of that adventure. If it is organized to carry on a business for an undefined time, it is a partnership at will, terminable by notice from either partner. Where it is entered into for a fixed term, the better doctrine seems to be that it can not be dissolved by the mere act of one single partner, although there is considerable authority in the U. S. for the view that it can. (See *Solomon* vs. *Kirkwood*, 55 Mich. 256.) The happening of any event which makes the business of a firm unlawful, or the partnership relation between its members unlawful, works its dissolution by the operation of law, as does the death or the bankruptcy of any partner in the absence of an agreement to the contrary. A court may decree the dissolution of a firm because of the insanity or permanent incapacity of a partner, or because a member other than the one

suing has been guilty of serious misconduct, or because the circumstanees of the case show that a decree of dissolution will be just and equitable.

Unless the dissolution is produced by operation of law, it is important that notice thereof be given, or the retiring partners may be made liable for the debts of the new business. Actual notice must be given to those who have dealt with the old firm, but no particular form is required, while notice by publication in a newspaper of general circulation in the vicinity is sufficient as to all others. It is the legal duty of all members to coneur in sueh notification.

After a firm is dissolved, the authority of each partner, unless bankrupt, and his partnership rights and obligations continue for the purposes of winding up the firm's affairs only. All executory contracts of the partnership are to be performed; its assets, including the good will of the business, are to be converted into cash and to be applied first to the payment of firm creditors, next to the payment of advances, if any, by the respective partners, then to the payment of the capital furnished by each partner, and the residue is to be divided among the partners in the proportion in which profits are divisible. In the absenee of an agreement on the subject, profits are divisible equally between the partners, and not in proportion to their contributions of capital. The losses of a partnership business are payable first out of the profits, next out of capital, and then by the various partners in the proportion in which profits are divisible. In ease any of the partners are wholly insolvent, the losses are to be borne ratably by the others.

The position of a surviving partner has been rendered anomalous by the failure of the courts to aceept the entity idea of a partnership. He holds the legal title to the firm personalty. If sued on a separate debt, he can set off a firm claim; and if he sues on a firm credit his separate indebtedness may set off against it. He ean make a general assignment of firm property for the benefit of firm creditors with preferences. Yet he has not a joint tenant's benefit of survivorship. He is bound to a partner's good faith in disposing of the firm property and in distributing it to firm ereditors and to the representatives of deceased members. In Britain, however, this duty does not amount to a trust, and a deceased partner's representative has not the rights of a *cestui que trust* in the firm property; his claim is only "a debt accruing at the date of the death"; "there is nothing fiduciary between the surviving partner and the dead partner's representative, except that they may respectively sue each other in equity." (Partnership Act, § 43; *Knox* vs. *Gye*, Law Reports, 5 House of Lords 656.) The prevailing view in the U. S. is somewhat different. It is fairly indicated in *Preston* vs. *Fitch* (137 N. Y., at pp. 56–58), where it is said that "the property of a late firm comes to the surviving partner impressed with a certain kind of a trust, founded upon his duty to dispose of or realize upon such assets, and therefrom to pay the debts of the late firm, and to pay over the share of any balance to the estate of the deceased partner." The exact nature of this trust and the respeetive legal rights of the survivor and of the deceased partner's estate remain quite indefinite; and it is impossible to deduee from the decisions, even within a single jurisdiction, a body of consistent rules upon this topie.

We have seen that a firm creditor may enforce at law his judgment against the firm property or that of any partner. In case of the death of a partner, or of the insolvency or bankruptcy of a firm or any of its members, and of the administration of the partnership and individual estates, a different rule obtains, except in a few jurisdictions (e. g. Connectieut, Louisiana, South Carolina, Vermont, Virginia), and firm property is applied first to firm debts, while the separate property of each partner is applied first to his individual debts, any surplus from either estate being carried to the other. This rule was adopted in early bankruptcy eases as "a sort of rough code of justice," and has been adhered to as a matter of convenience, although at variance with the mercantile system of settling accounts, and open to severe criticism. A joint and several obligation of the partners, incurred in the firm business, or an obligation upon whieh the firm and its members, or any of them, are successively liable, as a note made by the firm and indorsed by the partners individually, is entitled to share in each estate until paid in full. As a rule, the firm ean not prove against the estate of one of its partners in eompetition with his separate ereditors, nor can a partner prove against the firm estate or the estate of any copartner in competition with firm creditors. An exception is made in case the property of the firm has been fraudulently converted by a partner, or that of a partner has been so converted by the firm without consent or subsequent ratification, and in Britain in the case of debts accruing between distinct trades carried on respectively by the firm and by a partner.

Limited Partnership.—New York, first among common-law States, adopted this institution in 1822, borrowing many of its features from the *société en commandite* of the French law. Later in the same year Connectieut introduced it into her legal system, and these two statutes have formed the models for legislation upon this subject by most of the U. S Several attempts have been made to introduce it into Britain, but without suceess. Limited partnership statutes, it is judicially declared, have two main objects: (1) To enable capitalists, without incurring the risks of general partners, to invest money, and thus promote trade, and to help those who have not sufficient wealth to earry on business ventures for whieh they have the requisite integrity and capacity; (2) to protect those dealing with the firm. The leading eharacteristics of this system are: (1) The publication of the names of the general and those of the special partners, of the amount of capital, of the nature and location of the business, and of the date of its commencement and termination; (2) the aetual eontribution of the avowed capital; (3) the protection of this partnership fund from secret and improper diminution for the benefit of the special partner or favored ereditors. A limited partnership must eontain one or more general partners, who have the authority and are subjeet to the liabilities of common-law partners; while the special partners are prohibited from taking part in the active management of the business, and are not liable for its obligations beyond the amount of their eapital. Such a partnership ean be organized only by eomplying strictly with all the substantial requirements of the statute. An honest intention to comply with its terms will not suffiee, and a firm which has failed to conform to the statutory provisions is a general partnership with all its eommon-law liabilities. Although this institution was borrowed from the civil law, the eourts have resorted rarely to civil-law authorities when dealing with questions relating to it, but have applied to them, so far as possible, the common-law rules. At first they were disposed to give to limited partnership statutes a very strict eonstruetion in favor of firm ereditors, but at present they look upon this legislation "as serving a purpose consistent with the public welfare, and entitled to a reasonable construction for the protection of speeial partners as well as for that of others." (*Fifth Avenue Bank* vs. *Colgate*, 120 New York 381.) For the special rules governing the formation of limited partnerships, their renewal, the eonduet of their business, and their dissolution, the statutes of each jurisdiction should be consulted.

Standard treatises on the subjeet of this article are those of Bates and of Troubat on *Limited Partnership*; of Bates, Lindley, Parsons, and Story on *Partnership*. A valuable collection of cases on partnership has been published by Prof. Ames. FRANCIS M. BURDICK.

Parton, ARTHUR: See the Appendix.

Parton, ERNEST: See the Appendix.

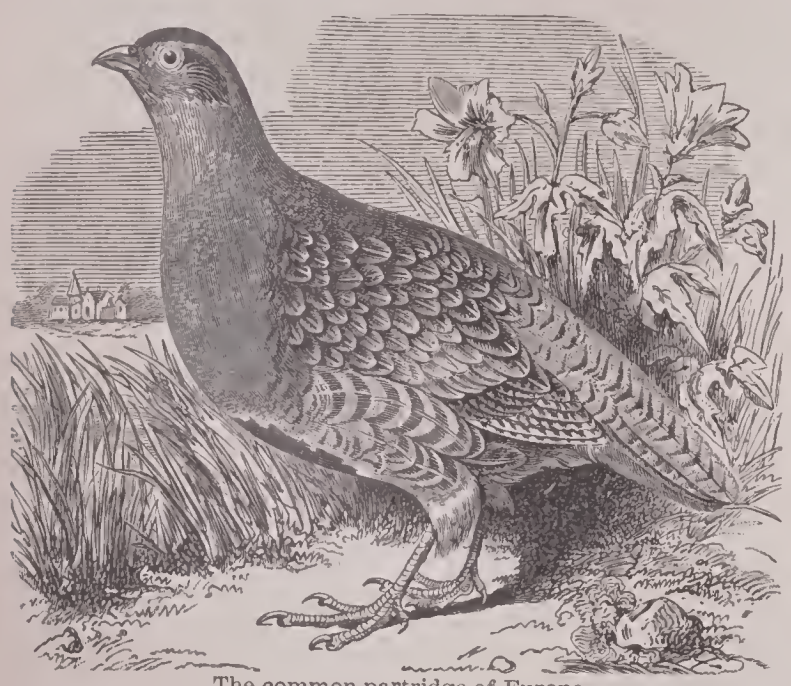
Parton, JAMES: author; b. at Canterbury, England, Feb. 9, 1822; was taken to New York when five years of age; educated in an aeademy at White Plains, where he became a teaeher at the age of nineteen; subsequently taught school in Philadelphia and New York; was for some years assistant editor of *The Home Journal*; was a prolific author and a leeturer on literary, social, and political topics; in 1856 married the story-writer "Fanny Fern"; resided in New York until Mar., 1875, when he became a resident of Newburyport, Mass. Among his works are *Biographies* of Horace Greeley (1855; new ed. 1868), Aaron Burr (1857; new ed. 2 vols., 1864), Andrew Jaekson (3 vols., 1860), Benjamin Franklin (2 vols., 1864); Thomas Jefferson (1874), and Voltaire (1881); *Humorous Poetry of the English Language* (1857); *People's Book of Biography* (1868); *Smoking and Drinking* (1868); *Famous Americans of Recent Times* (1870); *Topics of the Time* (1871); *Triumphs of Enterprise* (1871); *Words of Washington* (1872); *Caricature in all Times and Lands* (1877); *Captains of Industry* (1884; 2d series 1891). D. at Newburyport, Oct. 17, 1891.

Parton, SARAH PAYSON (*Willis*): story-writer; wife of James Parton and sister of Nathaniel P. Willis: b. at Portland, Me., July 7, 1811; married Charles H. Eldredge, of Boston, a bank eashier, on whose death she resorted to literature as a means of subsistence; obtained great success by her

short humorous essays entitled *Fern Leaves from Fanny's Portfolio* (2 vols., 1853–54); *Little Ferns for Fanny's Little Friends* (1853); wrote regularly for many years for *The New York Ledger*; issued several volumes of collected articles, and was author of two novels, *Ruth Hall* and *Rose Clark*. D. in New York, Oct. 10, 1872. See *Fanny Fern: a Memorial Volume, containing her Select Writings and a Memoir*, by James Parton (1873). Revised by H. A. Beers.

Part-ownership: a species of title to personal property which is employed mainly in the case of Shipping (*q. v.*). It is distinguished from joint tenancy by the absence of survivorship, from tenancy in common by the absence of the right to force a severance of the various owners' interests, and from partnership title by the fact that each person interested owns an undivided share of a chattel instead of a share in the business. Part-owners do not constitute a business entity, and are not, like partners, agents by reason of their business relations. In order to subject his associates to any obligation, or their interests in the common property to any lien, a part owner must obtain from them the authority therefor in fact; he possesses none by operation of law. Francis M. Burdick.

Partridge [M. Eng. *partriche*, from O. Fr. *pertris*, *perdrix*: Ital. *perdice*, *pernice*: Span. Portug. *perdiz* < Lat. *perdix* = Gr. πέρδιξ, connected, either as a derivative or an assimilation (folk-etym.), with πέρδομαι]: a name applied to various medium-sized game birds of the grouse family (*Tetraonidæ*). In England the partridge is *Perdix cinerea*, a bird about a foot long, of a delicate mottled gray. The



The common partridge of Europe.

red-legged partridge (*Caccabis rubra*) of Europe is slightly larger and more handsome. In the northern parts of the U. S. the name is given to the ruffed grouse (*Bonasa umbellus*), while in the southern this bird is known as the pheasant and the term partridge bestowed upon the quail, or bobwhite (*Colinus virginianus*). Finally, sportsmen in Australia have dubbed the true quail (*Turnix*) partridge, and in South America given the name to some of the larger tinamous, birds of a totally different group. F. A. Lucas.

Partridge, Alden, A. M.: soldier; b. in Norwich, Vt., about 1785; graduated at the U. S. Military Academy Oct. 30, 1806, when he was appointed first lieutenant of engineers; captain 1810; was retained at the academy as Assistant Professor of Mathematics until Apr., 1813, when he was appointed Professor, and in Sept., 1813, Professor of Engineering; commanded at West Point Jan., 1815, Nov., 1816, and Jan. to July, 1817; resigned Apr., 1818, and in 1819 was appointed principal of the surveying party to determine the northwest boundary of the U. S. In 1820 he founded a military school at Norwich, Vt., subsequently incorporated in the Norwich University, of which he was appointed president. He also established military schools in New Hampshire, Connecticut, Delaware, Pennsylvania, and Virginia, and delivered lectures on military matters throughout the U. S. He was appointed surveyor-general of Vermont 1822, and was a member of the Vermont Legislature 1833–34 and 1839. D. at Norwich, Vt., Jan 17, 1854.

Partridge, William Ordway: See the Appendix.

Partridgeberry, or **Checkerberry**: the common name of a trailing evergreen herb, *Mitchella repens*, belonging to the Madder Family (*q. v.*); found in the U. S., Canada, Mexico, and some parts of South America. It bears a red fruit, about the size of a whortleberry, which remains on the stem all winter. The wintergreen (*Gaultheria procumbens* of the Heath family) is sometimes, but incorrectly, called partridgeberry or checkerberry.

Revised by Charles E. Bessey.

Partridge-wood: a name applied in commerce and the arts to several handsome tropical woods used for veneering and for making small ornamental wares. It is more generally given to the wood of *Andira inermis*, a leguminous tree of the West Indies and South America. This wood is hard, and in Brazil is used in ship-building.

Party Wall: as commonly understood, a wall which stands on the line between two adjoining lots of land belonging to different owners, and in which both proprietors have common rights and a common use. Provided such common rights exist, it is not, however, essential that the wall stand on the line between the adjoining lots in order to have the character of a party wall. It may have that character though it stands wholly on the land of one proprietor (see Metropolitan Building Act, 18 and 19 Vict., ch. 122), and under some circumstances even where the wall does not abut on the line. (*Rogers* vs. *Sinsheimer*, 50 N. Y. 646.) In the common case, where the wall rests on both lots, the adjoining proprietors are, by the English common law, regarded as tenants in common of the wall, and probably, for the time being at least, of the land on which it stands; and the rights and obligations of the parties are such as pertain to that relation. (See Joint Ownership.) In the U. S., however, each of the adjoining owners retains the fee of the portion of the wall which rests upon his own soil and has an easement of user and support in the portion resting on the soil of his neighbor. From these principles are derived a number of special rules in respect to the use and maintenance of the wall, its repair, additions to its height, its rebuilding when necessary, etc., which differ in some important particulars from those which regulate the relations of the parties under the English doctrine. In England (so far at least as the London metropolitan district is concerned) and in several of the U. S. the mutual rights and obligations of the parties are carefully regulated by statute. The special rules above referred to will be found set forth at length in Washburne on *Easements and Servitudes* and in the *American and English Encyclopædia of Law*, title *Party Walls*. George W. Kirchwey.

Párvatī' [= Sanskr. *Pārvatī*, liter., femin. of *pārvata*, belonging to or coming from a mountain; so called because originally a personification of the mountain stream *Durgā*, flowing from (i. e. born of) the mountain Himavant]: a female divinity of the ancient Hindu pantheon, the consort of Siva. See Hinduism.

Parvin, Theophilus, A. M., M. D., LL. D.: obstetrician; b. in Buenos Ayres, Argentine Republic, Jan. 9, 1829; received his literary education at Lafayette College and at the State University of Indiana, where he graduated in 1847: graduated M. D. from the University of Pennsylvania in 1852; the following year began to practice medicine in Indianapolis; was Professor of Obstetrics in the Medical College of Ohio, in the medical department of the University of Louisville, in the Medical College of Indiana, and in the Jefferson Medical College, Philadelphia, where he now holds that chair. He has been president of the Indiana State Medical Society, of the Association of American Medical Journalists, of the American Academy of Medicine, of the American Medical Association, and of the American Gynæcological Society. His principal work is *The Science and Art of Obstetrics* (Philadelphia, 1886). He also edited *Winckel on Diseases of Women*. S. T. Armstrong.

Pasadena: city; Los Angeles co., Cal. (for location, see map of California, ref. 12–F); on the Los Angeles Terminal and the Southern Pac. railways; 9 miles N. E. of Los Angeles. It is at the foot of the Sierra Madre Mountains, at an elevation of 850 feet above sea-level, and is in the beautiful San Gabriel valley, noted for its orange and lemon groves and the cultivation of smaller fruit. The city is largely a residential place, and its unsurpassed climate and attractive scenery have given it wide repute as a winter resort. There are 9 grammar schools, a high school, the Throop Polytechnic Institute, the only institution of its

kind on the Pacific coast, 2 private preparatory schools, several kindergartens and other private schools, a public library, 2 national banks with combined capital of $200,000, a State bank with capital of $50,000, and 2 daily and 1 weekly newspapers. The Mount Lowe Railway ascends the Sierra Madre Mountains here. Pop. (1880) 391; (1890) 4,882; (1900) 9,117.

EDITOR OF "EVENING STAR."

Pascagou'la River: a stream formed in Greene co., Miss., by the union of Chickasawha and Leaf rivers. It flows S. into Pascagoula Bay, a beautiful arm of the Mississippi Sound. The river sometimes floods its valley at high water. It is navigated by small steamboats. Much timber is cut in its pine forests for the New Orleans market.

Pascal', BLAISE: mathematician and moralist; b. at Clermont-Ferrand, Auvergne, France, June 19, 1623. He was a precocious child, and in 1631 his father removed to Paris the better to care for his education. At the age of twelve he rediscovered by himself elementary geometry, which he had not been allowed to study; at seventeen his treatise on *Conic Sections* made him celebrated; at nineteen he made a calculating-machine to aid his father, who had removed to Rouen to take an office in the treasury department. These mathematical studies he followed up with valuable investigations in physics, on the weight of the atmosphere. When little over twenty he came under the influence of the Jansenist writers of Port-Royal, and gave himself up to fervent piety; but the severity of his study had undermined his health; his physician forbade him all work, and recommended the diversions of society. For a time these diversions, in a group of rather gay epicureans, absorbed him; but the entrance of his sister into Port Royal, his narrow escape from death in an accident at the bridge of Neuilly, and other events, brought him back to his former religious fervor, and he retired to Port-Royal. Though he returned from time to time to mathematical studies, developing the calculus of probabilities, and giving a solution of the problem of the cycloid (*Traité général de la Roulette*, 1659), his main interest was henceforth fixed on questions of morals, philosophy, and religion. He spent his last years, broken in health and wracked with pain, in the practice of a severe asceticism. D. Aug. 19, 1662. His two great works are the *Lettres provinciales* and the *Pensées*. The former was written in defense of his friend, Antoine Arnauld, who, involved in the Jansenist controversy, was the central object of the Jesuits' attack on Port-Royal. The first four letters are limited to a defense of Arnauld on the points at issue; but the remaining fourteen are a vigorous and eloquent attack upon the moral and religious principles and practices of the Jesuits. The *Lettres provinciales* were intended to carry the cause before the bar of public opinion, and the qualities of style, grace and clear precision, incisive wit, delicate and biting irony, intense earnestness, rising to indignant eloquence, caught the popular attention. In them French prose revealed a new power, and they are of the first importance in the development of French prose style. In their first separate and fugitive appearance (1656–57), and in the collected edition prepared by Nicole, they had an immense circulation, and they have been reprinted in a vast number and variety of editions. The other great work of Pascal, the *Pensées*, consists of the fragmentary materials of a projected *Apologie de la religion catholique*, which his health did not allow him to finish: they are "thoughts," single reflections or aphorisms, often of remarkable depth, of a soul that felt keenly the intellectual difficulties, and at the same time the imperious need of a firm religious faith. The minor works of Pascal comprise a *Discours sur les passions de l'amour*, *L'Esprit géométrique*, *L'Art de persuader*, three *Discours sur la condition des grands*, *Prière pour demander le bon usage des maladies*, and a few letters. An excellent edition, with a *Life* and notes, is that of E. Havet (2 vols., Paris, 1882). Cf. Sainte-Beuve, *Port-Royal*, liv. iii. The best English translation of Pascal's *Thoughts* is by C. Kegan Paul (1885); latest translation of *Provincial Letters* 1889.

A. G. CANFIELD.

Pascal, JACQUELINE: See the Appendix.

Pas'chal I.: pope; b. at Rome; became abbot of St. Stephanus; succeeded Stephen IV. in 817; crowned Lothaire as emperor 823. D. Feb. 10, 824.—PASCHAL II. (*Raniero*), b. at Bleda, Italy, about 1050; was a Cluniac monk; became a cardinal-priest, and in 1099 succeeded Urban II.; was involved in life-long contests with the Henrys (IV. and V.) of Germany concerning investitures. Henry V. kept the pope in prison for some time. Similar troubles with Henry I. of England were settled by compromise, by which Henry kept the substance of his former rights, but made unimportant concessions to the pope, and like concessions were made by the King of France. D. Jan. 21, 1118.

Paschal I.: antipope; a Roman archdeacon; elected pope by a faction of the Roman people and supported by the exarch of Ravenna in 687 A. D. Theodorus II., antipope, was chosen by another faction, but Sergius I. was declared the true successor of Conon, the deceased pope. Paschal was imprisoned as a simonial and pronounced a magician. D. in 694.—PASCHAL III., antipope (*Guido di Crema*); b. in Lombardy; became in 1155 a cardinal-deacon, and in 1164 was declared pope by Frederick Barbarossa, whose partisan he was. D. at Rome, Sept. 20, 1168.

Pasco: See CERRO DE PASCO.

Pas-de-Calais, paa'de-kaa'lā': department of France, formed out of the provinces of Artois and Picardy; bordering N. and W. on the Strait of Dover and the English Channel; area, 2,551 sq. miles. A range of low hills, rich in coal, iron ore, marble, and slate, traverses the department, ending in Cape Gris-Nez, and forming for a distance of several miles along the coast a row of cliffs similar to those on the opposite English coast. On both sides of this range of hills the ground is low, with a very fertile soil, except along the coast, which generally is marshy or sandy. Its agriculture and manufactures are in a very advanced state. Wheat, hemp, and fruits are largely cultivated; iron-foundries, glass-works, tanneries, mills, and beetroot-sugar factories are in operation, and important fisheries along the coast are carried on, especially in the neighborhood of Boulogne. Pop. (1896) 906,249.

Revised by R. A. ROBERTS.

Pa'sha, Pa'cha, or **Ba'shaw** [from Turk. *bash*, head, or from Persian *pa*, foot + *shāh*, king, the foot of the king): an honorary Turkish title; originally given to princes of the blood, and afterward to persons honored with high official functions. The title is now, as a mark of favor, sometimes conferred on persons holding no office. Pashas are of three classes, the symbol of their rank being formerly one, two, or three horsetails, which were carried before them on state occasions. A district or province governed by a pasha is called a pashalik. The male members of the reigning house, with the exception of the sultan, are called effendi. E. A. G.

Pasht: See BUBASTIS.

Pasini, paa-see'neĕ, ALBERTO: genre-painter; b. at Busseto, near Parma, Italy, in 1820; pupil of Eugenio Ciceri, E. Isabey, and Théodore Rousseau; was awarded third-class medal, Paris Salon, 1859; second-class 1863; medal of honor, Paris Exposition, 1878; officer Legion of Honor 1878. His subjects are chiefly scenes in Turkey and other Oriental countries, and his pictures are notable for skillful painting and rich effects of color. His *Entrance to a Mosque* is in the Wolfe collection, Metropolitan Museum, New York. His studio is in Paris, but he spends much of his time in the East.

WILLIAM A. COFFIN.

Pasiph'aë (in Gr. Πασιφάη): in Grecian mythology, a daughter of Helius, wife of Minos, King of Crete. Minos, when seeking to become king, thought to strengthen his claim on the throne by the assertion that the gods would grant whatever request he might make. In proof thereof he prayed to Poseidon to send him a bull from the depths of the sea for the alleged purpose of sacrificing him to Poseidon. Poseidon sent the bull, and the astonished Cretans made Minos king, but Minos kept the miraculous bull, and in his stead offered in sacrifice to Poseidon a less magnificent animal from his own herd. Enraged at the perfidy of Minos, Poseidon made the bull insane and caused Queen Pasiphaë to fall desperately in love with him. With the help of Dædalus Pasiphaë succeeded in holding intercourse with the bull, and the result of this union was the MINOTAUR (*q. v.*).

J. R. S. STERRETT.

Pas'kevitch, IVAN FEDOROVITCH: field-marshal; Count of Erivan, Prince of Warsaw; b. at Poltava, Russia, May 19, 1782; was educated as a page at the court of Paul I. at St. Petersburg; entered the army in 1800; distinguished himself in the campaigns against Napoleon, and was made a general in 1814; conducted in 1826 the expedition against Persia, and took Erivan; commanded in 1829 a Russian army in Asia against the Turks, and captured Erzeroum; suppressed in 1831 the revolution in Poland, compelled Warsaw to capitulate, and was appointed viceroy. As such he governed with severity, but with justice; the principles

he held were detested by the Poles, but not the man. In 1849 he led the Russian armies into Hungary and quelled the revolution, and in 1854 he commanded the Russian army on the Danube against the Turks. This time, however, he met with nothing but defeat and repulses. He resigned and retired to Warsaw. D. at Warsaw, Feb. 1, 1856.

Paso del Norte: See El Paso, Texas.

Paso del Norte, now called *Ciudad Juarez*: See Juarez.

Paspatis, Alexander George, M. D., LL. D.: philologist and historian; b. in the island of Scio in the Ægean Sea, 1814. Seized during the massacre of 1822, he was sold as a slave at Smyrna. Set free by his purchaser, he was taken by a philanthropist to the U. S., and graduated at Amherst College in 1831. He studied medicine at the universities of Paris and Pisa (1834–39); practiced his profession at Constantinople (1840–78); then removing to Athens was professor in the university and president of the leading Athenian literary and philanthropic societies. D. Dec. 24, 1891. Well versed in sixteen languages, he published principally in English, French, and Greek. His chief publications are Ὑπόμνημα περὶ τοῦ Γραικικοῦ Νοσοκομείου τῶν Ἑπτὰ Πύργων (1862); *Études sur les Tchinghianés ou Bohémiens de l'Empire Ottoman* (1870); Βυζαντιναὶ Μελέται (1877); *The English Version of the Revised New Testament* (1882); Τὰ Βυζαντινὰ Ἀνάκτωρα καὶ τὰ πέριξ Αὐτῶν Ἱδρύματα (1885); Χιακὸν Γλωσσάριον (1888); Πολιορκία καὶ Ἅλωσις τῆς Κωνσταντινουπόλεως ὑπὸ τῶν Τούρκων (1890). He left unfinished, though almost complete, Τὸ Γλωσσάριον τῶν Ἑλληνικῶν Διαλέκτων and Ἡ Κατάκτησις τῆς Πελοποννήσου. E. A. Grosvenor.

Pasque Flower [i. e. Easter flower. See Passover]: a name given to a ranunculaceous herb of Europe and Asia (*Anemone pulsatilla*), and also to some other species of *Pulsatilla*. They are spring-blooming plants, with poisonous and medicinal qualities. See the article Anemone.

Pasquinade: an anonymous attack, of a witty or sarcastic character. The name is derived from a certain mutilated marble statue, or group, in Rome, placed at the corner of the Palazzo Braschi (the present ministry of the interior), upon which ever since the fifteenth century it has been the custom to paste such attacks. This torso, which really represents Menelaus with the body of Patroclus, looking for succor in the midst of the battle, is popularly called *Pasquino*, as it is said, from a certain cobbler (or tailor, according to Castelvetro) of the end of the fifteenth century, Antonio Pasquino by name, at whose shop, close by the present situation of the fragment, idlers used to gather and make jests on passers-by and on the events of the time. It was the custom to frame the so-called *pasquinate*, or *pasquinades*, in the form of questions or answers directed to another famous statue, called Marforio, situated in the Via di Marforio, opposite the Mamertine prison. This latter statue, a colossal river-god, probably the Rhine or Danube, is now placed in the middle of the court (*cortile*) on the ground floor of the Capitoline Museum. A. R. Marsh.

Passaglia, päas-säal'yäa, Carlo: theologian; b. near Lucca, Italy, Mar. 2, 1812; was educated in Rome, entered the Society of Jesus, and was appointed Professor of Theology in the Sapienza in Rome. He was considered one of the most learned theologians of Italy, and was very popular on account of the enthusiasm with which he embraced the liberal policy of Pius IX.; but in 1861 he had to flee in disguise from Rome, having published his *Pro causa Italica ad episcopos Italianos*, in which he declared that the temporal power of the pope was unnecessary, and exhorted Pius IX. to sacrifice his secular power for the unity of Italy. He was immediately appointed Professór of Moral Philosophy at the University of Turin, and continued his polemics against the pope in a series of brilliantly written pamphlets. In 1863 he was elected a member of the Italian parliament, and openly reproached the Government for cowardice on account of the continued occupation of Rome by the French. Among his works are a treatise on eternal punishment and a criticism of Renan's *Vie de Jésus*. D. in Turin, Mar. 14, 1887.

Passaic: city (formerly known as Acquackanonk); Passaic co., N. J.; on the Passaic river, and the Erie, the Del., Lack. and W., and Susquehanna railways; 5 miles S. E. of Paterson, the county-seat, 12 miles N. W. of New York city (for location, see map of New Jersey, ref. 2–E) It has gas and electric light plants, 3 electric street-railways, system of water-works supplied from above the Passaic falls, 4 miles distant, 24 churches, 6 public-school buildings, public-school property valued at over $120,000, free public library, a national bank with capital of $100,000, 3 incorporated banks, and 2 daily and 5 weekly newspapers. The industrial establishments include dye and print works, rubber-works, 2 woolen-factories, worsted-mill, satinet-mill, 2 bleacheries, 2 planing-mills, 2 brick-yards, extensive vineyards, large winery, and chemical-works. The city has a picturesque and healthful location, and contains the residences of many New York business men. Pop. (1880) 6,532; (1890) 13,028; (1900) 27,777. Editor of "News."

Passaic River: a stream which rises in Morris co., N. J., and after a tortuous course of 100 miles flows into Newark Bay, 3 miles from Newark. It is navigable for 13 miles. At Paterson it has a remarkable fall of 72 feet, affording a very valuable water-power.

Passamaquod'dy Bay: an inlet of the Atlantic Ocean, forming part of the boundary between Maine and New Brunswick. It abounds in good and deep harbors and in fine views. Picturesque islands are numerous and the fisheries are important. Its tides average 25 feet in rise. It receives the noble estuary of the St. Croix.

Passau, paa'sow: town of Bavaria; at the confluence of the Ilz, Inn, and Danube; 72 miles by rail S. E. of Ratisbon (see map of German Empire, ref. 6–G). It consists of three different parts, built on the wooded hills between the rivers and defended by two fortresses and eight detached forts. It has several fine buildings, breweries, distilleries, manufactures of tobacco, leather, porcelain, metal-ware and mirrors, and a considerable trade in iron, timber, wheat, and Passau crucibles. The town grew up round an ancient Roman camp, and in 739 was made the seat of a bishopric founded by St. Bonifacc. By the treaty signed here in 1552 by Charles V. and the allied Protestant princes religious liberty was conferred on the Protestants of Germany. The cathedral and a great part of the town were destroyed by fire in 1662. It was annexed to Bavaria in 1805. Pop. (1890) 16,633. Revised by R. A. Roberts.

Passavant', Johann David: art critic; b. at Frankfort-on-the-Main, Germany, Sept. 18, 1787; studied the art of painting in Paris and Rome, but devoted himself subsequently to the theoretical and critical treatment of the art, and became inspector of the Städel Museum in his native city, where he died Aug. 12, 1861. He wrote *Rafael von Urbino und sein Vater Giovanni Santo* (3 vols., 1839–58); *Die christliche Kunst in Spanien* (1853); *Le Peintre-Graveur* (6 vols., 1860–64).

Passavant, William Alfred, D. D.: philanthropist; b. of Huguenot ancestry at Zelienople, Butler co., Pa., Oct. 9, 1821; graduated at Jefferson College, Canonsburg, 1840, and at Lutheran Theological Seminary, Gettysburg, 1842; was pastor at Baltimore, Md., 1842–44, and at Pittsburg, Pa., 1844–55. After 1855 his life was devoted to the service of various benevolent institutions, founded by his instrumentality. He founded successively hospitals in Pittsburg (1849), Milwaukee (1864), Chicago, and Jacksonville, Ill., and orphanages at Zelienople and Rochester, Pa., and Mt. Vernon, N. Y., besides being closely identified with the beginning of the orphanages at Germantown, Pa., and Boston, Mass. With a layman, A. Louis Thiel, he founded in 1870 Thiel College, Greenville, Pa. In 1891 he established the Lutheran Theological Seminary in Chicago. For these institutions it is estimated that he secured during his lifetime over $1,000,000. He was the first to introduce the order of deaconesses into the U. S. He was editor of *The Missionary*, Pittsburg, from 1845 until, in 1861, it was united with *The Lutheran*, Philadelphia, of which he was for many years coeditor. In 1880 he founded at Pittsburg *The Workman*, which was still in his care at his death June 3, 1894. He was the founder of the Pittsburg Synod, and the great organizer of the missionary work in the Americanized portion of the Lutheran Church. He was one of the founders of the Emigrant House and Mission in New York, and of the General Council of the Lutheran Church in America. He had superior gifts as a preacher, but they were subordinated to his special calling as an organizer of Church work. H. E. Jacobs.

Passavant, William Alfred, Jr.: clergyman; b. at Pittsburg, Pa., Jan. 23, 1857; educated at Western University, Pittsburg, Muhlenberg College and Theological Seminary, Philadelphia; entered the ministry 1879; was pastor at Baden, Pa., and Pittsburg (East End). Editor of *The Work-*

man, with his father, 1881–86. In 1887 he became sole editor of *The Workman*, and in 1889 superintendent of English Home Missions of the General Council. Upon his father's death, in 1894, he succeeded him as director of benevolent institutions and editor. H. E. Jacobs.

Pass Christian: town; Harrison co., Miss. (for location, see map of Mississippi, ref. 9–H); on Mississippi Sound, and the Louisv. and Nashv. Railroad; 58 miles E. N. E. of New Orleans, 82 miles W. S. W. of Mobile. It is the largest health resort on the Gulf coast, and has a water frontage of 6 miles, along which is a broad shell-paved avenue lying under the shade of magnificent live-oaks and lofty magnolias. Projecting into the sound are numerous fishing and promenade piers, dotted with picturesque pagodas. The average winter temperature is 60° F., and the prevailing winter breezes are from the southward across the Gulf of Mexico. The town has four large hotels and many boarding-houses and tasteful cottages, and is in an agricultural and stock-raising region. Resident pop. (1890) 1,705; (1900) 2,028.

Passenger-pigeon: a wild pigeon (*Ectopistes migratorius*) of Central and Eastern North America, deriving its name from its long migrations in search of food. The body is about 8 inches in length, and the tail is the same length. The bird is slaty blue above, shaded with olive gray on the back and wings, pale-purplish chestnut below, changing into white on the belly, iridescent on the sides of the neck. It builds a flimsy nest in trees and bushes, and lays one white egg, sometimes two. The passenger-pigeon feeds on various seeds, but is specially fond of acorns, beech-nuts, and rice. It is gregarious and formerly occurred in vast flocks, sometimes numbering millions. Owing to continued persecution on its breeding-grounds, where thousands were taken in nets, these enormous flocks are no longer found, and in the greater part of its natural habitat the bird has been practically exterminated. F. A. Lucas.

Passerat, pȧs'raa', Jean: Latinist and poet; b. at Troyes, France, in 1534. He led a rather unsettled life till 1569, when he went to Paris and found a protector in Henri de Mesme. He succeeded Ramus at the Collège de France, where he attracted many pupils. He wrote commentaries on Catullus, Tibullus, and Propertius, composed epigrams in Latin and French, and poems distinguished by alert grace, gay wit, and *esprit gaulois*, and was one of the chief authors of the *Satire Ménippée*, a satire on the Ligue. D. Sept. 12, 1602. His works were edited by P. Blanchemain (Paris, 1881). A. G. Canfield.

Pas'seres [Mod. Lat. (plur.), from Lat. *passer*, a typical perching bird]: name applied to a group of birds containing the typical song-birds, or perching birds, variously considered as an order, sub-order, or even as of lower value. Besides other technical characters, they have an ægithognathus palate, the deep plantar tendons free, manubrium Y-shaped, and tarsus with four to six tendinal perforations. There are, except in one genus, four toes, on the same level, and the fourth is never turned backward. The group includes something like 5,000 species, and is the equivalent of Huxley's *Coracomorphæ*; it comprises the Clamatores and Oscines (*q. v.*), and corresponds pretty nearly to the Insessores of other authors. F. A. Lucas.

Passion-flower: a name in its widest sense applicable to nearly all the species of *Passiflora*, the principal genus and type of the family *Passifloraceæ*, mostly climbing plants of tropical America, and a few other ornamental species in common cultivation. The name is derived from the fancied resemblance of the various parts of the flower to the means of our Lord's passion and death; the nails, the crown of thorns, the five wounds, and even the hammer and the cross itself, having been identified in the blossom. There are nearly 150 species of true passion-flower. Some of these bear edible fruits (called *granadilla*); many have active medicinal powers, and many others are cultivated in greenhouses for their beautiful flowers. Of these the best-known is the *Passiflora cærulea*, a native of Brazil. The U. S. has about ten native species, of which *P. incarnata* is showy, and the best known. Its fruit, called May-pop, is eaten in the Southern States. Revised by L. H. Bailey.

Passion-flower Family: the *Passifloraceæ*, a small group (250 species) of dicotyledonous trees, shrubs, and herbs, natives for the most part of tropical and sub-tropical regions, especially of the New World. The flowers, which are usually showy, have a superior compound ovary, three-lobed style, five stamens, five petals, and five sepals, the perianth segments often being united (gamosepalous or gamopetalous). Many species of the principal genus, *Passiflora*, are climbers, and are grown for ornamental purposes. Their beautiful flowers have a remarkable structure; the shallow calyx-tube bears the petals and a "crown" consisting of several concentric series of colored filaments, surrounding a columnar extension of the receptacle on which are borne first the stamens, and still higher the ovary with its three spreading styles. Charles E. Bessey.

Passionists, Congregation of the: a religious congregation in the Roman Catholic Church, founded at Ovado, Piedmont, in 1720 by Paul of the Cross (1694–1775). It was confirmed by Benedict XIV. in 1741 and 1746, and by Pius VI. in 1775. A congregation of women was added before the founder's death. The Passionists are numerous in the U. S. and Europe. They practice many austerities, and devote themselves to local missions and the work of preaching. The mother-house is on the Celian Hill in Rome. See *History of Religious Orders*, by Rev. C. W. Currier (1894), p. 463. Revised by J. J. Keane.

Passion-plays: See Miracle-plays and Ober Ammergau.

Passion-tide: a name given to the last two weeks of Lent, the first week of which is Passion Week and the last Holy Week (*q. v.*); but popularly, Holy Week is called Passion Week also.

Passive State (or **Passivity**) **of Metals**: terms applied by chemists to certain phenomena having a very wide range, and as yet very inadequately investigated, which do not all seem likely to be referred ultimately to the same cause. It is found that a number of the metals which are acted on and dissolved with energy by certain acids and other chemical solvents may under special circumstances become what is called "passive," the action of the acid or other agent being totally suspended, and the metal remaining immersed therein often with a clean, brilliant metallic surface, and having lost entirely the power to decompose the liquid. Strong nitric acid is the solvent that has been best investigated in this relation, though many other agents behave similarly. Keir first observed the phenomenon in the case of iron immersed in strong nitric acid and solution of nitrate of silver, and Schönbein, Faraday, and Herschel have been among its most distinguished investigators. Iron is made passive toward nitric acid of density = 1·2 to 1·35 by a number of different methods. A wire heated at one end till enfilmed with black ferroso-ferric oxide becomes passive, not only where heated, but for a certain distance beyond, showing that it is not the film which merely protects mechanically. If first dipped in fuming nitric acid or in a mixture of weaker acid with oil of vitriol, it becomes passive toward the weaker acid itself. Contact of an iron wire which is being powerfully acted on with another wire in the passive state, or with a platinum or gold wire, will often instantly transform the first wire to the passive condition. An iron wire which is made the positive pole of a voltaic circuit, the negative pole being platinum, becomes passive, and remains so when the current ceases. All the phenomena of passivity are usually referred to voltaic action, but it is as yet doubtful whether they are all of this nature; and it must be stated that little or no progress has yet been made toward a clear understanding of their causes. Revised by Ira Remsen.

Passover [transl. of Heb. *pesach*, passover, Easter (liter., a passing over, deriv. of *pāsach*, pass over), whence Gr. πάσχα, whence Lat. *pas'cha*, whence O. Eng. *pascha* > Eng. *pasch*; cf. *paschal*]: the first and the greatest of the three annual festivals of the Jews; instituted by Moses in commemoration of the deliverance of the Israelites from Egyptian bondage, and celebrated from the 15th to the 21st day of Nisan, both inclusive, thus falling between our March and April, at the time of the first full moon in the spring. The first and the last day of the festival were kept holy and observed by abstaining from all work, by prayers, hymns, thanksgivings, and other ceremonies, and during the whole period the bread was eaten without leaven, whence the name of the Feast of Unleavened Bread. On the evening of the 14th the Passover lamb was killed by the head of the family. The animal should be one year old, male, without blemish, and it should be roasted entire, with unbroken bones, and consumed entirely in one meal. The blood was sprinkled on the doorsill in commemoration of the night preceding the exodus from Egypt, when the angel went through the country and slew all the first-born, but passed

over the houses of the Israelites. The fat pieces were burned on the altar as a sacrifice, and the family, clad in traveling garb, gathered to partake of the roasted lamb, with prayers and hymns. On account of some uncertainty with respect to the fixing of the new moon by the Sanhedrin at Jerusalem, the Jews who lived in foreign countries in "exile" were ordered to celebrate all their festivals on two successive days—a law which is still in force among the orthodox. At present, however, the Passover feast has generally simply the character of a hallowed family feast among the Jews; but as the death and resurrection of Christ coincided with the celebration of the Passover, many of the symbols, commemorations, and ceremonies of this Jewish festival passed into the Christian Easter feast, receiving a broader and more ideal signification. For an interesting account of the Samaritan Passover, still observed on Mt. Gerizim, see John Mills's *Three Months' Residence at Nablus* (1864). For modern Jewish practice, see Edersheim, *Home and Synagogue of the Modern Jew*, and Bodenschatz, *Kirchliche Verfassung der Juden*. Revised by S. M. Jackson.

Pas'sow, Franz Ludwig Karl Friedrich: philologist; b. at Ludwigslust, Germany, Sept. 20, 1786; was educated at Gotha and Leipzig; became in 1807 Greek professor at Weimar; was 1810–14 director of the Conradinum at Jenkau near Dantzic; became in 1815 Professor of Ancient Literature in the University of Breslau; in 1829 became also director of the academic museum of art. D. at Breslau, Mar. 11, 1833. He published texts and translations of *Persius* (1809); *Musæus* (1810); *Longus* (1811); author of *Turnziel* (Breslau, 1818); an admirable Greek-German lexicon (Leipzig, 1819–24; 4th ed. 1831); *Grundzüge der griechischen und römischen Literatur und Kuntsgeschichte* (Berlin, 1816; 2d ed. 1829); and *Opuscula Academica* (edited by Bach, Leipzig, 1835). See Wachler, *Passows Leben und Briefe* (Breslau, 1839).

Pas'ta, Giuditta Nigri: opera-singer; b. at Saronno, near Milan, Italy, Apr. 9, 1798, of Jewish parentage; received her musical education in the Conservatory of Milan; made her *début* as a singer in 1815 on the minor stages of Leghorn and Parma; sang in 1816 in Paris and London without producing any great impression; returned to Italy and appeared with better success in Venice and Milan in 1819. Her great career began at Verona during the congress of 1822. In the following years she sang with great success in Paris and London, and subsequently in Naples, where Pacini wrote his *Niobe* for her, and in Milan, where Bellini composed his *Norma* and *La Sonnambula* for her. Her last engagement was at St. Petersburg in 1840. D. at her villa on Lake Como, Apr. 1, 1865. Revised by B. B. Vallentine.

Pas'tel [= Fr. from Ital. *pastello*, liter., a small loaf, pastry, dimin. of *pasto*, food < Lat. *pas'tus*, deriv. of *pas'cere*, *pastum*, feed]: a colored crayon made of pipeclay or other opaque material mixed with gum-water and some pigment. Pastel pictures are executed on roughened paper and parchment, and the color is generally worked on with the finger. This kind of picture has to be protected by glass, as every touch mars the surface.

Pasteur', Louis, D. Sc.: chemist and biologist; b. at Dôle, department of Jura, France, Dec. 27, 1822; studied physical sciences, especially chemistry, graduating D. Sc. from the École Normale in 1847, and was appointed professor in 1848 at Dijon, in 1849 at Strassburg, in 1854 at Lille, in 1857 at Paris, where he was director of the École Normale; in 1863 Professor of Geology, Physics, and Chemistry at the École des Beaux-Arts, and in 1867 Professor of Chemistry at the Sorbonne. Besides a number of essays in *Annales de Chimie*, he wrote *Nouvel Exemple de Fermentation* (1863); *Études sur le Vin* (1866); *Études sur le Vinaigre* (1868); *Études sur la Maladie des Vers de Soie* (1870); *Les Microbes* (1878). Several of his chemical works received prizes, and in 1874 the French Government gave him a pension, increasing it the following year, in consideration of his services to science and industry. In 1884 he laid before the Institute a method of curing or preventing Hydrophobia (*q. v.*) by inoculating with the poisonous virus in an attenuated form, and the commission of investigation declared the method efficacious. (See *Louis Pusteur; his Life and Labors*, 1885.) The Pasteur Institute, at Paris, was formally opened Nov. 14, 1888, in the presence of President Carnot and other distinguished persons. Pasteur was a member of many foreign and domestic scientific societies, and had been decorated by most of the European governments. D. Sept. 28, 1895. Revised by S. T. Armstrong.

Pasteurized Milk: See Milk.

Pas'to: a town in the southern part of the department of Cauca, Colombia; on a high plateau at the foot of the volcano of Pasto; about 50 miles from the boundary of Ecuador; 8,650 feet above sea-level (see map of South America, ref. 3–B). Pop. about 10,000. It is one of the oldest towns of the republic (founded 1539), is beautifully situated, has a healthful and cool climate, and is the center of a wheat-growing and grazing district; there is an active trade with Ecuador. Pasto is a bishop's see. It was an important Spanish stronghold during the war for independence. In 1834 it was destroyed by an earthquake. The volcano of Pasto, or La Galera, is the culminating point (13,990 feet) of the "knot" whence the three cordilleras of the Colombian Andes diverge. It is frequently in eruption. H. H. S.

Pastor [Mod. Lat., from Lat. *pas'tor*, herdsman, shepherd, deriv. of *pas'cere*, *pas'tum*, feed, pasture]: a genus of starlings, having representatives in Europe and the Old World tropical regions. They are extremely useful as destroyers of insects, but sometimes are destructive to small fruits. *P. roseus*, the rose-colored pastor of Europe, is a handsome bird, a good singer, and a favorite cage-bird.

The rose-colored pastor.

Pastoral Poetry: poetry which affects the matter or manner of rustic life, not for the purposes of accurate, even though sympathetic, description, but as a purely artistic device for conveying the interests and emotions of the poet himself, and of the society, not rural, in which he lives. The pastoral forms are many—idyls, eclogues, plays, or romances, in which the leading *rôles* are given to shepherds, shepherdesses, or other country folk, all bearing this generic name. Contradictory though it appear at first sight, the pastoral has historically been one of the most elaborate and artificial of all literary varieties, and has generally been produced only in societies that had reached an advanced stage of refinement. This by no means implies, however, as has sometimes been said, that it is the natural expression of luxurious and corrupt manners and morals, or that it always indicates in both poet and audience the lassitude and the disenchantment with real life which mark culture over-ripe and turning to decay.

The beginning of the pastoral, as we know it, is to be found in the *Idyls* of Theocritus (*q. v.*), who seems indeed to have been himself the literary inventor of it. Not that he had not, probably, much upon which to base the new form. There is a tradition from his own time that bucolic songs in dialogue had a religious origin, and were connected either with the cult of Artemis (cf. the ancient note *περὶ τῆς εὑρέσεως τῶν βουκολικῶν* given in the editions of the poet) or with the sorrows of Daphnis (cf. Ælian, *Var. Hist.*, x., 18). That there is some truth in this is made more probable by the fact that the famous Indian pastoral-drama the *Gîta-govinda* of Jayadeva deals with a religious theme—the love of Krishna, in guise of a shepherd, for the fair shepherdess Râdhâ. None the less, Theocritus has the honor of having first seen the literary possibilities of the *genre*, and, above all, of having used pastoral dialogue as a veil for his own sentiments and those of other real persons in the refined society in which he lived. This was the one original invention of the Alexandrian period of Greek literature, and it deservedly proved an immense success.

The Greek followers of Theocritus are not many nor very

important. The best known are Bion and Moschus, poets of the same school; and Longus (*q. v.*), whose date is uncertain, but whose *Daphnis and Chloë*, a prose romance, represents a stage of development of the pastoral removed by centuries from its origin. Far more important for literary history is the fact that the pastoral was taken up by Roman writers, and thus acclimated in Western Europe. Vergil seems to have been the first to write Latin idyls (*eclogæ*, as he called them), and he remains the chief pastoral poet of Rome. The pastoral idea, however, already began to transcend the narrow limits of the idyl proper, and to appear in various guises. Horace, Catullus, and Tibullus all show the influence of it; and toward the end of the empire, as in Ausonius and Claudian, it is a permanent motive in poetry. Even in the Latin poetry of the Middle Ages it is to be found, as in the work of Alcuin and other writers of Charlemagne's court.

In the twelfth and thirteenth centuries, a new and apparently independent stream added itself to the current of the classic pastoral tradition. This was the period when the courtly and chivalric poetry, both lyric and narrative, of the Middle Ages fully effloresced; and among the numerous poetic forms then invented and widely used appears the pastoral lyric, called in French *pastourelle*, in Provençal *pastoreta* or *pastorela*. Similar forms are to be found in almost all the Romance literatures of the time, and it is very difficult to say whether they reproduce with some exactness veritable popular songs, or are really, as they seem to be, completely artificial in character. At any rate, there can be no doubt of their wide popularity.

It was in Italy that the fusion was to come between these pastorals and the older classical ones, and it was in Italy, also, that the great extension of the pastoral to romances and dramas, as well as idyls, was to take place. The first notable examples of imitation of the classic idyl by Italians are the *eclogæ* that have come down to us, purporting to have passed between Dante and a certain Giovanni del Virgilio, teacher of grammar at Bologna. Whether the attribution be just or not, there is no doubt that these date from the first quarter of the fourteenth century. As was to be expected, the humanistic revival of classical studies that begins with Petrarch greatly helped the spread of the eclogue. The twelve poems of Petrarch's own *Carmen bucolicum* are the beginning of a long series of imitations, many of them remarkably beautiful, of the pastoral manner of Vergil. In Boccaccio, the friend and coadjutor of Petrarch in humanism, but in whom the mediæval poet and story-teller was much stronger, we have the beginning of the amplification of the pastoral, of which mention has been made. Naturally, he tried his hand, though with poor success, at the Latin eclogue (in his *Bucolicon*); but in his Italian pastorals, both in prose and in verse, we have an important addition to the imaginative forms of European literature. These pastorals are all of them directly or indirectly connected with Boccaccio's life at Naples and his love for Maria, natural daughter of King Robert ("Fiammetta"). The circumstances of this passion made it all the more natural for the poet to veil his account of it in pastoral allegory, as he does in his prose *Fiammetta* and *Ninfale d'Ameto* (the latter interspersed with songs), and his *Ninfale fiesolano* in *ottava rima*.

The example of Boccaccio proved fruitful. As the Renaissance advanced, as the knowledge of first the Latin then the Greek classics extended itself, Italian poets and romancers inclined more and more to strive for an ideal beauty remote from the uglinesses of real life, such as could be found only in the idyllic world of Theocritus, Vergil, and Longus. There is no stranger or more interesting phenomenon in the history of human culture than this growth in the fifteenth and sixteenth centuries of the dream of a primitive and unspoiled time, an Arcadia—a golden, Saturnian age, as Vergil had called it. Imaginations turned eagerly to those classics that were thought to have depicted such a world; and it is deeply significant that of all the Greek poets, Theocritus should have been the first to be printed (1481). It will be impossible here to mention even a tithe of the works, whether in Latin or Italian, that belong to this tendency. We can dwell in passing only on those that mark the perfection of the chief pastoral forms. Of these, two in particular, the romance and the drama, had a remarkable vogue both in and out of Italy.

The pure pastoral romance may be said to have reached its final stage in the *Arcadia* of the Neapolitan Sannazaro (1453–1530). Written in alternate prose and verse, this work contains within itself all the elements that had been tending to unite themselves in one artistic whole. Everywhere in it appear reminiscences of the classics, everywhere idyllic dreams. The influence of Boccaccio is strong, love of nature and of the rustic life of the fair country about Naples gives romantic charm, and finally the poet has known how to make the whole alive with a certain veiled, but none the less certainly personal, feeling. It is no wonder that the *Arcadia* swiftly made its way throughout Europe, and initiated a new style in all the chief literatures.

The rise of the pastoral drama was somewhat later than that of the romance. Apparently its origin is to be sought in the amœbæic recitation of Latin and Italian eclogues of which we hear in the fifteenth century. The Italian drama, as a whole, however, did not till this time free itself from its religious associations; and it is interesting to find that the first wholly secular play, Politian's *Orfeo* (recited at Mantua in July, 1471), is to all intents and purposes a pastoral. Through the sixteenth century we can follow the series of dramatic eclogues and pastoral dramas until at the end we have those ultimate specimens of the *genre*—Tasso's *Aminta* (written in 1573) and Guarini's *Pastor Fido* (1st ed. 1590).

During the sixteenth century all Europe was feeling the influence of the Italian Renaissance, and it is not surprising to find that the pastoral in all its forms was speedily imitated in every cultivated literature. We see this first perhaps in the Spanish Peninsula, where very early in the century we find Juan de la Encina and his school writing pastoral plays, *eglogas* as they call them. A little later the Portuguese Christóvam Falcão and Bernardim Ribeiro give great popularity both to the eclogue proper and to the pastoral romance; and soon their countryman Montemayor, though he wrote in Spanish, produced in his *Diana Enamorada* a pastoral tale that speedily became known all over the Continent. From this on the literature of the Spanish *Siglo de Oro* is filled with the Arcadian ideal and its pastoral expression.

In France much the same thing happened, though not so early or so completely as in Spain and Portugal. Perhaps the more purely French allegorism of the Middle Ages—that of the *Roman de la Rose*, for example—which had by no means died out even in Marot's time, prevented somewhat the acceptance of the pastoral allegory. Still the Pléiade began to devote itself somewhat to the cultivation of the latter, and in the *Bergeries* of Remi Belleau (1565–72) we have direct imitation of Sannazaro's *Arcadia*. Amyot's translation of the *Daphnis and Chloë* of Longus (1559) also did much to diffuse a taste for the pastoral romance. The results of these influences appear later in the great series of romances, half pastoral, half chivalrous, initiated by the *Astrée* of Honoré d'Urfé (1567–1625). They appear also still later in the well-known masquerading of the regency and the reign of Louis XV., and in the paintings of Watteau.

England, even more completely than France, made welcome the pastoral motive. During the sixteenth century, as is well known, both Italian and Spanish books were eagerly read in England; and Sir Philip Sidney, in his *Arcadia*, shows familiarity not only with Sannazaro, but also with Montemayor and Ribeiro, to say nothing of the French. So deeply was the fancy of the English touched by the Arcadian ideal that it became a permanent element in the work of almost all the great Elizabethans. We can mention only by way of illustration Spenser's *Shepherd's Calendar*, Shakspeare's *As You Like It*, Fletcher's *Faithful Shepherdess*, and the *Masques* of Ben Jonson and his group. Milton still felt deeply the charm of the pastoral form, as his *Comus* and *Lycidas* show. It had not wholly evaporated in the early eighteenth century, as is proved by Shenstone's *Pastoral Ballads*; and even Allan Ramsay's *Gentle Shepherd* (1725), which initiates the true English description of nature and rural life as they really are, is not without reminiscences of an earlier pastoral time when poets dreamed of rustic loves and joys rather than inquired into them.

And now finally we must speak briefly of the diffusion of the pastoral in Germany. Here it was from France, rather than directly from Italy, that the form made its appearance. The *Hercynia* of Opitz, published in 1622, is mentioned as the first veritable example; and this was inspired by d'Urfé and by that insignificant work, *Les Bergeries*, of Racan. Throughout the seventeenth and early eighteenth centuries the German pastoral flourished wondrously, though with

the charm mostly lost and the allegory terribly exaggerated. Not till 1754 did what may be called a classical work appear—Gessner's *Daphnis*, followed two years later by his famous *Idyllen*. The fame of these echoed even beyond the limits of Germany, and within those limits they had many imitators. Two great examples of the form must further be mentioned, though in both the invading realism of the nineteenth century makes itself harmfully felt. These are the *Luise* of Johann Heinrich Voss, published in 1795, and the better-known poem which it inspired, Goethe's *Hermann und Dorothea*, published in 1797.

The nineteenth century has not tolerated the pastoral. Here and there a poet has given something of idyllic charm to his description of country scenes; here and there a novelist in revolt against convention has sought relief in an impossible rustic world (e. g. George Sand in *La Mare au Diable* and other novels); but the day of the old gracious pastoral dream is for the mass of writers and of men past.

There exists as yet no general work on the history of the pastoral. A. R. Marsh.

Patago'nia [from Span. *patagón*, a large foot, in allusion to gigantic footprints said to have been found by the first discoverers]: a name originally applied to all the southern part of South America, with a vague limit northward, about lat. 38°, or 39° S.; it is still used for convenience, but is generally restricted to the portion E. of the Andes and S. of the Rio Negro, forming the Argentine territories of Neuquen, Rio Negro, Chubut, and Santa Cruz (*qq. v.*), with a small strip at the southern end belonging to Chili. Generally speaking, the surface of this region consists of plateaus which form a series of terraces from the eastern slope of the Andes to the sea; much of the soil is arid, composed of sand, shingle, or bowlders, and impregnated with salts; but portions are suitable for grazing, and some of the valleys of the Andes and near the coast are well adapted for wheat-growing. The climate is dry, and during the summer months (November to April) warm, but subject to violent winds; the winters, especially in the southern part, are cold and are ushered in by storms. Settlements are rapidly springing up near the coast; the interior is inhabited only by wandering Indians, now greatly reduced in number. These Indians are of several tribes, classed together as Patagonians, but called Tehuelches or Southern People by the Araucanians; they are unusually tall (many of the men being over 6 feet in height), but the descriptions of giants given by old explorers were probably exaggerated. They number about 20,000, and most of them are now more or less friendly to the whites. Patagonia, as originally defined (including the narrow strip W. of the Andes), was practically abandoned to the Indians until about 1860. It was nominally attached to the viceroyalty of La Plata or Buenos Ayres, and the whole of it was claimed, after the revolution, by the Argentine Confederation. The Chilian settlements, as they were extended southward, encroached on the western slope, and gave rise to many disputes. In 1881 all the strip W. of the summits of the Andes, together with the borders of the strait of Magellan, was definitely given up to Chili; it now constitutes the province of Llanquihue and the territory of Magallanes; area, 83,115 sq. miles, and an estimated population of about 85,000. The other portion, which is now incorporated into Argentina, and is divided into five territories, has an area of 268,000 sq. miles and a population of about 100,000. See Darwin's *Voyage of a Naturalist*; Lady Florence Dixie, *Across Patagonia* (1880); Fontana, *Exploración en la Patagonia Austral* (in *Boletin del Instituto geográfico Argentino*, 1886), and many recent papers in the same bulletins; also, Hudson, *Idle Days in Patagonia* (1893).
Herbert H. Smith.

Pataps'co River: a stream which rises in Carroll co., Md.; flows 80 miles S. and S. E., and enters Chesapeake Bay by a fine estuary, on which stands Baltimore. In its upper course it is very rapid, affording much water-power. Its estuary admits first-class ships.

Patchogue, pa-chōg': village (incorporated in 1893); Suffolk co., N. Y. (for location, see map of New York, ref. 8–D); on the Long Island Railroad; 53 miles E. of New York city; near Blue Point, on Great South Bay. It is the chief harbor for the fishing and oyster boats of the bay, has a beautiful lake at each extremity, and is one of the most popular places of resort on the Long Island coast. There are several hotels and boarding-houses, good dock facilities, a union free school, 5 churches, a State bank with capital of $75,000, and 2 weekly newspapers. The industries comprise fishing and oystering, and the manufacture of lace, paper, and brass goods. Pop. (1900) 2,926. John M. Price.

Patchou'li, or **Patchouly** [= Fr., from East Indian name]: an odoriferous labiate plant (*Pogostemon patchouli*) of Southern Asia. It is extensively used in perfumery and against the ravages of clothes-moths. India ink and India shawls derive their peculiar odor from this plant. The Orientals use it for stuffing mattresses and to ward off contagion and vermin. They also mix it with tobacco for smoking. It grows to a height of 2 or 3 feet, bears spikes of densely whorled small flowers, and ovate leaves 2 or 3 inches long.

Patel'la, or **Knee-pan** [*patella* = Lat. kneepan, liter., a small pan, dimin. of *pa'tena*, pan, dish, deriv. of *pate're*, lie or spread open]: a probably sesamoid bone found in the tendon of the quadriceps extensor muscle of the thigh, just anterior to the knee-joint. It develops from one or two centers. It does not begin to form until the child is from three to six years of age.

Patents [deriv. of *patent* in *letters patent*, i. e. letters open to the perusal of all, from Lat. *pa'tens*, pres. partic. of *pate're*, lie open]: letters issued by a government granting to inventors the exclusive use of their inventions for definite periods.

I. *Their History.*—The practice of thus inciting inventors to improvements in arts and industries is of remote origin. So far as concerns modern jurisprudence, however, it was first adopted by the English, and the common law gave to the king the power of granting such privileges; but this power was abused, and patents were granted not only to projectors who deserved them, but to favorites and venal speculators, who thus obtained monopolies of the traffic in many of the necessaries of life and not a few of its conveniences, the right to which had existed in the public from time immemorial. The term *patent* was thus early applied indiscriminately to the rightful privileges by which inventors were rewarded for creating new and valuable improvements which had never belonged to the people, because they had never before existed, and to the wrongful monopolies, like those for the sale of salt, currants, vinegar, potash, pilchards, and many other articles, the right to traffic in which had always and undeniably belonged to the public. It was the latter class of patents, the wrongful monopolies, that constituted the inciting cause of the Great Revolution. And the same enactment, the famous Statute of Monopolies, that swept away the arbitrary and unconstitutional power of the British kings excepted from its operation the patents granted to inventors. As this statute did not establish, but confirmed, the practice of thus encouraging improvements in the useful arts, such practice may be traced unbroken from the complex systems of statute jurisprudence and equity practice of fifty-eight nationalities, states, and colonies to-day back to the time when Edward III. issued the first recorded patent to "two friars and two aldermen" for an alleged discovery of the philosopher's stone; but the separation of patents for new inventions, rightfully granted to those who added to the wealth of their country by increasing its industrial resources, from the wrongful monopolies that crushed the people was a matter of slow growth. It may be said to have taken first positive and decided form in a hot debate in Parliament on Nov. 20, 1601, in the reign of Elizabeth, and it ended only with the dethronement of the Stuarts; but the Statute of Monopolies in 1623 (21 James I.), although it did not end the struggle, defined and made clear the principles of the common law. For by this last "the crown, as the patron of science and art and guardian of the common weal, had power to grant many privileges," even "although, *primâ facie*, as it was said, they appear to be against the common right; the *consideration* was the invention of a new manufacture or the introduction of a new trade; the grant could only be by charter or letters patent, and the term of privilege was to be reasonable." (See *Coryton on Patents*, p. 27.) The earliest form of these privileges was that of "conducting exclusively *new* trades, or dealing in objects of commerce *hitherto unknown*, as a *reward* and *encouragement* to parties introducing them." The common-law granting of patents has, it may be remarked, an apt illustration in the Scottish practice, for in Scotland, up to 1852, patents were issued to inventors in the total absence of a statute on the subject.

The earlier patents were based upon the condition that the invention be *worked* within the realm, this *working* being the consideration paid by the patentee for the protec-

tion afforded. In some cases a tax or a portion of the profits was paid to the crown—the former still a feature of the British patent laws, from which it has passed to those of France and Belgium; but the secret of the invention was not required to be revealed until after the expiration of the patent. From this it resulted that the inventor frequently succeeded in keeping his invention from the public even after the expiration of the term, and hence the *making known* of the invention became, subsequently, an essential part of the consideration for which the patent was issued. To this end it was at a very early date required as a preliminary to the issue of a patent that the inventor should place on record a description of his invention so "full, clear, and exact" that any one skilled in the art could proceed to put it in practice, and so definite in its statements as clearly to distinguish between what is new and what is old. The development of the patent law has been coincident with that development of the industries which has been due for the most part to the law itself. The earliest triumphs of modern invention, Watt's steam-engine, Arkwright's spinning-machinery. Cort's puddling process, Dudley iron manufacture, furnished in the litigation of the patents thereon the established precedents upon which the decisions of courts in patent cases all over the world are based. Previous to 1852 the British patent law related only to England. Scotland, as previously remarked, granted patents under the common law; Ireland had a separate patent law so costly and imperfect that many British inventors lost their inventions in the latter island before they could patent them there. In 1852 this was remedied by the law still in force, which embraces in one patent "England, Scotland, Ireland, the principality of Wales, the Isle of Man, and Berwick-upon-Tweed." The British patent law has from the beginning placed the introducer of a new improvement on the same footing as an original inventor. It requires no preliminary examination to determine the question of novelty, and declares a patent invalid if the invention has been previously publicly known in the realm. Prior to the Patents, Designs, and Trade-marks Act of 1883 the initial expense of obtaining a British patent was onerous, but this has been practically reduced to one-third of the former expense by the act just mentioned. Renewal fees, payable before the expiration of the fourth year of the term of the patent, and annually thereafter, are required to keep the patent alive. In lieu of these the renewal fees may be paid in two lump sums, one before the end of the fourth and the other before the end of the eighth year of the term, at the option of the patentee.

The patent system of Great Britain was the parent stem from which all others have sprung. In 1641 the general court of Massachusetts granted a ten years' patent to Samuel Winslow for a process of making salt. In 1672 the printed statutes of Connecticut provided that "there shall be no monopolies granted among us but of such new inventions as shall be judged profitable and for the benefit of the country, and for such time as the general court shall judge meet." Massachusetts and Connecticut were pioneers in transplanting the British system, although similar examples are found in the other colonies (or States) up to the time when the first U. S. patent law, the act of 1790, came into force.

The statute of 1790 provided for the granting of letters patent on "any useful art, manufacture, engine, machine, or device, or any improvement therein, not before known or used." The petition for the grant was to the Secretary of State, the Secretary of War, and the Attorney-General. The patent was issued on the approval of these officials or any two of them. The description of the invention was certified by the Attorney-General, and the President caused the great seal of the U. S. to be affixed on the issue of the patent. The term of the patent was for "any term not exceeding fourteen years" in the discretion of the aforenamed members of the cabinet. Although discretionary power was vested in these last, no preliminary examination to determine actual patentability was, in practice, instituted by the act. Provision was duly made for punishing infringers, the English idea of patentable novelty substantially adopted, and a schedule of Government fees, that, exclusive of 10 cents per 100 words for copying specification on filing same, amounted to $3.70. A patent could be issued "to any person," no distinction between citizens and foreigners being made. In 1793 a new statute was passed, repealing that of 1790, although retaining much of its substance. This act of 1793 restricted the grant of patents to citizens of the U. S.; provided that the petition should be to the Secretary of State; that owners of patents from any State should be incapable of holding a patent from the U. S. except on condition of relinquishing the State patent; that interfering applications should be decided by arbitrators; that patents obtained "surreptitiously or upon false suggestion" could be declared void on motion made and proof produced before the U. S. district court of the district wherein the patentee resided, if made within three years from the date of the patent, but not afterward; and provided further that the Government fee paid by applicant for a patent be $30. This act of 1793 also provided that infringers should pay at least triple damages to the patentee. In 1794 a supplement permitted parties to suits set aside, suspended, or abated by the act of 1793 to revive them. During the following forty years various amendments were made to the patent laws, and in 1833 all previous statutes on this subject were repealed. The act of 1833, while retaining many features of the old law, introduced many changes. It attached to the department of state "an office to be denominated the Patent Office, the chief officer of which shall be called the commissioner of patents." This law was the first to institute the system of preliminary examinations to determine the patentability of inventions before issue of patents thereon, and from the single examiner appointed under it has come the immense staff of examiners and the complicated system of examinations, appeals, etc., that now obtains; and which, while undoubtedly productive of much good, has just as undoubtedly been the means of robbing many a poor inventor of the rights that belonged to him in justice, equity, and law. This statute provided a board of appeal, to which appeal could be had from adverse decisions of the examiner and commissioner. Aliens resident in the U. S. for one year, and who had made declaration of intention to become citizens, were allowed to take out patents for the same fees as citizens; but for a subject of the King of Great Britain, the fee was $500, and for all other foreigners $300. This law provided also for the filing of caveats on partially perfected inventions, confirmed the right of reissue, fixed the standard of damages in infringement cases at the actual damages, except where exemplary damages were held by the court to be warranted, and in such cases limited the award to three times the actual damage; and placed the power of extending patents for an additional term of seven years after the expiration of the original fourteen in the hands of a board composed of the commissioner of patents, the Secretary of State, and solicitor of the treasury. From 1836 to 1873 the patent laws were frequently amended. In the latter year they were codified in title 60, chapter i., of the U. S. Revised Statutes, in which form, with a few amendments, they still remain. Some of the important provisions of this statute are the extension of the term of patents from fourteen to seventeen years; the abrogation of extensions of patents granted since Mar. 2, 1861, by the commissioner; the compulsory attendance of witnesses in patent cases; the establishment of a board of examiners-in-chief, intermediate between the examiners and the commissioner, to hear appeals from the decisions of the former; the repeal of the provision permitting withdrawal of two-thirds of the fee in case of rejection, and the sweeping away of all distinctions between citizens and foreigners in the granting of patents. It caused a decided advance in the utility of the patent office by providing for the printing of all patents as fast as issued. Brief abstracts, together with decisions of the courts in patent cases, decisions of the commissioner, etc., are published weekly in the official gazette.

II. *The Law relating to Patents.*—Patent laws are laws which prescribe under what formalities and conditions patents may be granted, and provide for enforcing the protection which the patent grants. A patent to a first inventor is not, as is often erroneously supposed, a grant of right to the *invention*. It is merely a grant of right to *protection* in the exclusive use of the invention. An inventor has a right to use his invention without a patent. The grant of protection to an inventor in the exclusive use of his invention for a limited time is so well founded in justice and public policy that, although not of remote origin, it has been adopted by all civilized nations. In many dependencies, having no patent laws of their own, inventions receive the protection of the patent laws of the mother-countries. Thus, for instance, a patent granted in Spain protects the invention in Cuba and the Philippines, and in nearly all of them the protection is granted to the first inventor. In Great Britain it is granted to the first introducer of the

invention, whether he be the inventor or an importer of the invention. In most countries this protection is granted on condition of a forfeiture of the right unless the invention be put into use by the patentee within a specified time. The length of time for which the protection is granted in different countries varies from three to twenty-one years, but is generally limited to the shortest term during which protection, if any, has been previously granted for the same invention in any other country. The authority for the patent laws in the U. S. is the clause in the Constitution which declares that Congress shall have power "to promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries." In consequence of this delegation of power by the several States, legislation on the subject of patents for new inventions belongs especially to Congress, and by such legislation jurisdiction for the administration of the patent laws belongs to the Federal courts.

For what Subjects-matter Patents may be Granted.—The act now in force provides "that any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement thereof not known or used by others in this country, and not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof, and not in public use or on sale for more than two years prior to his application, unless the same is proved to have been abandoned, may, upon payment of the duty required by law and other due proceedings had, obtain a patent therefor." It will be noticed that, by the language of the Constitution, Congress was given power to secure to inventors the exclusive right to their "discoveries," while the statute purports to secure what has been "invented or discovered." As the statute puts "invented or discovered" in the alternative, thereby indicating that Congress understood those terms to refer to different things or to things of different origin, it appears as if Congress had exceeded its authority in providing protection for *inventions* as well as for *discoveries.* Notwithstanding this disjunctive use in the statute of the terms "invented" or "discovered," the courts have held that, with reference to patentable subjects-matter, *discovery* is synonymous with *invention*, and such, from previous adjudications which had taken place in England, was well understood to be the import of those terms at the time of the adoption of the Constitution of the U. S., and the verbal discrepancy has been disregarded to effectuate the known intent of the organic law. It will be noticed that only four classes of patentable subjects-matter are mentioned in the U. S. statute; but these are sufficient to comprehend patentable improvements of any kind. In the English law only one was mentioned, being "manufacture," but the courts of England by construction give that one term sufficient scope to embrace all kinds of patentable subjects-matter. As used in the statute, the term "machine" includes all kinds of mechanism, whether machines proper or apparatus which have a mode of operation in working out or producing a result. The term "manufacture," according to the patent laws of the U. S., includes all kinds of useful articles which are made, except machines and compositions of matter, such, for example, as fabrics, tools, implements, wearing apparel, household furniture, etc. The designation "composition of matter" includes all kinds of mixture or compounds of substances, such as medicines, articles of food and drink, perfumeries, paints, dyes, etc. The term "art" comprehends all methods and processes which may consist of modes of procedure with or without new ingredients or materials. It is often difficult to determine to which of the four classes of subjects-matter mentioned in the statute an invention belongs, and it frequently happens that an inventor is entitled to separate patents for three kinds of subject-matter, all having reference to the same production: for the article itself, the method of producing it, and the machinery used therein.

To whom Patents may be Granted.—Patents are granted to original and first inventors. This is subject to the qualification that a foreign inventor who has not made his invention known in the U. S. will not be permitted to step into the place of an inventor who, in the U. S., has *bona fide* made the invention. Patents may be applied for and obtained by the executors and administrators of inventors. An inventor may assign his invention and may have a patent issue to the assignee. An invention by joint inventors must be patented to both.

What constitutes Patentable Inventions.—The mere conception of an idea is not patentable. An invention to be patentable must be capable of use without the addition of further invention or the necessity of further experiment apart from the exercise of mere workshop skill. It must be so matured that the means of producing the result can be accurately and fully set forth. When the invention consists of a process or of a composition of matter, it is not necessary, in order to entitle its author to a patent, that he should understand the rationale of the chemical changes involved. He has brought such an invention to a patentable condition when he has ascertained what articles are to be used and how they are to be used to produce the desired result. Some inventions are new in kind, while others are only new as improvements on something which in kind had prior existence. The former are patentable much more broadly than the latter. When an invention consists of doing by a machine what had previously been done by hand only, or had never been done at all, it is new in kind. The first sewing-machine and the first recording telegraph are instances of inventions which were new in kind. To give an invention patentable novelty it is immaterial whether it was the result of much or little research or labor. An invention or discovery made by accident is none the less patentable. New combinations of either new or old elements are patentable, but a combination of old elements, to be patentable, must produce some new result due to the co-operative or reciprocal action of the combined parts. The mere addition of one old device to another, each producing its own result in such manner that their combination produces those same two results and no other, is not patentable, and is not invention, this being commonly designated as an aggregation merely, and owing its origin to workshop skill or judgment as distinguished from the exercise of the inventive faculty. Any part in a machine which does not participate in the mode of operation of the machine is regarded as a dead part. Nearly all patents on machinery are for combinations of parts some or all of which are old. When a single part or any combination of parts less than the combination of the whole is new, then such part or such sub-combination of parts is patentable, as well as the entire combination, and they can be patented by separate claims in one patent or by a plurality of patents. Although an invention, to be patentable, must, with the exception mentioned, be new and useful, it does not follow that all new and useful productions are patentable. There are many things which, though both new and useful, are not patentable. Any change which was so obvious as to exclude the possibility of the exercise of the inventive faculties being necessary to produce it is not the subject of a patent. Any improvement which is merely the result of mechanical skill or superior workmanship is not patentable. A new discovery of a law of nature or of an abstract principle is not patentable. A discovery consisting of the adoption of a known equivalent of what was already in use is not patentable; such, for illustration, as the removal from a machine of one of the elements which it has in combination with other elements, and the substitution in its place of another known element possessing only the same function and performing only the same office in the combination as did the part for which it was substituted. In a process or composition of matter the substitution of one known chemical agent for another having only the same function is not patentable. Combinations in mechanism consisting of a mere assemblage of old parts, each part possessing only the same function and performing only the same office in the combination as it did out of it, and none of the parts co-operating with the others to produce any new or improved result, are not patentable combinations, but in judgment of law are mere aggregations of old elements. A new use of an old thing, called a double use, is not patentable; that is to say, if a machine or an instrument be known and used for one purpose, a discovery that it can be used to advantage for another purpose, accompanied by an actual application of it unchanged to such new purpose, is not patentable, but in such cases a very slight adaptation of it for the new use will render it patentable. This exclusion of a new use of an old thing from patentability is for the reason that when an invention is made, its author, having created it, is entitled to all its attributes, whether discovered by him or by any one else subsequently to his invention; and when that right passes from him to the public, it becomes vested with the same right. Anything which is injurious to public health, to good morals, or public policy is not patentable.

Utility.—Although the statute requires the invention to be useful, yet no particular degree of utility is necessary to render an invention patentable. It need not be more useful than what was previously known for the same purpose. The requirements of the law are answered so far as utility is concerned if the invention be not absolutely frivolous or injurious to the public.

How an Inventor may Lose his Right to a Patent.—An inventor who has acquired a right to a patent may lose it in two ways: 1. By neglecting to apply for a patent for more than two years after the invention has been put into public use or on sale. The "public use" mentioned in the statute is not limited to a continuous public use for more than two years, but comprehends also a single instance of such use more than two years before the application for a patent. Public use has been judicially defined to be a use in public. The loss of an inventor's right to a patent by neglecting to apply for it for more than two years after the invention has been either used in public or put on sale is in the nature of a forfeiture of his right, and does not depend upon his intention. Nor is the lapse prevented by ignorance on his part of such public use. The contrary was held for many years, but a recent decision of the U. S. Supreme Court has reversed the former practice. A patent expires with the expiration of the term of a foreign patent previously obtained on the same invention, but not with the lapse of the former patent from non-payment of the taxes or the non-working of the invention required by the patent laws of various countries. 2. An inventor may so deal with his invention as to create an abandonment or dedication of it to the public at any time. This he may do either by express declaration or by his silence while with his knowledge its use is generally adopted by others. Such a surrender of an inventor's right is a matter of intention on his part, but intention may be inferred from existing facts. Delay alone to apply for a patent, no matter for how long, will not constitute abandonment, but unreasonable delay, associated with the fact of the same invention being originated by another and patented or put into general use by him, will constitute abandonment. Hence if a person unreasonably neglect to apply for a patent after completing his invention, he does so at the peril of losing his right. The issue of a patent is no guaranty to its owner of the right which it purports to secure. A patent is only *primâ facie* evidence of such right. It gives to its owner a right of action against infringers of the patent, and authorizes him to contest his right to the thing patented. Proof against a patent at any time during its term, in a suit brought for an infringement, that the patentee was not the first inventor of the thing patented, or that its subject-matter was not patentable, or that the inventor lost his right by forfeiture or abandonment, or any other fact against the validity of the patent, will invalidate the patent. When an invention has been previously patented in a foreign country, the U. S. patent will expire with the term of the foreign patent, or, if there be more than one, with that having the shortest term. If an inventor disclaims a part of his invention in his original application, he will be precluded from claiming it afterward. If an inventor has neglected to claim the whole of his invention he must file his application for reissue with due diligence—ordinarily, within two years—or he loses the right to receive a claim commensurate with the actual invention, there being, however, some exceptions to this rule. Certain irregularities in the proceedings incident to obtaining a patent may restrict the scope of the grant or even invalidate the grant.

How Patents are Obtained.—Patents are obtained by applications in the form of petitions to the commissioner of patents, accompanied by a description, including drawings. Models may be demanded by the Patent Office, but for several years past have not often been required. When the invention is of a composition of matter, specimens may in like manner be required by the commissioner. The commissioner of patents is the head of the Patent Office, and has a corps of assistants called examiners, among whom the different patentable subjects-matter are divided, and whose duty it is to examine applications to ascertain whether the papers are in proper form and whether the invention described therein is, so far as they can ascertain, new and useful. On the commissioner receiving an application for a patent, he refers it to the proper primary examiner for his examination into the state of the art to which the invention appertains, and for his report of the result of his examination to the commissioner. If no reason is found against granting the patent, it is allowed and issued. If any cause is found by the examiner against the grant, it in such case is reported to the applicant; and if he can by explanation or argument remove the objection, the patent will still be issued, otherwise it will be refused by the primary examiner. From the decision of the primary examiner an appeal lies to a board of three examiners, designated examiners-in-chief. From a decision of the board of examiners-in-chief an appeal lies to the commissioner of patents, and from his decision an appeal lies to the Supreme Court of the District of Columbia. When an application is made for a patent which in the opinion of the commissioner would interfere with any pending application or with any existing patent, notice is given to the parties interested, and an opportunity granted to them to show by evidence which was prior in date of invention; and the patent will be issued to the one proved to be the first. The business in the Patent Office has become so extensive that there has grown up a class of persons known as patent agents or solicitors of patents, who conduct Patent Office business in behalf of inventors, and, being located in different parts of the U. S., are always accessible to inventors. The term for which patents for inventions issue in the U. S. is seventeen years. If an inventor, after conceiving the outlines of his invention, desires further time to mature the same, and in the meantime to guard against any other patent being granted for the invention, he may do so by filing in the patent office a caveat, setting forth the design and distinguishing characteristics of his invention and praying protection of his right until he shall have matured his invention. Such caveat will be preserved in secrecy by the commissioner of patents, and the effect of it will be to entitle the caveator for one year to notice from the commissioner of any application which may be made for a patent which would in any way interfere with his right. After receiving such notice, if any be given, the caveator will be allowed three months in which to file a complete application.

Designs.—New designs are also patentable, such as a design for a manufacture, bust, statue, alto-relievo, or bas-relief; designs for printed fabrics; ornaments, patterns, prints, or pictures to be placed on or worked into any article of manufacture; also new shapes.

Amendment of Patents.—A patent may be amended by being surrendered to the commissioner and the grant of an amended one, called a reissue, in its stead, or by filing with the commissioner a disclaimer of so much of the thing patented as the patentee was not the first inventor of. To amend by a reissue, the original patent and an amended specification must be delivered to the commissioner, asking an acceptance of the surrender and a grant of a reissue in conformity with the amended specification. A patent may by a reissue be amended in either its descriptive parts or its claims so as to conform to what the patentee was the first inventor of; but no new matter can be introduced into the reissue, nor, in case of a machine patent, can the model deposited on the original application or the drawings attached to the patent be amended except each by the other; but when there is neither model nor drawing, amendments may be made upon proof satisfactory to the commissioner that such new matter or amendment was a part of the original invention and was omitted from the original specification by inadvertence, accident, or mistake. Under late decisions, however, this provision is little more than nugatory. A reissue in which the claims are expanded should be applied for with diligence, and not delayed long after the issue of the original patent.

Repeal of Patents.—There is no statutory provision for the repeal of patents; but where patents interfere by each claiming the same invention, any one interested in either patent may institute a suit in equity against the owners of the other patent, in which case the court has power to declare either patent invalid in whole or in part. It is also understood that the Attorney-General of the U. S. has a right of action to invalidate a patent where there was fraud in the issuing of it.

Sale and Transfer of Patents.—A patentee may sell his entire patent or any undivided part of it for the whole or any specified part of the U. S. The conveyance of such an interest, to be valid, must be in writing, and is called an assignment. Such an assignment will be void as against any subsequent purchaser or mortgagee for a valuable consideration without notice that such assignment had been made, unless it be recorded in the Patent Office within three months from its date. Parties having an undivided interest in a patent are not thereby constituted partners, but are

tenants in common; and any of such parties may grant licenses to others to use the invention in making, using, and vending the patented article, and receive and retain the consideration for the same without liability to their co-owners. Licenses under patents need not be in writing. They may be oral or implied. A license to a party to use the invention is not divisible or assignable unless expressly made so by its terms. A license, although in writing, need not be recorded. An invention not patented is assignable, but an invention is not salable or assignable before it is made, because a thing not *in esse* is not the subject of sale. An agreement, however, to assign an invention when made will be operative upon it as soon as it shall be made.

Remedies for the Protection of Patent Rights.—The law protects patentees against false representations of others. It provides that any person who, without authority from the patentee, shall in any manner mark upon anything made, used, or sold by him, for which he has not obtained a patent, the name, or any imitation of the name, of any person who has obtained a patent therefor, or who shall in any manner work upon or affix to any such patented article the word "patent" or "patented" or the words "letters patent," or any word of like import, with the intent to imitate or counterfeit the mark or device of the patentee, or who shall in any manner mark upon or affix to any unpatented article the word "patent" or any word importing that the same is patented, for the purpose of deceiving the public, shall be liable for every such offense to a penalty of $100. In case of an infringement of a patent, the law gives its owner right to remuneration for past infringement and to have further infringement prevented. He has a right to an action at law for a trial by jury, in which his recovery will be the actual damages he has sustained from the infringement. He also has a right to sue in equity, in which he can recover not only damages, but, in addition thereto, according to the statute, the profits realized by the defendant from the infringement, and obtain an injunction restraining further infringement; and where no serious doubt is raised respecting the validity of the patent or on the question of infringement, he may, on short notice, have a preliminary injunction restraining the infringement during the pendency of the suit. In suits for infringement all of the owners of undivided interests in the patent for the territory in which the infringement has been committed must be joined as coplaintiffs or cocomplainants. Where there has been a joint infringement, the infringers are jointly and severally liable for the infringement. Ignorance on the part of an infringer of the existence of a patent at the time of infringement is immaterial, so far as his liability for the infringement is concerned. To entitle a patentee to recover for an infringement of his patent, he is not required to show that the infringer knew of the existence of the patent. Still, neither the patentee nor his assigns are allowed to recover damages for infringement, unless it appear that they marked the patented articles made or sold by them "patented," together with date of patent, or that the defendant was personally notified of the infringement and continued to infringe after such notice.

Relation of a Patentee to the Government.—The relation between the public and the inventor is that of contracting parties. It will be noticed that in forming this relation the public neither promises nor imparts anything to the inventor except legal protection to his property, while it receives a valuable addition to its productive resources. From this relation of the inventor to the public, it will be realized how strong is his claim to a full and efficient protection to his right, because (1) he has purchased the protection to his property in the invention for a special and valuable consideration; (2) he receives no greater protection than is furnished to others for other property without a special purchase; and (3) the protection is only for a limited time, while for tangible property the protection is without limitation of time; but notwithstanding this manifestly superior claim of patentees to full protection for their property in patented inventions, their title to such property is treated with comparative indifference, and trespass upon it by others is not held in the same disrepute as is trespass upon other kinds of property. Patents have been, and to a considerable extent still are, regarded as monopolies, creating undue restriction upon the rights of the public and appropriating to individuals what belongs equally to all. One cause of this false impression is a mistake as to what a patent grants, and an assumption that by it the government grants to a patentee an exclusive right to something of which the public was previously in possession; while another is found in the fact that patents for new inventions had their rise, and for a considerable time their progress, in England in the society of other grants, which did confer upon individuals privileges which belonged of right to the public, and which were therefore odious monopolies, and which in the course of time became so obnoxious to the people as to be entirely abolished. From the fact that patents for new inventions were introduced in the form of and contemporaneously with oppressive monopolies which took rights from the public and gave them to individuals, they caught and have retained some of the odium, and even the name, of monopolies. The distinction between a monopoly and a meritorious patent was drawn in the Statute of Monopolies, which declared "that all monopolies, and all commissions, grants, licenses, charters, and letters patent heretofore made or granted, or hereafter to be made or granted, to any person or persons, bodies politic or corporate whatsoever, of or for the sole buying, selling, making, working, or using of anything within this realm, . . . are altogether contrary to the laws of this realm, and so are and shall be utterly void and of none effect, and in nowise to be put in use or execution," and qualified this declaration by the proviso following, viz.: "That any declaration before mentioned shall not extend to any letters patent and grants of privilege for the term of fourteen years or under hereafter to be made of the sole working or making of any manner of *new manufactures* within this realm to the *true and first inventor and inventors* of such manufactures." From the causes above stated the courts of England, for many years after the introduction of patents, treated them with disfavor, and whenever they became the subject of litigation struggled to invalidate them. Patents for new inventions, however, are not monopolies, have none of their properties, and were never considered as such by the common law or intended to be so regarded by the Statute of Monopolies. The common-law definition of a monopoly is given by Lord Coke in the following words: "A monopoly is an institution or an allowance by the king, by his grant, commission, or otherwise, to any person or persons, bodies politic or corporate, of or for the sole buying, selling, making, working, or using of anything *whereby any person or persons are sought to be restrained of any freedom or liberty which they had before or hindered in their lawful trade.*" Justice and consistency require that the property of an inventor, the creation of his own mind, should be exonerated from any idea of his being the grantee of an odious monopoly. Patents should be regarded in their true light of rewards dictated by sound public policy to meritorious men who contribute by their creations to the welfare of the country and of the world.

Revised by FRANCIS M. BURDICK.

Pater, WALTER HORATIO: author; b. in London, Aug. 4, 1839. He proceeded to Queen's College, Oxford, and graduated in 1862, and was elected to an open fellowship at Brasenose College. He was a subtle critic of art and literature, and master of a very graceful prose style. His works are *The Renaissance* (1877; 3d ed. 1888); *Marius the Epicurean* (1885); *Imaginary Portraits* (1887); and *Appreciations* (1889; 2d ed. 1890), besides many articles in the principal reviews. D. in Oxford, July 30, 1894. H. A. B.

Pater'culus, GAIUS VELLEIUS: historian; b. about 19 B. C.; entered early the Roman army, and served from 1 to 13 A. D. under Tiberius in Germania, Pannonia, and Dalmatia. The year of his death is unknown, but his *Historiæ Romanæ ad M. Vinicium Cos. Libri II.* reached to 30 A. D. The first manuscript of this book, and the only one that has come down to us, was discovered by Beatus Rhenanus at Murbach in Alsace, and printed at Basel in 1520. The best editions are that by Orelli (Leipzig, 1835), that by Kritz (2d ed. Leipzig, 1840), and the text by Haase (2d ed. with emendations by Mommsen, 1863) and by Halm (Leipzig, 1876). The beginning is wanting, and there is also a portion lost after the eighth chapter of the first book.

Revised by M. WARREN.

Pater'no: town of Italy; in the province of Catania, Sicily; situated at the foot of the western slope of Etna, about 9 miles from the city of Catania, on one of the routes to the summit of the volcano (see map of Italy, ref. 10-G). Remains of ancient aqueducts and the ruins of an old bridge over the Simeto may be seen here, and other traces of the Roman period. There is an old Norman castle, occupying an elevated position. Paterno has been supposed to occupy the site of the ancient *Hybla Major*. The vicinity is fertile in grapes, olives, hemp, etc. Pop. 15,230.

Pa'ter Nos'ter [Lat., Our Father, the opening words of the Lord's Prayer]: the name given by Roman Catholics to the Lord's Prayer. In the ancient Church it was regarded as so sacred that its formula was kept a secret from the uninitiated. (See ARCANI DISCIPLINA.) In later times this prayer was repeated by the vulgar as a charm. The closing words, "For thine is the kingdom," etc., are not present in all the versions, and some Christians do not use them.

Paterson: city (founded in 1791, incorporated in 1850, known as the "Lyons of America"); capital of Passaic co., N. J. (for location, see map of New Jersey, ref. 2–E); on the Passaic river, the Morris Canal, and the Erie, the Del., Lack. and West., and the N. Y., Susquehanna and West. railways; 15¾ miles N. W. of New York city. It is built partly on a broad plain and partly on the slopes of ranges of hills that inclose it on three sides, Garret Mountain, about 500 feet high, overlooking it on the S. W. The river, which affords exceptional power for manufacturing, runs through the city, and Passaic Falls, 72 feet high, are within its limits. The city is lighted by electricity and gas. In 1900 there were 880 manufacturing establishments (representing 132 industries) reported. These had a combined capital of $37,800,621, employed 29,625 persons, paid $48,628,932 for wages and $20,516,000 for materials, and had products valued at $92,682,498. The principal industry was the manufacture of silk and silk goods, which had 126 establishments and $26,948,868 capital, employed 20,480 persons, paid $12,420,061 for wages and $20,438,460 for materials, and had products valued at $50,948,287. Then followed foundry and machine-shop products, which had 44 establishments and $4,106,021 capital, employed 6,027 persons, and had products valued at $8,110,261; malt liquors, 7 establishments, $1,000,000 capital, and products valued at $2,176,208; iron and steel, 5 establishments, $2,126,426 capital, and products valued at $3,210,284; dyeing and finishing textiles, 10 establishments, $2,866,281 capital, and products valued at $6,415,876; and jute and jute goods, 1 establishment, with products valued at $950,640. The foundry and machine-shop products included locomotives, metal bridges, steam fire-engines, cotton machinery, heavy castings and brass and plumbers' goods. The city is connected by trolley-lines with Passaic, Rutherford, Newark, Hoboken, and Jersey City. Many mills are supplied with power from a raceway that runs through the manufacturing district. Paterson contains 76 churches, 22 public schools, several private schools of high grade, 3 hospitals, 2 orphan asylums, free eye and ear infirmary, Old Ladies' Home, Children's Day Nursery, free public library, electric street-railways, 3 national banks, combined capital $850,000, savings-bank, capital $100,000, 3 trust companies with a combined capital of $350,000. There are 5 daily, 6 weekly, and 4 monthly periodicals. Pop. (1890) 78,347; (1900) 105,771. HARRY B. HAINES.

Paterson, WILLIAM: merchant; b. at Skipmyre, Dumfriesshire, Scotland, in 1665; was persecuted as a Covenanter by Charles II.; settled at London as a merchant; visited the West Indies, where he obtained much information about the localities of the Spanish Main from the buccaneers; issued proposals for the establishment of the Bank of England, of which, upon its establishment in 1694, he was one of the directors. Paterson made unsuccessful efforts in England in the same year to organize a scheme of colonization in Darien; obtained from the Scottish Parliament in 1695 an act of incorporation; obtained large subscriptions, and proceeded to Darien with a considerable number of emigrants; was unsuccessful on account of quarrels, fever, famine, and the opposition of the Dutch, Spanish, and English Governments; returned to Scotland 1700; was an advocate of the union of Scotland with England; entered Parliament 1708; obtained some compensation for his losses about 1715; wrote several treatises on economical subjects. D. at Westminster, Jan. 22, 1719. See *Biographies* by Bannister (1858) and Pagan (1865), and the *Works* of Paterson (edited by Bannister, 3 vols., 1859).

Pathology [Gr. *πάθος*, suffering, disease + *λόγος*, discourse, reason]: that branch of medical science which treats of disease. It includes the study of the pathological alterations of the body, their causes, and their effects. Generally the subject is divided into ætiology, which treats of the causes of disease; pathological anatomy, which treats of the character of the structural alterations; and general pathology, which treats of the laws under which pathological alterations are produced, and the effect which they have on the function and structure of the other parts of the body.

Under disease we mean a definite alteration in some part of the body which produces a definite series of functional disturbances which we call symptoms. By the study of these symptoms we are able to recognize the situation of alteration and its character. The structural alterations of the body are divided into those which are congenital, and due to imperfections in the development and growth of the organism, and those which are the result of disease. All anatomical changes in the body not due to defects of development are the result of influences not inherent in the body, but acting on it from without.

We may regard life as due to the sum of external influences acting on the body. The character of these influences must be such that under them all the organs of the body act in a normal or physiological manner. When an ordinary external influence is increased to a great degree it may become a cause of disease. Disease is, however, most generally produced by the action of influences different from those ordinarily acting. When an organ is diseased it may be that injurious substances are brought to the organ by the circulation, or it may be that the blood while of a normal quality may vary from the normal quantity, or the part may become affected from direct injury or from its proximity to another diseased organ. These structural alterations of part have an effect not only in impairing their functions, but the impaired function of one organ, if it be an important one, has an effect on the function and structure of the other organs.

The infectious diseases are due to the action of microscopic living organisms which find suitable conditions for their development in the animal body, and as a result of their growth produce various alterations. Experimental pathology forms an important branch of pathology, and to its development a great deal of recent progress made in the increase of our knowledge of disease is due. In this lesions are produced in lower animals, or they are given various diseases by inoculating them with the organisms causing the disease. In such experiments there is the advantage that the effect of the lesions on the functions of the parts can be studied more closely, and by killing the animals at various stages of the disease its gradual course can be traced out.

W. T. COUNCILMAN.

Pathology, Vegetable: a department of botany which deals with the diseased conditions of plants. It is coextensive with physiology, which deals with plants and their organs in their normal, active state. The subject is thus too large to be treated in any but a summary way in this article, which professes to give no more than a mere outline.

Scientifically speaking, "disease is a condition in which the functions of the organism are improperly discharged" (*Ward*). While this general statement applies equally to plants and animals, it must not be assumed that there is a complete identity between their pathological conditions. In a plant nearly all cells are short-lived, and in the growth of an organ or member death follows close after the advancing mass of living, active cells. In a long-lived tree it is its normal condition that perhaps more than 99 per cent. of its mass is dead tissue. Again, in such a tree we observe the periodic death and separation of great masses of tissue in the fall of the leaves and flowers, and the ripening and fall of fruits. These examples will suffice to show why a reference to many languishing or dying cells is excluded from this discussion, which is confined to that part of the subject which deals with what may be called the abnormal pathology of cells, tissues, and organs.

1. *Unfavorable Habitat.*—For ordinary land-plants this includes not only such matters as altitude above sea-level, forest or plain conditions, etc., but even more, the particular conditions of the soil. In a hard soil, even if it is fertile, many plants starve because their roots can not penetrate it. The same thing takes place in a barren soil, although it may be soft and easily penetrated. In a soil which is too dry the plant starves not only for want of water (its most important food), but also for want of the solutions of nitrogenous and other solid food-matters. On the other hand, most land-plants soon languish if their roots are long in a soil which is filled with water. Here it appears that many of the roots die, and the plant starves in the midst of plenty. Sachs has shown that ordinary soil-roots die in completely wet soil, on account of the exclusion of air. In addition to this, in field-culture a wet soil is always colder than one which is moist; thus the absorption of nutritive solutions by the roots may be so checked as to result in starvation.

Occasionally the soil contains injurious or poisonous sub-

stances. Some salts, as those of potash, and soda are sometimes so abundant as to destroy nearly all vegetation. The presence of mineral oils or of some gases in the soil quickly kills the roots of all plants. Here again, as in the preceding cases, it appears that the plant is in fact starved by the cutting off of the supply of water and other food.

2. *Unfavorable Atmospheric Conditions.*—When the air is very dry the loss of water by the plant is excessive, and when this exceeds the water-supply the cells lose their turgidity, become enfeebled and almost inactive. Such cells may regain, to a great extent, their normal activity when the humidity of the air is increased.

Many gases in the air act as poisons to the cells with which they come in contact. The gases from burning coal, especially from that which contains sulphur, and those which escape from chemical-factories are often very destructive to vegetation. "Hydrochloric acid gas, nitric acid in vapor, and chlorine are also very destructive to vegetation, even when in such minute amounts as to be unnoticed on account of their odor" (*Goodale*).

Too intense or too feeble light is injurious to plants. Pringsheim has shown that in very intense white light the chlorophyll granules lose their color, and the cell is soon killed. In deficient light, as when plants are more or less shaded, they lose their color and become slender and weak. To a large extent this loss of strength is doubtless due to lack of nutrition through the inability of the chloroplasts to assimilate carbon.

When subjected to a temperature which is too high the plant wilts, and by the rapid loss of water by evaporation the leaves and younger stems become dry, as if scorched. In a low temperature (but not freezing) the activities of the cells are mostly suspended, and if this is prolonged the plant suffers from a loss of nutrition. When actual freezing takes place death usually follows on account of the withdrawal of the water from the protoplasm. A quick alternation from heat to cold appears to be more harmful than when the change is a gradual one. The so-called sun-scald upon the trunks of apple-trees appears to be the result of the heating of the tissues of the inner bark and younger wood by the afternoon sun on bright winter days followed quickly by a low temperature. The cells are made active by the heat, and when the temperature suddenly falls they are killed.

3. *Mechanical Injuries.*—Here may be mentioned the wounds, as by the breaking or removal of branches, the injuries from hail and lightning, and the twisting and rupturing of the tissues of the stems and leaves by violent winds, in all of which many cells are at once destroyed, exposing others, which in turn are usually injured also by drying, decay, or the attacks of harmful organisms (bacteria, fungi, or insects). Even when the wound has become covered by the growth of living tissue over it, the dead tissues of the original wound are frequently the origin of a more or less rapidly spreading decay, usually hastened by the presence of fungous filaments.

Most of the injuries produced by insects and other small animals are mechanical. The roots, stems, leaves, flowers, and fruits are often badly wounded by biting insects (*Coleoptera*, *Orthoptera*, and the larvæ of *Lepidoptera* and *Hymenoptera*). Here the injury to the plant is twofold; it suffers from the wounds as such, and also from lack of nutrition. The sucking insects (*Hemiptera*), by withdrawing water and other food-matters, to this extent decrease the nutrition of the plant. In addition, in some cases the insect injects a poisonous or irritating fluid, which either kills the tissues or causes abnormal growths, the latter resulting in the formation of galls of various kinds.

4. *Parasitism.*—One of the most fruitful sources of diseased conditions is the presence of parasitic vegetable organisms in the tissues. In a few cases these are phanerogams, as in the dodder and mistletoe, but by far the greater number are fungi and bacteria. The diseases produced by fungi and bacteria manifest themselves in many ways, and are known as anthracnose, blights, gummosis, mildews, rot, rusts, scab, smuts, spots, etc. In some of these there is a slow invasion of the tissues of the host by the parasite, with little apparent harm to the former, while again there may be very great changes in the tissues, resulting in the atrophy of organs, or much more commonly in their hypertrophy. In some again the tissues tend to dry and shrivel up, while in others they are turned into foul, decaying masses. The presence in root-cells of the cabbage and turnip of those low organisms of doubtful affinity, the *Mycetozoa*, gives rise to the distorted growths known as "club-root."

5. *Teratogeny.*—Doubtless we must regard the monstrous growths so frequently found in plants as involving pathological conditions of the tissues of the parts concerned. We know little as to the cause of these malformations, and may here do no more than indicate in a very general way their kinds, as described by Masters, as follows: (1) Abnormal union of parts; (2) abnormal separation of parts; (3) abnormal positions of parts; (4) arrest of development (stasismorphy); (5) over-development (pleiomorphy); (6) perverted development (metamorphy); (7) irregular development (heteromorphy); (8) multiplication of parts; (9) suppression of parts; (10) overgrowth (hypertrophy); (11) undergrowth (atrophy).

See further the articles Blight, Mildews, Rot, Rusts, Scab, and Smuts.

Literature.—B. Frank, *Die Pflanzenkrankheiten* (1879); G. L. Goodale, *Physiological Botany* (1885); Ernst Hallier, *Phytopathologie* (1868); M. T. Masters, *Vegetable Teratology* (1869); Paul Sorauer, *Handbuch der Pflanzenkrankheiten* (1886); H. M. Ward, *Diseases of Plants.*

Charles E. Bessey.

Pathros [Egypt. *Pa-ta-res*, the South Land; Septuagint, Παθούρης]: the Hebrew name of Upper Egypt as distinguished from the Delta region, which was usually known as Mizraim (Isa. xi. 11; Jer. xliv. 1, 15; Ezek. xxix. 14).

Pat'kul. Johann Reinhold, von: soldier and diplomat; b. about 1660 of a wealthy and influential family of Livonian nobility; received a military education, and served as a captain in the army, but became famous afterward as a diplomatist, or rather as an intriguer. Livonia was at that time a possession of the Swedish crown; and in the controversies between the Livonian nobility and the Swedish king Patkul played a conspicuous part. Accused of rebellion, he was summoned to Stockholm, but on his arrival there he soon discovered that the judgment was sure to go against him. He escaped to Courland, but was sentenced to death, and his estates were confiscated. For some time he lived in Switzerland and France, occupied in scientific studies, but in 1698 he entered the service of Augustus II. of Saxony and Poland, and the formidable alliance which was formed shortly after against Charles XII. by Augustus II., Peter the Great, and Frederick IV. of Denmark was principally Patkul's work. It seems, however, as if he could serve no friend and no purpose with full faith. In 1705 Augustus II. arrested him and put him in the dungeons of Sonnenstein; and when Charles XII. made Patkul's surrender one of the conditions of peace, Augustus II. consented. On leaving Saxony the Swedes carried him away with them, and Oct. 10, 1707, he was broken on the wheel and beheaded in the convent of Kazimierz near Posen.

Patmore, Coventry Kearsey Dighton: poet; b. at Woodford, Essex, England, July 23, 1823; son of Peter George Patmore, a man of letters. He was assistant librarian in the British Museum 1846–68; author of *Poems* (1844); *Tamerton Church Tower* (1853); *The Angel in the House* (4 parts, 1854–62), and other works; edited the *Autobiography* of Barry Cornwall. A collective edition of his poems was issued in 1886. D. Nov. 26, 1896. H. A. B.

Patmos, or **Patinos** [Gr. Πάτμος, Mediæv. *Palmo'sa*]: an island in the Ægean Sea; one of the Sporades, all of which belong to Turkey; 29 miles W. from Asia Minor, and 18 miles S. of the western extremity of Samos. Steamships pass near it when going from Constantinople to Egypt or Syria. It is a jagged, irregular mass of rock, 9 miles long and 5 miles broad, composed of two unequal parts which are united by a narrow isthmus, on the east side of which is an excellent harbor. Barren and dreary, it was a dreaded place of banishment under the Romans. St. John was confined here under Domitian, and released on the tyrant's death (96). According to Greek tradition he wrote his Gospel in the little village of Katavafsis, which no longer exists, and the Apocalypse in the south part of the island in a grotto now included in the tiny chapel of St. Anne, half way up the hill overlooking the town. This hill is crowned by the forest-like monastery of St. John the Theologian, erected in 1088, and now occupied by about forty monks. In the library are 239 manuscripts. The archives contain valuable ecclesiastical documents. The air is remarkably healthful, and pest and cholera are unknown. The inhabitants, numbering about 4,000, are industrious Greeks who gain a scanty subsistence by fishing, navigation, weaving a coarse kind of cloth, and working in Asia Minor or on the larger islands.

E. A. Grosvenor.

Pat'na: city; in the province of Bengal, British India; on the right bank of the Ganges, 285 miles N. W. of Calcutta (see map of N. India, ref. 6–H). It extends with its suburbs along the river for a distance of 7½ miles. It is indifferently built, handsome brick buildings alternating with mud huts covered with tiles or thatched; but it has some manufactures of shawls, table-cloths, lacquered ware, and, being situated on the East India Railway, it has become the center of the opium-trade. It is the chief seat of Mohammedanism in India. Pop. (1891) 165,192.

Paton, John Gibson, D. D.: missionary; b. on the farm of Braehead, parish of Kirkmahoe, near Dumfries, Scotland, May 24, 1824; during his educational course in the University of Glasgow and the Reformed Presbyterian Divinity Hall, he was missionary in Glasgow; was missionary in Tanna, New Hebrides, from 1858 till 1862, when he was driven away; traveled in the interests of the New Hebrides mission, in Australia 1862–63, in Great Britain 1863–64, in the Australian colonies 1865, in Great Britain and North America 1892–94; and since 1865 has been missionary in Aniwa, New Hebrides. Dr. Paton was moderator of the Synod of the Reformed Presbyterian Church in Scotland 1863; delegate to the Pan-Presbyterian Council in Belfast 1884, and at Toronto 1892. An account of his life has appeared in two forms—an autobiography edited by his brother, *John G. Paton, Missionary to the New Hebrides* (2 vols., London and New York, 1889–90; new ed. Chicago, 1 vol., 1892), and *The Story of John G. Paton Told for Young Folks* (New York, 1892). C. K. Hoyt.

Paton, Sir Joseph Noel: historical painter; b. at Dunfermline, Scotland, Dec. 13, 1821. He was a designer for a manufactory of damask fabrics, and went to London at the age of twenty, where he entered the schools of the Royal Academy. In 1847 his pictures entitled *Christ Bearing the Cross* and *The Reconciliation of Oberon and Titania* won for him a prize of £300 at the Westminster Hall competition. The latter work is in the National Gallery, Edinburgh. He was elected a member of the Royal Scottish Academy in 1850, and in 1867 was knighted. He is a sculptor of ability and a writer on archæological subjects. Studio in Edinburgh. William A. Coffin.

Patras: fortified town of Greece, in the Morea, on the Gulf of Patras; capital of the nome of Achaia and Elis; has a large though precarious harbor; is connected by rail with Athens (see map of Greece, ref. 16–J). Its customs receipts are larger than those of any other town in Southern Greece. The city is the seat of an archbishopric; and is well built and prosperous. It exports oranges, lemons, and currants, which are extensively cultivated in the vicinity. Pop. (1896) 37,958. E. A. G.

Patriarch [Gr. *πατριάρχης*, father or chief of a race, family, or country, patriarch; *πατριά*, fatherhood, paternal lineage, clan + *ἄρχειν*, rule]: a title. In the Old Testament it was applied to heads of families till the time of the twelve sons of Jacob, who were the last patriarchs. In Jewish post-Christian history the Jewish pontiff, whose authority centered at Tiberias and extended over all the Jews W. of the Euphrates from about 175 to 415, was called Patriarch of the Jews. In ecclesiastical history, in the fourth century the Bishops of Rome, Antioch, and Alexandria assumed the title, as representative of the Christians in Europe, Asia, and Africa respectively. To them were added the patriarchs of Constantinople and Jerusalem. The Roman Catholic Church reckoned twelve patriarchs attached to her communion; namely, of Constantinople, Jerusalem, Antioch, Venice, West Indies, Lisbon, Antioch (of the Melchites), Antioch (of the Maronites), Antioch (of the Syrians), of the Catholic Armenians in Cilicia, and the Chaldeans or Nestorians of Babylon; and also the Bishops of Aquileia and Bourges. The Eastern Orthodox or Greek Church reckoned five: of Constantinople, Rome, Alexandria, Antioch, and Jerusalem. Considering the patriarchate of Rome as vacant through heresy, she established the patriarchate of Russia in 1437, which was suppressed in 1700 by Peter the Great. Various other ancient Christian communities, as specially the Armenians, retain the same office and title. Patriarchal functions are mainly of precedence and supervisory.
E. A. Grosvenor.

Patriarchies: See Ethnology; also Indians of North America.

Patrician [from Lat. *patri'cius*, pertaining to the nobility, of senatorial rank, deriv. of *pa'tres*, nobles, senators, liter., fathers]: a name given to the members of the Roman *gentes*, constituting the original *populus Romanus*. The Roman historians supposed that originally the *patricii* were the sons of the senators or patres. So Livy: "Patres certe ab honore, patriciique progenies eorum appellati" (Liv. I. 8). Doubtless the true explanation of the word patrician is that offered by Mommsen; he says: "Whoever was begotten in an illegal marriage or out of marriage was excluded from the membership of the community. On this account the Roman burgesses assumed the names of the 'father's children' (*patricii*), inasmuch as they alone in the eye of the law had a father." (*Hist. of Rome*, ch. v., vol. i., p. 69, Eng. trans.) It is certain that the patricians were the original burgesses of Rome; in the earliest times there was no plebeian class inside the state. The patricians were divided into certain clans, *gentes* as they were called: the gentes were divided into families, and all these families were connected together by certain religious rites called *sacra gentilicia*. Attached to each household were the slaves and the clients, the latter including foreign refugees and emancipated slaves. Sometimes a patrician would marry a client's daughter, in which case the children resulting from the marriage would take rank neither with the patricians nor the clients; they would have no political rights, but would be independent. There were many ways in which a state of independency might be attained by the clients; as, for instance, when a patron died and left no heir. Thus there soon arose in Rome a third class, the plebeians. To the class so formed were added many citizens among the conquered tribes round about Rome; after the conquest of Alba many of their citizens were brought to Rome, only a few being received as burgesses, while the majority joined the plebeians. The civil history of Rome for more than four centuries after the foundation of the city presents a constant struggle between the two orders of patricians and plebeians. At the beginning of the struggle the whole political, judicial, and hierarchical power was in the hands of the patricians; at the end of it a perfect equalization had taken place. The first great advantage gained by the plebeians was the establishment of magistrates of their own, tribunes of the plebs (495 B. C.), for the sole object of the protection of plebeians. During the next half century from that date rapid advances were made; intermarriage between the two orders was sanctioned; the consulship was for a while discontinued and the office of military tribune established, to which plebeians were made eligible; and a way into the senate was prepared for the plebeians by throwing open the quæstorship. The patricians, however, at this date still retained some of the highest offices; they alone were eligible for the augurships and the pontificate. Further, two new offices were created—offices of the highest power—the censorship and the prætorship of the city. By the coming of the Gauls (390 B. C.) the work of equalization was thrown back somewhat, but only for a time. By the Licinian rogations the consulship was restored, and it was definitely arranged that one of the two consuls should be a plebeian. In B. C. 356 a plebeian was raised to the dictatorship; in 351 the censorship was thrown open; the prætorship followed soon after; and at length, in 300 B. C., the plebeians were elected to the highest sacred offices, the pontificate and the augurships. Some offices of no political significance continued to be reserved to patricians, but in general from this time forward the title of patrician carried with it no advantages apart from the respect which was considered due to high birth and the memory of noble ancestry. After the transference by Constantine of the seat of imperial authority to Byzantium the term *patricius* was made a personal title, indicating a rank a grade lower than that of consul. Revised by G. L. Hendrickson.

Patrick, Saint (Lat. form *Patricius*): the apostle and patron saint of Ireland. His baptismal name was *Succat* (brave in battle). His name as a captive was Cothraighe; later he was called Magonus, or Imigonus, or Maun; on his ordination he took the name Patricius. His birthplace is not certainly known, and his dates are all disputed. The dates in this article are probably only approximations. He says of himself, in his *Confession*, that he was born at "Bannavem Taberniæ," which may probably be identified with Kirkpatrick, near Glasgow, in Scotland. He was born about 372; was a captive and the slave of the King of Dalaradia in Ireland from 388 to 395; went to Gaul, and was there ordained priest and bishop; went to Ireland as a missionary in 432, and died at Saul, near Strangford Lough,

County Down, Ulster, where many years before he had founded his first church, on Mar. 17, 465, the day now sacred to his memory. Ireland was then occupied by a great number of petty tribes, most of which were evangelized by Patrick. So well was the work accomplished that Ireland became known as the "island of the saints." The method employed was that of dealing cautiously and gently with the old paganism of the people. The chieftains were first won over, and then their clans. Much that has been related of Patrick is fabulous; but his autobiographical *Confession* and his *Epistle to Coroticus*, both unquestionably genuine, reveal a devout, simple-minded, unlettered man, and a most discreet and energetic missionary. It is a very curious fact that in these writings of his we find no mention of the pope, and no trace of purgatory, auricular confession, transubstantiation, or worship of the Virgin; while salvation by faith and all the related doctrines are clearly taught. See W. D. Killen's *Ecclesiastical History of Ireland* (2 vols., London, 1875); Whitley Stokes's *The Tripartite Life of St. Patrick, with other Documents relating to that Saint* (1887); Eng. trans. of all his writings, by C. H. H. Wright (1889). Revised by S. M. Jackson.

Patriotic Societies in the U. S.: See the Appendix.

Patripas'sians, or **Monarchians** [*Patripassians* is from Lat. *pa'ter*, *pa'tris*, father + *pa'ti*, *pas'sus*, suffer; *Monarchians* is from Gr. *μόνος*, single + *ἀρχή*, first place, beginning, principle]: Antitrinitarians of the ancient Christian Church, who either taught, or were charged with teaching, either expressly or by implication, that God the Father was incarnated and suffered in the person of Jesus Christ. They denied the doctrine of Three Persons in the Godhead, teaching only three manifestations of the One Person. For themselves, they claimed that they were emphasizing both the unity of God and the divinity of Christ. Of those who held to the heresy in its bolder form, the most eminent were Praxeas of Asia Minor, who was in Rome between 190–200 A. D., Noëtus, who was excommunicated at Smyrna shortly after 200, and the two popes Zephyrinus (202–218) and Callistus (218–223). A much finer type of the heresy was developed by Beryllus of Bostra, recovered to orthodoxy by Origen in 244, and by Sabellius of Ptolemais in Egypt, 250–260 A. D., whose system has frequently reappeared, especially in Occidental Christendom. See Christology.

Patroclus (in Gr. *Πάτροκλος*): the friend of Achilles; a son of Menoëtius of Opus, a brother of Peleus, the father of Achilles. Of his participation in the Trojan war, his death by the hand of Hector, and the frightful revenge which Achilles took, the *Iliad* contains a grand picture in its songs xvi.–xxiii.

Patronage [from Lat. *patro'nus*, protector, patron, deriv. of *pa'ter*, father]: in general, the right of making appointments to vacant benefices, but it is commonly limited to the right of presenting candidates to vacant ecclesiastical benefices. So long as the Christian Church was chiefly missionary there could, of course, be no question of patronage. In the district or diocese which was placed under his superintendence the bishop fixed his residence at the religious house, where he lived together with a number of priests, as many as were sufficient for the religious instruction of the population of the diocese, and the whole establishment was maintained at the expense of the episcopal treasury. In course of time the bishop at the cathedral church would establish and endow branch churches in his diocese and nominate a priest among the *episcopi clerus*, who enjoyed the revenues of the parish endowment. Soon, however, when Christianity became the generally accepted religion, the bishop became unable to provide his whole diocese with churches or the churches with revenues. Private persons of wealth and piety then took the duty upon themselves. The count, the baron, the lord of the castle, built on his domain a church and endowed it with land or other property sufficient to maintain the building and the priest. He now became the patron of this church; and he enjoyed the right of nominating a person in holy orders to be the officiating minister. So far the development was natural and sound. The third Lateran Council of 1179, and also the fourth of 1215, decreed that presentation by the patron, or induction, as it was called, was by itself not sufficient to confer any ecclesiastical benefice, as it referred only to the temporalities of the office; institution or investment, with its spiritualities, was furthermore necessary; and as this could only be given by the Church, the bishop, or the pope, the patron's right of appointment was thereby actually annulled. In the thirteenth century the pope claimed for himself the patronage of all benefices whose incumbents died at the court of Rome; and as the number of ecclesiastics of all ranks and from all countries who visited Rome was very great, this claim was of considerable importance. The pope also gave dispensations for non-residence and for holding several benefices at the same time, and even assumed the right of giving away bishopries, abbacies, and other ecclesiastical benefices before they were vacant—a measure which roused general indignation, so much the more as it was well known that he sold them. In England, under Edward I., an act of Parliament made every one subject to heavy penalties who should venture to enforce the authority of such papal provisions in England. France also made vigorous and successful protest. (See Gallican Church.) With the Reformation the patronage generally returned to the original possessor, the founder of the church. In England it is treated exactly like any other piece of property; it may be connected with the manor, and is then called *appendant advowson*, and it may have been separated from it and belong to a person, in which case it is called *advowson in gross*. In Scotland it was twice canceled and twice re-established; it still exists there, but in a somewhat restricted form. In Denmark it was abolished by the constitution of 1848. In the Episcopal Church in the U. S. the right of appointing to vacant ecclesiastical positions, such as rectorships or the position of an assistant minister, rests with the vestry as representing the congregation. Sometimes the bishop has a coordinate power with the vestry, or the right to choose one from two or more nominations. Rarely, if the clergyman is not liable to episcopal censure, can the bishop veto the appointment of one of his vestries. In unorganized congregations or missions the bishop usually nominates the incumbent. Revised by W. S. Perry.

Patronage (in politics): See Civil Service.

Patrons of Husbandry: a secret order having for its object the mutual protection and advancement of the interests of the agricultural classes.

At the close of the civil war in the U. S. the agricultural interests in the Southern States were greatly depressed; the poverty of the farmers, the difficulty in obtaining efficient labor, the imperfect and ruinous methods of cultivation, and the absence of mixed husbandry were sufficient causes for this depression. In order to seek relief, President Johnson appointed O. H. Kelly, of the Bureau of Agriculture, as agent of the Department of Agriculture of the South, to collect statistical information for publication with a view to encouraging immigration to the South. While on this mission he conceived the idea of an association that would not only improve the condition of agriculturists in all parts of the U. S., but would also bind them into one great brotherhood. He communicated his conclusions to several employees of the Government at Washington, who received Kelly's plan of organization with favor, and held a conference with him on Nov. 15, 1867, when "Patrons of Husbandry" was adopted as the name of the order and the "grange" as the name of its constituent bodies and place of meeting. On Dec. 4 of the same year another meeting was held, officers were elected and the National grange formally organized. The early growth of the order was slow, and many obstacles seemed almost insurmountable for the time being. In Jan., 1871, not more than eighty-eight subordinate granges and three State granges were in existence, but during that year the number of granges was more than doubled and for many years each succeeding year brought many new granges and greatly increased membership. In 1892 nearly every State and Territory contained granges, and many were reported in Canada.

In States where granges are most numerous they have been a potent factor in improving the condition of the farmer and his family. The saving in money by combining orders and purchasing for cash, encouraging the practice of selling direct to the consumer and buying from the manufacturer, the combining of granges in one or more counties to form mutual fire relief associations—all have aided in improving the financial condition of the members of this order; yet even greater benefits have been derived from the discussion and practice of improved methods of agriculture, the establishment of grange libraries and reading-circles, and the great prominence given to educational work.

Comparatively early in the history of the order the granges in several of the Western States undertook the control of the railways, elevators, and other commercial enter-

prises, with indifferent success for the time being: afterward they succeeded in bringing about more favorable legislation for the agriculturist. The founders made it a part of the fundamental law that the order should not meddle with political questions. Agriculturists of all political parties and of none are equally welcome in the order, but they must not bring into it discussion of partisan politics or party measures under penalty of expulsion.

Though the National grange was formed first the *subordinate grange* is really the unit of organization, and must consist of fifteen members, of whom not less than four must be women. A complete grange must have thirteen officers, viz.: Master, overseer, lecturer, steward, assistant steward, chaplain, treasurer, secretary, and gate-keeper may be all men: Ceres, Pomona, Flora, and lady assistant steward must be all women. These each have their appropriate insignia of office and their well-defined duties. There is also an executive committee of three persons, and often an organist and librarian. Subordinate granges confer four degrees, and all business meetings are held in the last or fourth degree. The meetings of subordinate granges are held monthly or oftener, and may determine upon such measures as shall promote the interests of the grange and its members. *Pomona granges* are county or district organizations composed of masters and past masters of subordinate granges and their wives, who are members with other fourth degree members in good standing, who are recommended by subordinate granges in the county for the fifth degree. The Pomona grange is essentially a fifth degree grange, although its business, aside from degree work, is done in the fourth degree. *State granges* are composed of masters of subordinate granges and their wives, who are members of subordinate granges. It is, however, provided that when these become so numerous as to render the body too large, delegates shall be selected to represent the whole body upon such a basis as the grange shall decide. The sixth degree belongs to the State grange, though it may confer the fifth degree at pleasure. The *National grange* is the highest in authority, and the laws enacted by the State, Pomona, and subordinate granges must not conflict in any way with those enacted by this body. The National grange confers the sixth and seventh degrees. The State and National granges meet annually. The officers of the State and National granges are the same as those of the subordinate grange. The officers of the subordinate granges are elected for one year, those of the State and National granges for two years. GEORGE C. WATSON.

Patronymic [from Gr. *πατρωνυμικός*, like the father's (sc. *ὄνομα*, name); *πατήρ*, father + *ὄνομα*, name]: a proper name formed upon the basis of a father's or ancestor's name, and indicating descent. Family names like Johnson, Williamson, Peterson, were originally patronymics attached to the Christian name of an individual for the sake of more precise distinction. The element *Mac-* in Irish names like MacCarthy signifies "son of" (O. Ir. *macc*, boy), and is cognate with Goth. *magus*, boy, from which Goth. *magaþs*, girl: Germ. *magd*: Eng. *maid*; similarly the Aramaic *Bar-* in names like *Bar*abbas, *Bar*timeus, *Bar*tholomeus. Very commonly a mere suffix serves the purpose, as in the case of the Greek *-ides*, as *Peleides*, son of *Peleus*, *Philippides*, son of *Philippos*; or *-īon*, as *Kronīon*, son of *Kronos*. In Teutonic the suffix *-ingas* or *-ungas* is used similarly; thus O. Eng. *Hrēþling*, son of *Hrēþel*; also in tribal names, O. Eng. *Wylfingas*: M. H. Germ. *Wülfinge*. It survives in modern English family names and place-names like *Manning*, *Billings*, *Reading*, *Walsingham*, *Buckingham*; cf. Germ. names *Göttingen*. This suffix represents an Indo-Europ. *-enḱós*, or *-n̥ḱós*; cf. Gr. *-ακος* in *Ἵππακος* (: *Ἵππων*). B. I. W.

Patroons: those Dutch settlers in the colony of New Netherland (afterward New York), who on certain conditions as to colonizing enjoyed manorial rights over their lands. To obtain the privileges of a patroon it was necessary to plant a colony of fifty persons over fifteen years of age on lands selected for the purpose, and within four years after notice was given of intent to colonize. The rights of these proprietors, as enumerated in the charter of 1629 "to all such as shall plant colonies in New Netherland," were of a semi-feudal nature, and the colonies were governed by the same laws as the feudal manors of the United Provinces. Accused of encroachment on the rights of the West India Company, the patroons were involved in continual quarrels with the directors, and were more zealous in undertaking trade ventures for their own profit than in bringing in new colonists. The feudal tenures of these manorial lords were maintained after the Revolution, and although laws were passed in 1779 and 1785 abolishing them, the proprietors contrived a form of deed by which the tenant bound himself to perform services and pay rents and dues in the same manner as before the old system was abolished. From 1839 to 1847 there was considerable opposition to these burdens, and associations of so-called ANTI-RENTERS (*q. v.*) were organized to redress the grievances of tenants. F. M. COLBY.

Patten, SIMON NELSON, A. M., Ph. D.: economist; b. at Sandwich, Ill., May 1, 1852; educated at Northwestern University, Evanston, Ill., and at the University of Halle, Germany, where he received the degree of Ph. D. in 1878. He was elected Professor of Political Economy in the University of Pennsylvania 1888. He is author of *The Stability of Prices* (1888); *The Consumption of Wealth* (1889); *The Economic Basis of Protection* (1890); *Principles of Rational Taxation* (1890); *The Educational Value of Political Economy* (1891); *The Theory of Dynamic Economics* (1892); and many valuable papers on economic topics to the *Annals* of the American Academy of Political and Social Science, *The Political Science Quarterly*, *The Journal of Economics*, Conrad's *Jahrbücher*, and other periodicals. C. H. T.

Patterson, CARLILE POLLOCK: superintendent of civil survey; son of Daniel Tod Patterson; b. at Shieldsboro, Bay of St. Louis, Miss., Aug. 24, 1816; appointed midshipman Sept., 1830; joined the frigate Brandywine in October, and served in the Mediterranean squadron; in Feb., 1836, returned to the U. S. in the line-of-battle ship Delaware, carrying his father's flag as commodore; was passed midshipman June, 1836; graduated from Georgetown College, Ky., as civil engineer early in 1838; joined the U. S. Coast Survey, and served until 1841; as second lieutenant of the U. S. brig Boxer cruised in the West Indies until Jan., 1844; again in Coast Survey in 1845, and conducted a hydrographic party in the Gulf of Mexico; took command of Pacific mail steamship Oregon in Jan., 1850; resigned as lieutenant in the navy Sept., 1853, and remained on the Pacific coast until Mar., 1861. In May, 1861, he became hydrographic inspector U. S. Coast Survey, and so continued until Feb. 17, 1874, when he was appointed superintendent of that work. D. Aug. 15, 1881. See COAST AND GEODETIC SURVEY.

Patterson, DANIEL TOD: naval officer; b. on Long Island, N. Y., Mar. 6, 1786; appointed midshipman in the navy in 1800; attached to the frigate Philadelphia when that vessel ran on a reef near Tripoli in Oct., 1803, and surrendered to Tripolitan gunboats. Patterson remained a prisoner until peace was concluded in 1805; promoted to the rank of lieutenant in 1807, and of master-commandant in 1813. In 1814 he commanded naval forces at New Orleans, and for able co-operation with Gen. Jackson in defending that city received the thanks of Congress. He commanded the flotilla which captured and destroyed the forts and other defenses of Lafitte, the pirate, on the island of Barataria; was appointed captain in Feb., 1815; commanded the frigate Constitution 1826–28 in the Mediterranean; served as navy commissioner 1828–32; commanded the Mediterranean squadron 1832–36; and from 1836 was commandant at the navy-yard, Washington, where he died in 1839.

Patterson, Rev. GEORGE: See the Appendix.

Patterson, JOHN: b. at New Britain, Conn., 1744; graduated at Yale College 1762; became a lawyer; removed to Lenox, Mass., 1774; was a member of the first and second provincial congresses of Massachusetts 1774–75; raised a Berkshire regiment of minute-men and started for Cambridge within eighteen hours of receiving the news of the battle of Lexington; took part in the disastrous expedition against Canada and the battles of Trenton and Princeton; was appointed brigadier-general Feb. 21, 1777; rendered important services at the battle of Stillwater; was present at Burgoyne's surrender and at the battle of Monmouth; remained in service throughout the war; was engaged in the suppression of Shays's rebellion 1786; settled soon afterward at Lisle, Broome co., N. Y.; became a county judge, member of the State Legislature, of the constitutional convention of 1801, and of Congress 1803–05. D. at Lisle, July 19, 1808.

Patterson, ROBERT: military officer; b. in Tyrone County, Ireland, Jan. 12, 1792; at an early age came to the U. S., and subsequently became a very successful merchant of Philadelphia. On the outbreak of the war with Mexico he was appointed a major-general of volunteers in the service

of the U. S., and commanded a division under Gen. Scott, taking part in the battle of Cerro Gordo. On the breaking out of civil war in 1861 he was mustered into the service of the U. S. as major-general of Pennsylvania troops assembled under the President's first call on the States (Apr. 15, 1861) for 75,000 men for three months. Commanding the force on the Potomac in the neighborhood of Harper's Ferry, opposed to the Confederate force under Gen. J. E. Johnston, he was charged with neutralizing that force and preventing its junction with Beauregard at Manassas Junction; but Johnston succeeded in effecting a junction, his advance reaching Manassas on the 20th, the battle of Bull Run ensuing the next day. (See BULL RUN.) On the expiration of his commission (July 27, 1861) Gen. Patterson was mustered out of service. He from that time resided in the city of his adoption, Philadelphia, one of her most honored and influential citizens, and one of the largest mill-owners in the U. S. D. Aug. 7, 1881.

Patterson, ROBERT WILSON, D. D., LL. D.: minister; b. near Maryville, Tenn., Jan. 21, 1814; was educated at Illinois College and Lane Seminary; was tutor in Illinois College 1839–40; supplied several churches 1840–42; was pastor of the Second Presbyterian church, Chicago, from its organization, 1842–74; Professor of Evidences and Ethics in McCormick Seminary 1873–81; president of Lake Forest University 1876–78; and lecturer in Lane Seminary 1880–83. Dr. Patterson was moderator of the General Assembly (New School) at Wilmington, Del., in 1859. D. in Evanston, Ill., Feb. 28, 1894. C. K. HOYT.

Patteson, JOHN COLERIDGE, D. D.: missionary; b. in London, England, Apr. 1, 1827; educated at Merton and Baliol Colleges, Oxford; became a fellow of Merton 1852; curate of Alfington, Devonshire, 1853; went in 1855 with Bishop Selwyn to New Zealand; labored as a missionary until 1861, when he was made Bishop of the Melanesian islands; spent the remainder of his life visiting the islands under his episcopal charge, and endeavoring to suppress the kidnaping of the natives to be carried to Queensland; was killed on the island of Nukapu by the Melanesians, Sept. 20, 1871. His *Life* has been written by Miss C. M. Yonge (2 vols., London, 1874) and by Francis Awdry, *The Story of a Fellow-soldier* (1875).

Patti, ADELINA MARIA CLORINDA: singer; b. in Madrid, Spain, Feb. 19, 1843. Her father, Salvatore Patti, was a Sicilian, her mother a Roman, and both were operatic singers. In 1844 her parents removed to the U. S., and lived humbly in New York. At the age of four the child displayed wonderful talent. She received instruction on the piano from her sister Carlotta, who later became a singer of high reputation, and in vocalization from her step-brother Barili, and her brother-in-law, Maurice Strakosch. When about nine years of age Adelina appeared at a concert in New York, and achieved a remarkable success. In a series of concerts given in connection with Maurice Strakosch and Ole Bull, the infantile prima donna's share of the profits amounted to $10,000. On Nov. 24, 1859, she made her *début* in opera at the Academy of Music, New York, appearing as Lucia. She made professional visits to Boston, Philadelphia, and other cities, and went to Europe in 1861 under the management of Maurice Strakosch. The London managers would not give her an opportunity to sing, and she was on the point of returning to the U. S., when manager Gye, of Covent Garden theater, promised to allow her to sing three times, for which she was to receive no pay whatever. She appeared May 14, 1861, as Amina, in *La Sonnambula*, and her triumph was instantaneous. Since that time she has sung in all the capitals and the principal cities of France, Germany, Italy, Spain, Russia, Mexico, and South America. In 1868 she was married to the Marquis de Caux in London, but was divorced from him in 1878. She married, in Wales, Signor Nicolini, an opera-singer, June 9, 1886. Nicolini died in 1898, and in 1899 she married Baron Rolf Cedarstrom. She has a magnificent country-seat at Craig-y-Nos, Wales. Her repertory is chiefly confined to the Italian school.

Pattison, MARK: scholar: b. at Hornby, Yorkshire, England, 1813; was educated at Oriel College, Oxford, and was elected a fellow of Lincoln College, in that university, in 1840. In 1861 he became rector of his college. He published *Tendencies of Religious Thought in England from 1688 to 1750* (1860); *Report on Elementary Education in Protestant Germany* (1860; 2d ed. 1871); *Suggestions on Academical Organization, with Special Reference to Oxford* (1868); *Pope's Essay on Man*, with notes (1869; 6th ed. 1879); and *Pope's Satires and Epistles*, with notes (1872; 2d ed. 1874). He also wrote a biography of Milton, and a celebrated *Life of Casaubon* (2d ed. 1892), and published annotated editions of Milton's sonnets, etc. D. at Harrogate, July 30, 1884. A volume of his *Memoirs* was published in 1885; of collected *Sermons* in 1885; and of *Essays* in 1889. For a sketch of his wife, see DILKE, LADY EMILIA.

Revised by A. GUDEMAN.

Patton, FRANCIS LANDEY, D. D., LL. D.: clergyman; b. at Warwick, Bermuda, West Indies, Jan. 22, 1843; educated at University College, Toronto, Canada; studied theology at Knox College, Toronto, and at Princeton Theological Seminary, graduating at the latter institution in 1865; was ordained by the Presbytery of New York, and was pastor of Presbyterian churches in Eighty-fourth Street, New York, 1865–67, Nyack 1867–71, and Chicago 1874–81, and from 1871 to 1881 was Professor of Didactic and Polemical Theology in the Presbyterian Theological Seminary at Chicago. In 1873–76 he edited *The Interior* at Chicago; became Professor of the Relations of Philosophy and Science to Religion in Princeton Theological Seminary 1881; and in 1888 president of the College of New Jersey. He was moderator of the Presbyterian General Assembly in 1878.

Revised by S. M. JACKSON.

Patuxent River: a stream which rises 18 miles E. of Frederick, Md.; flows S. S. E. and S., and falls at last into Chesapeake Bay by a wide and deep estuary. Its valley is very narrow, and the river is for many miles a navigable tidal stream, abounding in oyster-beds of great value.

Patwin Indians: See COPEHAN INDIANS.

Patz'cuaro: a city near the central part of the state of Michoacan, Mexico; beautifully situated on the plateau, by a lake of the same name; 7,185 feet above the sea; pop. (1893) about 10,000 (see map of Mexico, ref. 7–G). It is said to have been a very ancient capital of the Tarascan Indians. The lake is about 30 miles in circumference, and contains several forest-covered islands. Patzcuaro is connected with Morelia and Mexico by rail, and, being the center of a rich agricultural region, is rapidly growing. Much of the beautiful feather-work sold in Mexico is made here. H. H. S.

Pau, pō: chief town of the department of Basses-Pyrénées, France; picturesquely situated on the Gave du Pau, at a height of over 600 feet above the sea; 143 miles S. S. E. of Bordeaux (see map of France, ref. 9–D). It has fine promenades, commanding magnificent views of the Pyrenees. It was formerly the capital of the kingdom of Béarn and Basse-Navarre, which was united to France in 1620. It has a remarkable old castle, built by Gaston de Foix in 1363, in which Henry IV. was born, several good educational institutions, linen, steel, leather, and chocolate manufactures, and an active trade in wine, hams, fruits, and flour; but the inhabitants chiefly depend upon their 4,000 winter visitors, of whom many come from England. Pop. (1896) 33,012.

Paul, SAINT: the apostle to the Gentiles; b. in Tarsus, in Cilicia, a province of Asia Minor, probably about 1 A. D. His name at first is Saul, but from Acts xiii. 9 Paul, without explanation of the change. He was a Benjamite and a Pharisee. He was also a free-born Roman citizen; his father must therefore have been enfranchised. As was the practice among the Jews, even those of independent condition, the lad was taught a trade. Hair-cloth for tents was one of the chief products of Cilicia, and the trade of tent-making was the one which this boy learned.

Education.—Doubtless he received such education as could be furnished in the synagogue schools of Tarsus; he was sent to Jerusalem, where he became a pupil of the great Gamaliel, grandson of Hillel, and one of the seven great Jewish Rabbans. Saul must have been studying in Jerusalem while Jesus was in seclusion at Nazareth; but it is unlikely that Jesus and Paul ever met. It is probable that after completing his study of the law with Gamaliel he returned to Tarsus, and was dwelling there during the term of Christ's public ministry.

Return to Jerusalem.—After the death of Christ we find Paul again in Jerusalem. The sect of the Nazarenes is growing rapidly, and Jewish conservatism is alarmed. One of the younger leaders of this sect, a deacon named Stephen, undertakes an active propagandism, and in the synagogues of "the Libertines and of the Cyrenians and of the Alexandrians and of them of Cilicia and of Asia" (Acts vi. 9) there is hot controversy between this zealous advocate of what the Jews called "The Way" and the orthodox Jews.

The Martyrdom of Stephen.—When, shortly after, Stephen was arrested and dragged before the Sanhedrin on a charge of blasphemy, Saul was undoubtedly present, for when Stephen was condemned to death by stoning Saul accompanied the mob of executioners to the place outside the gate where the deed was done, and the witnesses who hurled the missiles laid down their garments at his feet. The narrative in the Acts was written by one of Paul's traveling companions, and it is altogether probable that the report of the execution was gleaned from the apostle's own lips. That "Saul was consenting unto his death" is not an accusation but a confession, and the serene and triumphant faith of the first martyr made an impression on his mind which was never effaced. It has been supposed that either before or soon after the death of Stephen Saul was elected a member of the Sanhedrin; the principal evidence of this is his statement that he was not only active in the persecution of the Christians, but that when they were condemned to death he gave his vote against them (Acts xxvi. 10). This is the literal meaning of the Greek, but it may be used metaphorically. If Paul was a member of the Sanhedrin he must have been married and the father of a family, and the absence of all allusions to such relations, in those passages where a man of his mental habit would have been sure to refer to them, makes it seem highly improbable that he could have had a family.

Whatever may have been his official position, there is no doubt that he became about this time the leader of the persecution which was raging against the Christians. Not only in Jerusalem and its environs did he harry them to prison and to death, but by some strange confusion of jurisdiction or connivance of officials he received from the chief priests authority to proceed to Damascus, the capital of another province, five or six days' journey distant, that he might stamp out the heresy in that region.

It was on this journey that the remarkable event took place which changed the whole current of this impetuous life. Most truly has Dr. Harnack said that this event "has proved to be of transcendent importance for the religious history of mankind."

This man had been, as he testifies, a most conscientious observer and a most strenuous upholder of the Jewish law, but a hard, literal conformity to a merely external standard brought him no satisfaction, and his restless spirit sought in a still more intense devotion the peace which had always eluded him. The lonely journey to Damascus gave him time for meditation; doubtless the gentle and tolerant words of his old master Gamaliel came back to him with power, and in the midst of these mental overturnings a vision of the Nazarene appeared to him in the sky, and a voice in the Hebrew tongue cried: "Saul, Saul, why persecutest thou me?" Paul's own belief was that Jesus appeared to him. The one thing certain is that from this hour he ceased to be a persecutor of the Nazarenes and became, in due time, their foremost leader. At Damascus he was received and befriended by those whom he had come to destroy.

"Many days" passed, not less than three years, it would seem, before Paul ventured to return to Jerusalem. Part of this time was spent, as he tells us, in seclusion in Arabia. He felt that repose and meditation were needed that he might comprehend the nature of his vocation, and understand the relation between the old faith and the new. When, at last, he went back to the scene of his Pharisaic exploits, although the distrust of the disciples was overcome, the enmity of his former coreligionists was inflamed, and he was forced to flee to his home in Tarsus. Here he tarried, we know not how long, perhaps preaching Christ in the synagogues of Cilicia. After a while a remarkable interest in the story of the Gospel was awakened in Antioch, and Barnabas, who had been commissioned to take the superintendency at that place and who had great confidence in Paul, sought him out at Tarsus and entered into active association with him in this work. Here for more than a year these two wrought side by side in the great Syrian capital, and here it was that the disciples, who became a great multitude, were first called Christians.

Missionary Journeys.—From Antioch Barnabas and Saul set forth upon the first of those missionary journeys which were to occupy the remainder of his active life. These journeys took him by sea many times across the Eastern Mediterranean and the Ægean, and by land through Syria and the whole of Western Asia and Southern Europe; in nearly every prominent city of Asia Minor and of Greece he preached the Gospel and established churches; his activity during these missionary years must have been prodigious. In the first of these journeys he was accompanied by Barnabas and Mark, later by Silas and Timothy and Luke, the writer of the Acts of the Apostles. His practice on entering any city was to put himself first in communication with the synagogue of the Jews, and to impart to them his message; if they would not receive it he turned to the Gentiles. His success in gathering converts and establishing churches, when measured by the standards of modern missionaries, was certainly phenomenal. In Ephesus, in Thessalonica, in Athens, in Corinth he heralded the Gospel, sometimes to groups gathered in the market-places, sometimes to assemblies of philosophers, sometimes in little companies assembled in some hospitable home.

Arrest in Jerusalem.—On his return from his third missionary journey he was arrested in Jerusalem on the charge of profaning the temple, and was only saved by Roman officers from destruction by the mob. After a tedious imprisonment he appealed to the emperor's court, and so at last was forwarded as a prisoner to Rome, where for two years he awaited trial, dwelling in his own hired house, "receiving all that went in unto him, preaching the kingdom of God, and teaching the things concerning the Lord Jesus Christ with all boldness, none forbidding him" (Acts xxviii. 31). This is the end of all historical record concerning the apostle. There are many conjectures and traditions respecting his future career, and inferences from some of his epistles make it probable that his first trial resulted in an acquittal; tradition says that he then set forth upon another missionary journey, which was interrupted by his arrest and his second imprisonment at Rome, where he finally suffered martyrdom. All these rest upon very uncertain foundations.

The trustworthy records of Paul's life are found only in the Acts of the Apostles and in his epistles. (See Pauline Epistles, The.) Of the latter, thirteen in the New Testament are ascribed to him, not counting the Epistle to the Hebrews; nearly one-fourth of the bulk of the New Testament literature is supposed to have come from his pen. The authorship of some of these epistles is, however, in dispute. From the letters whose genuineness is unquestioned we may have the substance of his doctrine. Paul was the philosopher of the apostolic group; it is to him that we chiefly owe the reasoned statement of the principles of Christianity.

Doctrine.—Paul's doctrine is, moreover, largely the product of his own experience; what he teaches he has verified. He knows that neither perfection nor peace can be won by "the deeds of the law"; that neither in obedience to an external rule nor to the ethical imperative is the way of life revealed. The effort after self-perfection only emphasizes the self; when our thought is fixed upon our own performance, we miss, through our self-consciousness, the beauty of holiness. By the deeds of the law shall no flesh be justified. It is only when the soul goes out of itself in unselfish devotion to some worthy object that it finds life. When the man who has been struggling after perfection by obedience to the law learns that the struggle is hopeless, and surrenders himself to Him who in his own person reveals the law of the spirit of life, he passes from bondage to liberty, from death to life. Thus Christ is the end of the law for righteousness to every one who believeth; the perfection that we miss by aiming at it, we win by an unselfish trust in Him who is the revelation in human form of the divine perfection. It is impossible here to present, even in outline, the various analogies under which Paul seeks to express these sublime truths. His glowing metaphors have often been hardened into dogmas, but it has been impossible to suppress the life that pulsates through all his writings; after the Christ, in whom and for whom he lived, he is the one incomparable teacher of Christendom.

The First Reformer.—He is also the first of the Christian reformers; but for him the apostolic church would have been only a modified type of Judaism. The other apostles were strongly inclined to insist that no man could become a Christian without first becoming a Jew. It was Paul who demolished this barrier and opened the door of the Christian fellowship to the Gentile world. No more daring innovation was ever attempted. The victory which was won for Christian liberty in the council of Jerusalem, under the leadership of Paul, was one of the most illustrious and beneficent in Christian history. From this time his commission as the apostle to the Gentiles was unquestioned, and the truth "that the Gentiles are fellow heirs and fellow members of the body of Christ and fellow partakers of the

promise in Christ Jesus through the Gospel" was once for all established as the Christian doctrine.

LITERATURE.—Of books devoted to the life of Paul, a few of the most accessible are Conybeare and Howson's *The Life and Epistles of St. Paul*; Farrar's *The Life and Work of St. Paul*; Lewin's *The Life and Epistles of St. Paul*; and Stalker's *The Life of St. Paul*. Of books in foreign languages, some of the more important are Neander's *History of the Planting and Training of the Christian Church*; Baur's *Paul the Apostle of Jesus Christ*; and Renan's *The Apostles* and *St. Paul*. WASHINGTON GLADDEN.

Paul, Saint VINCENT, de: b. at Pony, Gascony, Apr. 24, 1577, in humble circumstances; received his first instruction from the Franciscan friars at Acqs; studied afterward at Toulouse: took holy orders in 1600, and was captured in 1605 by pirates on a voyage from Marseilles to Narbonne, and carried as a slave to Tunis. In 1607 he succeeded in making his escape; visited Rome and then Paris; was appointed chaplain to the ex-queen Margaret of Valois, and in 1622 chaplain to the galleys at Marseilles; repaired in 1627 to Paris, where he developed an extraordinary activity in the establishment and management of charitable institutions, hospitals, asylums, etc., and in the foundation of religious fraternities, the Lazarists, the Sisters of Charity; was a member of the "council of conscience," by which all ecclesiastical preferments were distributed. D. at St. Lazare, Sept. 27, 1660. He was a man not only of great religious and philanthropic zeal, but also of wonderful knowledge of human nature, great practical tact, and unflagging energy. His order of the Priests of the Mission, confirmed by Parliament in 1631 and settled in the house of St. Lazarus in 1632, was not immediately successful, but became eventually an institution of great importance. He was beatified by Benedict XIII. in 1729, and canonized by Clement XII. in 1737. His *Maxims and Counsels for Every Day in the Year* appeared in English translation (London, 1884). There are numerous *Lives* of the saint, e. g. in French by A. Loth (Paris, 1879) and Jean Morel (1884); in English by C. A. Jones (London, 1873).

Paul: the name of several popes. PAUL I., a Roman, succeeded his brother, Stephen III., in 757, and died at Rome, June 28, 767. He was an able prelate, and strengthened the papal authority in spite of its numerous enemies.—PAUL II. (*Pietro Barbo*), b. at Venice, Feb. 26, 1418; became a cardinal in 1440; was chosen in 1464 to succeed Pius II. He is especially noted for his hostility to the spirit of the Renaissance and his persecution of the humanists. He preached a crusade against George Podiebrad, King of Bohemia, who favored the Hussites. D. at Rome, July 28, 1471.—PAUL III. (*Alessandro Farnese*), b. at Canino, Feb. 29, 1468; succeeded Clement VII. as pope in 1534. He pursued with address and vigor his two chief aims in life, the aggrandizement of the Farnese family and the suppression of heresy. Among the prominent events of his important pontificate were the publication of a brief condemning slavery in 1537, the excommunication of Henry VIII. of England 1538, the approval of the order of Jesuits 1540, and the convocation of the Council of Trent 1545. D. at Rome, Nov. 10, 1549.—PAUL IV. (*Giovanni Pietro Caraffa*), b. at Capriglio, June 28, 1476; became Archbishop of Chieti 1507; was nuncio to London, and later had a high public office at Madrid; became Archbishop of Brindisi 1518; founded the Theatines 1524; became cardinal 1536; succeeded Marcellus II. as pope 1555; joined France in the war for the conquest of Naples from Spain 1555–57; strove for the elevation of his family, and his impolitic course regarding England and Germany strengthened the Protestant cause. He was bitterly hated by the common people of Rome on account of his austere rule. D. at Rome, Aug. 18, 1559.—PAUL V. (*Camillo Borghese*); b. at Rome, Sept. 17, 1552; became legate to Spain and cardinal 1596; succeeded Leo XI. as pope 1605. This pontificate was marked by the interdict laid upon Venice, the close of the Molinist controversy, the establishment of the Congregation of the Oratory and the orders of the Ursulines and the Visitation, and by great activity in the work of missions in heathen regions. D. at Rome, Jan. 28, 1621.

Paul: Czar of Russia; b. at St. Petersburg, Oct. 2, 1754; was the son of Peter III. and Catherine II.; succeeded to the throne on Catherine's death in 1796. He immediately set about to reverse her policy in every particular. His reign began well. Kosciusko and the other Polish prisoners were liberated and treated with generosity. In 1799–1800 his troops served in Italy and Switzerland against France; but in 1800 he changed sides, embraced the cause of Napoleon, and challenged to personal combat any prince who refused to join him in a league against Great Britain. Meanwhile the pucrilities and tyrannies of his rule begot a strong popular discontent, and he was murdered in his bed-chamber by his nobles, Mar. 24, 1801. Paul had some generous qualities. His own family he treated with a kindness before almost unknown in the Russian imperial house. He intended, it is said, to give Poland her freedom and autonomy; but his feeble intellect, his scanty education, and an absurd and almost insane self-conceit led him into many acts of tyranny.

Paul, powl, HERMANN, Ph. D.: philologist; b. at Salbke, Magdeburg, Prussia, Aug. 7, 1846: studied in Berlin and Leipzig; lectured in the University of Leipzig 1872–74; became professor at Freiburg, Baden, in 1874. He has published: *Ueber die ursprüngliche Anordnung von Freidanks Bescheidenheit* (1870); *Zur Kritik und Erklärung von Gottfrieds Tristan* (1872); *Gab es eine mittelhochdeutsche Schriftsprache?* (1872); *Zur Nibelungenfrage* (1877); *Untersuchungen über den germanischen Vocalismus* (1879); *Principien der Sprachgeschichte* (1880); *Mittelhochdeutsche Grammatik* (1881); an edition of *Gregorius*, by Hartmann von der Aue (1873); *Altdeutsche Textbibliothek* (1882, *sqq.*); *Beiträge zur Geschichte der deutschen Sprache und Literatur* (1874–91); *Grundriss der germanischen Philologie* (1889, *sqq.*).
BENJ. IDE WHEELER.

Paulding, JAMES KIRKE: author; b. in Pleasant Valley, Dutchess co., N. Y., Aug. 22, 1779. He received a scanty training in school, and in early life removed to New York, where his sister had married William, an elder brother of Washington Irving, with whom he became associated in the authorship of *Salmagundi* (1807), but the second series of *Salmagundi* (1819) was by Paulding alone; became in 1814 secretary of the board of navy commissioners; was navy agent at New York city from 1825 to 1838, and was Secretary of the U. S. Navy 1838–41; was a facile essayist and humorist, and author of numerous works, among which were novels, political pamphlets, poems, etc. The best of his writings are *The Dutchman's Fireside* (1831), a novel, and a *Life of Washington* (1835). D. at Hyde Park, N. Y., Apr. 6, 1860. Revised by H. A. BEERS.

Paulding, JOHN: b. in New York, 1758; served through the Revolutionary war, being three times taken prisoner; was one of the captors of Maj. André, for which service he received from Congress a silver medal, inscribed on one side "Fidelity" and on the other "Vincit Amor Patriæ," and was granted an annuity of $200. D. at Staatsburg, N. Y., Feb. 18, 1818. A monument to his memory was erected at Peekskill over his remains in 1827 by the corporation of the city of New York, and his name has been given to one of the northwest counties of Ohio, his companions, Van Wart and Williams, having been similarly honored.

Pauli, pow'lĕĕ, GEORG REINHOLD: b. in Berlin, Germany, May 25, 1823; studied philology and history at Berlin and Bonn; lived in Great Britain from 1847 to 1855, and was appointed Professor in History at Rostock in 1857, at Tübingen in 1859, at Marburg in 1867, and at Göttingen in 1870. Besides several minor essays on various subjects, and some larger works relating to the history of England, he wrote *König Alfred und seine Stellung in der Geschichte Englands* (Berlin, 1851; Eng. trans. by Thomas Wright, London, 1852) and *Bilder aus Alt-England* (Gotha, 1860; Eng. trans. by E. C. Otté, London, 1861). The sharp criticism to which he subjected the policy of the government of Würtemberg in a review in the *Preussische Jahrbücher* (1866) occasioned his removal from Tübingen to Marburg. D. June 3, 1882.

Pauli'cians: a dualistic sect of the Eastern Church, which originated in Armenia in the middle of the seventh century, in the village of Mananalis, near Samosata, where lived Constantine Silvanus, its founder, and preached in that locality from 657 till 684, when he was stoned for heresy. Our knowledge of the sect comes from their enemies, and is defective as well as vitiated by prejudice; but it seems to be proved that they were dualists; held that the soul proceeded from God but the body from the evil one; denied the perpetual virginity of Mary, and opposed Mariolatry, the doctrine of the atonement, and the Church view of the sacraments. Their founder had put an inordinate value upon the Pauline epistles, and so did his followers.

They also had in their canon the four Gospels, the Acts, the Epistles of James, John, and Jude; but they rejected the Epistles of Peter, because he had opposed Paul, the Revelation, and all the Old Testament. They were zealous for the Scriptures, and held in honor those among them who were their copyists and circulated these copies. They had no sacerdotal caste, but pastors and teachers, and were devout Bible students. After their founder their great man was Sergius, murdered for his faith's sake (835). After it had spread quietly in Armenia for about two centuries, though now and then persecuted by the Byzantine emperors, the Empress Theodora (842–857) undertook to suppress the sect. More than 100,000 are said to have been put to the sword, and the rest were exiled. Some fled to the Saracens, others to the Bulgarians, and in Bulgaria remnants of the sect were found as late as the sixteenth century. In the thirteenth century Paulician ideas were introduced into Europe by those who returned with the crusaders, and such sects as the Cathari and Bogomiles had Paulician elements.

SAMUEL MACAULEY JACKSON.

Pauline Congregation: See PIARISTS.

Pauline Epistles, The: letters written to churches and individuals by the apostle Paul.

1. *Number, Order, and Date.*—It is the common opinion that thirteen of these epistles have been preserved to us. From about the fifth century to the Reformation era the Epistle to the Hebrews was also reckoned as a Pauline epistle, making fourteen. This opinion arose in the Eastern Church, and at length became prevalent chiefly through the great influence of Jerome and Augustine. In the early centuries of the Christian era the epistle was not held to be Pauline by the Fathers of the Latin or Western Church. Clement of Rome quotes it, but does not refer it to Paul. Neither Irenæus nor Hippolytus quotes it as Paul's, and Tertullian ascribes it to Barnabas. Two considerations—one negative, the other positive—seem decisive against the Pauline authorship of Hebrews. (*a*) The epistle does not purport—as do all other alleged Paulines—to have been written by Paul. (*b*) The language, style, and modes of thought are characteristically different from Paul's.

The common view respecting the order and approximate dates of the epistles may be shown by the following grouping, which is not only chronological but according to their subject-matter: I. *The earlier or missionary epistles*, 1 and 2 Thessalonians, written at Corinth during A. D. 52 or 53. II. *The great doctrinal epistles*: Galatians, written at Ephesus within the period 54–57; 1 Corinthians, written at Ephesus in 57 or 58; 2 Corinthians, written in Macedonia in 57 or 58; Romans, written at Corinth, A. D. 58 or 59. III. *The epistles of the imprisonment*: Colossians, Philemon, Ephesians, Philippians, commonly believed to have been written during the apostle's Roman imprisonment during the years 62–63. IV. *The Pastoral Epistles*: 1 Timothy and Titus, written in Macedonia, and 2 Timothy, written during a second Roman imprisonment, shortly before the apostle's martyrdom. The date of this group is supposed to be 67 or 68.

Several points in this grouping have been called in question by competent scholars who accept the Pauline authorship of all thirteen letters. By some (as Bleek, Davidson, Conybeare and Howson, and Lightfoot) Galatians is placed third, instead of first, in the second group. On this view it was written in Corinth, probably during 57 or 58. Bishop Lightfoot gives as reasons for this view: (*a*) Galatians most closely resembles 2 Corinthians in its personal and apologetic elements and Romans in its doctrinal method and content, and thus naturally falls between them. (*b*) The development of Judaizing opposition to Paul best accords with this order. (*c*) This order corresponds to the development of doctrine. (See Lightfoot's introduction in his *Commentary on Galatians*, pp. 36–56.) While these arguments are not very cogent, they are perhaps as much so as that for the earlier date, which is based upon the rather indefinite expression in Gal. i. 6, "I marvel that ye are *so quickly* removing from him that called you," etc.

Many distinguished German scholars held that the first three epistles of the third group were written during Paul's imprisonment at Cæsarea (Acts xxiii. 23, xxvi. 32). The ingenious arguments by which this theory is supported may be found in full in Meyer's *Commentary on Ephesians*, Introduction, § 2. This view has found little favor with English scholars.

Bishop Lightfoot maintained that Philippians was the earliest of the *epistles of the imprisonment* on the following grounds: (*a*) Philippians stands apart from the other three in spirit and matter. (*b*) It reflects the state of Paul's mind which is illustrated in Romans and in 1 and 2 Corinthians. (*c*) Colossians and Ephesians are more nearly related to the *pastoral epistles* than is Philippians (see Lightfoot's dissertation, *Order of the Epistles of the Captivity*, in his *Commentary on Philippians*, pp. 30–46); but the progress of the Gospel at Rome, which had penetrated even the emperor's household (iv. 22), the Philippians' knowledge of Paul at Rome, the sending of Epaphroditus, his labors, sickness, etc., would point to a later time of writing, as would also the fact that Paul was more confident of release (ii. 24) than when Colossians and Ephesians were written, and so was, presumably, nearer to it.

Incidental allusions to lost epistles of Paul are found in 1 Cor. v. 9, and Col. iv. 16. These passages, according to their most natural interpretation, show that Paul wrote a letter to the Corinthians (antedating our 1 Corinthians), and that at the time when he wrote to Philemon and to the church at Colossæ he also wrote an epistle to the neighboring church at Laodicea. Some discern in passages like 2 Cor. ii. 4 and vii. 8, 9, allusions to a letter to the Corinthians intermediate between 1 and 2 Corinthians. General allusions to the frequency with which Paul wrote private letters, only one of which—that to Philemon—is extant, are found in 1 Cor. xvi. 3, 2 Cor. x. 10, and 2 Thess. iii. 17.

2. *Occasion and Aim.—1 Thessalonians.*—The narrative of the founding of the Church at Thessalonica is found in Acts xvii. 1–9. Some Jews, many women of noble birth, and many proselyte Greeks, accepted the Gospel, but Jewish opposition at length drove the apostle and his assistants from the city. Paul was eager to revisit his converts, and had twice purposed to do so, but had been hindered (ii. 18). When he could no longer restrain his anxiety to hear from them, he sent Timothy (from Athens, where they were at that time; cf. Acts xvii. 15) to encourage them and learn their state. Meanwhile Paul went on to Corinth. There Timothy joined him and brought his report concerning the Church. This report was the occasion of the epistle. Though faults and errors were to be corrected, their progress and patient endurance of persecution gave Paul great joy. The keynote of the letter is "Now we live, if ye stand fast in the Lord" (iii. 8).

2 Thessalonians.—In 1 Thessalonians Paul had encouraged his converts to endure their trials with patience by expressing the hope of the Lord's speedy return (iv. 16, v. 2). This expectation—fostered chiefly by a letter falsely purporting to have been written by Paul, ii. 2—became the occasion of developing a fanatical spirit among the Thessalonians. So near did they think the *parousia* to be that they abandoned their occupations (ii. 1–12, ii. 15, iii. 10–12). Paul wrote the epistle to rebuke this spirit, to urge them to resume their employment, and to divert their attention to certain events which should precede the *parousia* (see ii. 1–12).

Galatians.—The occasion of this epistle is found in the presence in the Galatian community of Jewish-Christian teachers who insisted that Gentiles who became Christians must also become Jews, that is, be circumcised and keep the Old Testament law as such. It is generally thought that these Judaizers had come from Palestine (so Meyer); others (as Neander) suppose that they were partly from Judea and partly native to Galatia, and still others (as Weiss) maintain that they were connected with Jewish-Christian congregations which had been gathered in Galatia previous to Paul's founding the Gentile-Christian churches in the province. No data exist for settling this question. Whoever these persons were, it is certain that they did not comprehend the newness and completeness of Christianity; it was to them but an appendix or supplement to the Old Testament system. Paul was the champion of the opposite view. For him Christianity was complete in itself and those who accepted it were not under the law. His opponents' position was contrary to the decision of the apostolic conference held at Jerusalem (Acts xv., Gal. ii.) at which the most conservative primitive apostles, Peter, James, and John, had approved his teaching and disclaimed any desire to supplement or change it.

1 Corinthians.—From v. 9 it appears that Paul had written to the Corinthians an earlier letter than 1 Corinthians. There are hints in v. 10, vii. 1, viii. 1, xii. 1, xvi. 1, and xvi. 12 of a letter from them to the apostle in return. The inquiries contained in this letter, and the condition of the

Corinthian church which they revealed, were the occasion of the epistle. An additional occasion lay in the report which Paul had received concerning divisions among them from the slaves of a certain Corinthian woman, Chloe (i. 11). These party rivalries seemed to the apostle more important than the inquiries contained in the letter of the Corinthians, for he takes up that subject first and devotes to it a large share of the epistle.

2 Corinthians.—It is impossible to determine with certainty the events which intervened between the two Corinthian epistles. It is certain, however, that opposition to Paul had increased in the Church. The Jewish-Christian portion—probably the Christ-party, especially—had accused him of fickleness, double-dealing, and cowardice, and had cast suspicion upon his character and apostleship. The aim of the epistle was to refute these calumnies, and to vindicate himself as a man and as an apostle. In chapters. i.–viii. Paul addresses himself more to the faithful majority, and in the latter part of the epistle turns more directly to the hostile Judaizers—the "false" or "exceeding apostles"—the extremists who had come to Corinth with letters of recommendation from Palestine.

Romans.—The occasion of this epistle is not clear, and many theories respecting it have been advanced. Baur regarded it as a polemic against Jewish Christianity; Schwegler as a defense of Paul's doctrine; Weizsäcker as intended to fortify Christians against attacks upon their faith in the future; Weiss as an attempt to draw up a statement of his doctrine of salvation, defending it on all sides against objections. Some combination of these views seems necessary. There are large polemic and apologetic elements in the epistle, and the protection of his converts against attacks upon their faith by Judaizers and the commendation of his doctrine to the favorable consideration of Jewish Christians may have been subordinate motives in writing. We may state his main object thus: To present a fuller exposition and defense than he had yet made of his "gospel" in contrast to Judaizing teaching and in its application to the Christian life. The growing importance of the Roman Church, by reason of its size and position, would furnish a sufficient reason why he should address the letter to them, although he had not founded the Church and had never even visited it.

Colossians.—This epistle was written to combat the errors which certain false teachers were introducing into the churches of the Lycus valley. The heresy appears to have been a sort of Jewish eclecticism which combined some of the tenets of the Essenes with Gnostic speculations. Its leading characteristics were: (*a*) Asceticism, a self-imposed subjection to ordinances and severity to the body (ii. 16–23). (*b*) Notions akin to the Gnostic doctrine of æons; theories of intermediate agents (angels) between God and the world (ii. 9. 10, 18). (*c*) An over-emphasis of an alleged knowledge on the part of its adherents (ii. 8–10, 18; cf. i. 9, 15, 16, 26, ii. 2, 10, 19). The tendency of this speculation was to degrade Christ to the rank of a creature, and to substitute ascetic rigors for trust in divine grace. In opposition to these false views Paul insists on the headship of Christ over the world and its powers, and upon the sole sufficiency for salvation of his person and work.

Philemon.—This is a private letter written at the same time as Colossians, and addressed to a Colossian Christian and friend of the apostle (Philemon). It is written to commend Onesimus, a slave of Philemon, who had stolen from his master and gone to Rome. There he met Paul and became a Christian. Paul sends him back to his master with a cordial commendation of his changed character. He reminds Philemon that he owes his own conversion to himself, and entreats him to receive his former servant as a Christian brother.

Ephesians.—No definite occasion for this epistle can be confidently assigned. By many critics it is regarded as an encyclical letter designed for a group of churches; by others it is believed to be the epistle to the Laodicean Church alluded to in Col. iv. 6. The omission of the phrase "in Ephesus" (i. 1) in the best MSS. strongly favor the first view, although it is not easy to explain satisfactorily the remaining words on the supposition of this omission. Perhaps a blank space was originally left in order that the name of the particular place where the letter was read might be inserted. The epistle resembles Colossians most nearly in scope and contents. Certain differences may, however, be noted: (*a*) Ephesians treats more of redemption in general (soteriology); Colossians of the Redeemer personally (Christology). (*b*) Ephesians aims at edification and education; Colossians at the refutation of heresy. (*c*) Ephesians treats more of the relation of Christ to the Church; Colossians of his relation to the universe. (*d*) In Ephesians the pre-eminence of Christ is made to depend more upon the divine will; in Colossians more upon his metaphysical nature.

Philippians.—When Paul was a Roman prisoner the Philippian Church, to which he was especially attached, sent one of their number, Epaphroditus, to supply his wants. This epistle is a letter of thanks for the gift, but it goes beyond its primary purpose and gives information concerning himself, adding warnings and advices for their benefit. It is the warmest and most affectionate of all Paul's letters.

The Pastorals.—These letters are addressed to the trusted helpers of the apostle, Timothy and Titus, to encourage and aid them in their work in Ephesus and Crete respectively. In them he has no occasion to deal with definitions or defenses of the Gospel. He urges the evangelists to adhere to "sound doctrine" and to avoid certain current speculations as unprofitable. These tendencies are characterized as a "different doctrine" (1 Tim. i. 3) from his own, and as dealing with Jewish fables, endless genealogies, and strivings about the law (Tit. 3, 9, 1 Tim. i. 4). We can not identify these speculations with the tenets of any particular sect.

3. *Criticism.*—F. C. Baur (1792–1860), the founder of the Tübingen school, admitted but four epistles (Galatians, 1 and 2 Corinthians, and Romans) as genuine. The others were rejected on grounds of internal evidence. The great doctrinal letters were made the standard of genuineness, and variations from these in style and contents were regarded as evidence of spuriousness. Since Baur's time, however, the tendency among the adherents of his school has been toward the admission of some of the discredited epistles as genuine. Holtzmann, Pfleiderer, and S. Davidson, for example, concede the genuineness of 1 Thessalonians and Philippians, and admit Pauline elements in 2 Thessalonians and Colossians. The pastoral epistles are most widely rejected on the following grounds: (*a*) There is no place for them in Paul's known life. (*b*) The errors combated in them belong to the post-apostolic age. (*c*) The church organization which they reflect is more highly developed than that found in the apostolic age. It is answered: (*a*) The Acts breaks off abruptly; Paul expected to be released from his imprisonment (Phil. ii. 24), and early tradition represents this to have been the fact. A place may thus be found for those letters in the apostle's last years. (*b*) The errors of the pastorals show no close affinity to the Gnosticism of the second century. (*c*) The only church officers in the pastorals are presbyter-bishops and deacons (as in Philippians).

In recent years a school has arisen which rejects even the four "undisputed" epistles. The chief representative of this type of criticism is Rudolf Steck, a Swiss professor. His theory of the history of the apostolic age is the opposite of that propounded by the Tübingen school. He maintains that the sharp opposition between the principles of faith and works, or grace and merit, which the doctrinal letters reflect, would develop only slowly and late, and therefore the writings in which this conflict of principles is presented must fall within the post-apostolic age. He places these writings in the second century. In opposition to this theory both the critical and the conservative schools agree in maintaining that the sharpest conflict of opposing principles is experienced in the early stages of a controversy, and that the development is toward adjustment and reconciliation. The extra-canonical literature of the second century shows no such contrast of Pauline and Judaizing Christianity as is illustrated in Galatians and Romans. Steck's theory reverses the common order of history, and is contrary to all the evidence which bears upon the progress of the controversies between the Gentile-Christian and the Jewish-Christian branches of the Church.

LITERATURE.—Only a select bibliography of recent literature can here be given. The works referred to are, in most instances, such as treat of the literary and historical questions connected with Paul's epistles rather than of his life in general or of his theology. F. C. Baur's *Paulus, u. s. w.* (Stuttgart, 1845; 2d ed. Leipzig, 1866–67), marks an epoch in the criticism of the Pauline epistles. More recent German treatises are largely taken up with the problems so boldly raised and discussed in this work. Many recent critics still follow Baur's method, and in part adopt his

arguments, while modifying more or less his premises and conclusions. S. Davidson's *Introduction to the New Testament* (3 vols., 1848–51; 3d ed. 2 vols., London, 1894) is conservative in the first edition; the second and third reproduce largely the Tübingen criticism. E. Renss's *Geschichte d. Heiligen Schriften d. Neuen Testament* (Halle, 1842; 6th ed. 1887; Eng. trans. Edinburgh, 1 vol., 1884; Boston, 2 vols., 1884) is a critical summary and history of opinion with ample references to the literature. P. J. Gloag's *Introduction to the Pautine Epistles* (Edinburgh, 1874) is a conservative summary and review of opinions. In H. A. W. Meyer's *Commentary on the New Testament* (various editions; Am. ed. New York, 1884–86) the introductions to the epistles are elaborate and conservative treatises. Those on the pastorals are written by Meyer's continuator, Huther, who maintains their genuineness, as Meyer did not. Meyer held to the genuineness of all the other epistles. J. B. Lightfoot's introductions and dissertations in his *Commentaries on Galatians* (8th ed. London, 1884), *Philippians* (8th ed. 1885), and *Colossians and Philemon* (9th ed. 1890), are of the highest value. The dissertations are published separately in a volume entitled *Dissertations on the Apostotic Age* (London, 1892). A. Sabatier, in *L'Apôtre Paut* (Paris, 1881; Eng. trans. New York, 1891), gives a vivacious treatment of Paul's letters in their historical setting, unfavorable to the pastorals. The English translation contains an essay *per contra* by the translator, G. G. Findlay. *Das Urchristenthum, u. s. w.* (Berlin, 1887,) and *Der Paulinismus* (Leipzig, 1873; 2d ed. 1890), by O. Pfleiderer, discuss the Pauline literature in the spirit and method of Baur, with important modifications, however, in detail. H. J. Holtzmann's *Einleitung in das Neue Testament* (Freiburg, 1885; 2d ed. 1886) is a history and summary of opinions from the standpoint of the "critical" school. B. Weiss's *Lehrbuch d. Einteitung in d. Neue Testament* (Berlin, 1886; 2d ed. 1889; Eng. trans. 2 vols., Edinburg, 1888, and New York, 1889), critical but conservative, is the best manual at present available in English. *An Introduction to the New Testament*, by M. Dods (New York, 1888), is a brief presentation of the main results of criticism. F. Godet's *Studies in the* (Pauline) *Epistles* (London, 1889) are popular essays, conservative in tone. *The Epistles of Paut the Apostle*, by G. G. Findlay (London, 1892), and J. R. Lumby's *Popular Introduction to the New Testament* (London, 1883) are both excellent manuals for popular use. In vols. ii. and iii. of the *Hand-Commentar zum Neuen Testament* (4 vols., Freiburg, 1891) are found elaborate introductions (by Schmiedel, Lipsius, and von Soden) on the Pauline letters. They are written from the critical point of view, and account is taken of the latest discussions. F. Godet's *Introduction au N. T.*, vol. i., *Les Épitres de S. Paul* (Paris, 1893), contains a history of the criticism of the Pauline epistles from the first century to the present time. The standard treatise of the modern radical criticism is *Der Galaterbrief nach seiner Echtheit untersucht* (Berlin, 1888), by R. Steck. The opinions of Steck are shared more or less fully by certain Dutch theologians, as Loman, van Manen, van Loon, and Völter. For a review and critique of these views, see Lipsius, *Hand-Commentar, Einleitung zu Gal.*, pp. 8, 9; Pfleiderer, *Der Pautinismus* (2d ed.), pp. 34–38; A. C. Zenos in the *Presbyterian Review* (Jan., 1891); and Knowling, *The Witness of the Epistles*, ch. iii. (London and New York, 1892). GEORGE B. STEVENS.

Pauli'nus, MEROPIUS PONTIUS ANICIUS: a Latin writer from Gaul; b. in Burdigala (Bordeaux) in 353; pupil of Ausonius, and through his influence made consul suffectus before 379. In 389 he was converted to Christianity, and in 409 made Bishop of Nola in Campania, which office he held until his death in 431. Hence he is commonly called Paulinus Nolanus. His extant works consist of some fifty letters and thirty-six poems in various meters, which show considerable culture and poetic feeling, with reminiscences of Horace, Vergil, Lucan, and Juvencus. The best account of his Christian poetry is given by Manitius, *Geschichte der Christlich-lat. Poesie*, pp. 261–297. See Migne, *Patrol.*, vol. lxi. A critical edition is promised by Hartel for the Vienna *Corpus Script. Eccles. lat.* M. WARREN.

Paulist Fathers, or **The Congregation of St. Paul the Apostle**: a missionary society of priests in the Roman Catholic Church, founded in 1858 by Rev. Isaac Thomas Hecker, and approved by Pope Pius IX. They are chiefly men who have abandoned Protestantism. The motherhouse is in New York.

Paullinia sorbilis: See GUARANA.

Paulo Affonso Cataract: See SÃO FRANCISCO RIVER.

Paulown'ia imperia'lis: scientific name of a fine tree of the family *Scrophulariaceæ*, a native of Japan. It has something the habit of a catalpa, the leaves being large and heart-shaped, the branches being crooked and nearly horizontal; the flowers are in large clusters of a pale-violet color, and precede the leaves. The tree rarely exceeds 40 feet in height, and its trunk is usually less than a foot in diameter. In the U. S. it is hardy as far N. as New York. The luxuriant growth and great heavy leaves make it a desirable tree for many effects in landscape-gardening.
Revised by L. H. BAILEY.

Paulsen, powl'sen, FRIEDRICH, Ph. D.: professor of philosophy and pedagogy; b. in Langenborn, Schleswig, July 16, 1846; educated in the common schools of his native town, the gymnasium in Altona, and the Universities of Erlangen and Berlin; privat docent 1875–78, extraordinary professor 1878–93, and Professor of Philosophy since the autumn of 1893 in the University of Berlin. In philosophy Paulsen is classed with the new-school Kantians. His published works and numerous magazine articles give him a foremost rank among German philosophers, but no less important are his contributions to the history of pedagogy. In respect to secondary and higher education he is a recognized authority. His principal works are: *Versuch einer Entwicketungsgeschichte der Kantischen Erkenntnisstheorie* (1875); *Geschichte des gelehrten Unterrichts auf den deutschen Schulen und Universitäten, vom Ausgang des Mittetatters bis auf die Gegenwart* (1885); *System der Ethik* (1889; 3d ed. 1894); *Einteitung in die Philosophie* (1892; 3d ed. 1894); *Wesen und Geschichte der deutschen Universitäten* (in the work edited by Lexis, *Die deutschen Universitäten*, 1893). J. E. RUSSELL.

Paulus, pow'lōos, HEINRICH EBERHARD GOTTLOB: theologian; b. at Leonberg, near Stuttgart, Würtemberg, Sept. 1, 1761; studied Oriental languages and theology at Tübingen, Göttingen, London, and Paris, and was appointed Ordinary Professor of Oriental Languages in 1789 at Jena, in 1803 at Würzburg, director of the department of public worship and education in 1808 at Bamberg, in 1809 at Nuremberg, in 1811 at Ansbach, but moved in the same year as Professor of Exegesis and Ecclesiastical History to Heidelberg, where he died Aug. 10, 1851. He was one of the most prominent representatives of the rationalistic theology in its historico-critical phase. Among his numerous works are *Clavis über die Psalmen* (Jena, 1791, Heidelberg, 1815); *Clavis über Jesaias* (1793); *Kommentar über das Neue Testament* (but it only goes to John xi.; Lübeck, 4 vols., 1800–04; 2d ed. 1804–05); *Leben Jesu* (2 vols., 1828); *Exegetisches Handbuch über die drei ersten Evangelien* (3 vols., Heidelberg, 1830–33; 2d ed. 1841–42). He edited Schelling's *Vorlesungen über die Offenbarung* (1843), which implicated him in a lawsuit. He wrote a partial autobiography, *Skizzen aus meiner Bildungs- und Lebensgeschichte* (Heidelberg, 1839), and left materials for a full biography, which were utilized by Prof. Reichlin-Meldegg under the title *H. E. G. Paulus und seine Zeit* (2 vols., Stuttgart, 1853).
Revised by S. M. JACKSON.

Pau'lus, JULIUS: a celebrated Roman jurist, contemporary with Ulpian, who held under Alexander Severus in 222 the office of præfectus prætorio. He was a voluminous writer, and more than 2,000 excerpts from his works are contained in the digests. His most important work, *Ad edictum*, embraced eighty books. An abridgment of his *Sententiarum ad filium libri V.*, is extant. See Huschke *Jurisprudentiæ Anteiustinianæ quæ supersunt*, pp. 450–561 (Leipzig, 1886). M. W.

Paulus, LUCIUS ÆMILIUS, surnamed **Macedonicus**: soldier; b. at Rome about 230 B.C.; a son of the consul of the same name, who fell at Cannæ 216; was prætor in 191; commanded afterward as pro-consul in the province of Further Spain, where he put down a formidable insurrection and defeated the Lusitanians; was consul the first time in 181, and a second time in 168; censor in 164. D. in 160. During his second consulship he finished the third Macedonian war by his brilliant victory over Perseus at Pydna. The Romans did not at once appropriate the territory of their vanquished enemy, but divided the Macedonian empire into four districts with oligarchical governments under the protection of Rome. Revised by G. L. HENDRICKSON.

Pau'lus Diac'onus, or **Levi'ta**: historian; b. at Cividale, in Friuli, about 725; educated at the Lombard court at

Pavia; he was ordained deacon not later than 763; at the instigation of Adelperga, wife of the Duke of Benevento, he composed about 770 his *Historia Romana*, a continuation of the *Breviarium* of Eutropius. (See edition by Droysen, Berlin, 1879.) He entered the monastery of Monte Casino, whence he addressed a poem to Charlemagne in 781, setting forth in a touching manner the sufferings of his family in consequence of Charlemagne's confiscation of their estates as a punishment for his brother's rebellion. Charlemagne was so much interested in the poet that he summoned him to his court. There Paulus lived till 787, and there he collected his *Homiliarius*, which was often reprinted in the fifteenth and sixteenth centuries and translated into German and Spanish, and wrote his *Gesta Episcoporum Mettensium*, printed in Pertz's *Monumenta Germaniæ Historica*, vol. ii. (Hanover, 1827); made an abridgment of Festus's *De Significatione Verborum* (see FESTUS); returned to Monte Cassino in 787. D. there about 797. His last and most important work was his *Historia Langobardorum Libri VI.*, which ends at 744, containing many valuable traditions. The best edition is by G. Waitz (Hanover, 1878) in the *Monumenta Germaniæ Historica*. See Felix Dahn, *Des Paulus Diaconus Leben und Schriften* (Leipzig, 1876). Revised by M. WARREN.

Paulus Ægineta: Greek physician and author; b. in Ægina at an unknown date, but Abulfaragius places him in the seventh century A. D., which is probably correct. His *De Re Medica Libri Septem* had great influence among European and Arabian physicians in the Middle Ages, and several Latin and Arabic versions were made. Of the Greek text the edition of 1528 (Venice) and 1538 (Basel) are complete. The Sydenham Society published (London, 1847) an improved edition of Francis Adams's complete translation, with abundant notes, in three volumes 8vo. Several other works of Paulus are mentioned by old writers. See SURGERY. Revised by J. R. S. STERRETT.

Paul Veronese: See VERONESE.

Pauncefote, Sir JULIAN: British jurist and statesman; b. at Munich, Germany, Sept. 13, 1828; educated at Paris, Geneva, and Marlborough College; called to the bar at the Inner Temple 1852; attorney-general of Hongkong 1865; chief justice of Supreme Court in Hongkong 1869; knighted 1874; Assistant Under-Secretary of State for the Colonies 1874; Assistant Under-Secretary of State for Foreign Affairs 1876; became permanent Under-Secretary of State for Foreign Affairs 1882; British minister at Washington 1889; ambassador to U. S. 1893. C. H. THURBER.

Pauperism [from Lat. *pauper*, poor (> O. Fr. *paure*, whence Eng. *poor*)]: in a general sense, the settled condition of large masses of people, who are more or less dependent on the alms of the community for their support. In earlier ages slavery, which was almost universal, rendered public assistance for paupers almost unnecessary, because the master was expected to provide for his aged and invalid slaves, as well as to assume the cost of rearing the young, which, in some modern communities, imposes the greater part of the public burden for the poor; but wherever slavery began to be abolished by individual emancipation, or by the result of war, or by other causes, pauperism, in the modern sense, began to take its place; and this process went on for centuries, from the earliest period of authentic Grecian history, until the present age, when the most general emancipations have taken place. Again, the reduction of large masses of the free population to a state of dependence, by the extension of landed estates and the effect of long-continued warfare, especially under the Roman rule, gave occasion for the greatest development of public charity which the world has seen, during the later years of the Roman republic and the first three centuries of the empire. When the rural inhabitants of Italy lost the land which they had cultivated, because great landlords absorbed the small *prædia* of their neighbors, they at once became dependent for support either on the rich, as clients, or on the public. It was to supply the needs of this class that the *leges frumentariæ* (corn-laws) were passed, at first cheapening the price of grain, and afterward providing for its distribution from the public granaries among the free-born poor of Rome and the provinces. These corn-laws were in fact poor-laws, and they laid the foundation of a pauper system of great extent, and very demoralizing in its influence, which prevailed from the time of Sulla through the flourishing period of the empire. It is said that in the reign of the Antonines 500,000 persons received this donation from the public—a proportion to the whole estimated population much larger than has usually prevailed under the pauper systems of Great Britain, France, or the U. S.

The pagan times give many examples of charity, and after Christianity began to influence the world the better adherents of the old religion exalted charity, both public and private, in emulation of the Christian practice. Cicero (*De Legibus*, xiv.) had proclaimed philanthropy as the basis of justice, and the Emperor Julian, following Cicero, regarded charity as the most sacred of duties. Similar sentiments were expressed by Plato, Xenophon, Seneca, and other ancient writers, whose works prove that the distribution of alms and the relief of the infirm and invalid were virtues well recognized by the followers of the older religions, but it was left for Christianity to make them its basis and rule. The introduction of Christianity may have checked in some degree the growth of pauperism in its Roman form, but the establishment of monasteries and religious houses, and even of churches, increased the number of persons who lived by begging; and vagrancy and mendicity were everywhere common when the legislation of Western Europe first began to take notice of the growing evil. The first poor-laws of England and France were decrees or statutes against vagrancy and mendicancy; and when at the Reformation many monasteries were broken up, and the administration of the church funds in the parishes was changed, a great number of paupers who had been relieved by the clergy or their servants were thrown upon the civil authorities for support, restraint, or relief. Economical changes going on at the same time in the century from 1520 to 1620 caused the number of poor people in England to increase greatly. Hence the increasing frequency of poor-law legislation in England from 1540 to 1601, when the famous statute (43 Elizabeth) which forms the basis of the pauper system both in England and the U. S. was enacted. An attempt had been made as early as the reign of Richard II. to repress vagrancy by severe statutes, and a law of Henry VII. sent beggars not able to work back to the parish of their last residence. The able-bodied beggar had been treated as a criminal much earlier, and in 1531 the law required him to be whipped and sent back to his birthplace. A few years later the local officers of each parish were required to support poor and vagrant persons, at the same time compelling them to labor; while almsgiving on the street or at the house-door was forbidden, on pain of forfeiting ten times the amount given. A "sturdy beggar" was to be whipped for the first offense, for the second his right ear was to be cropped, and for the third he was to be sent to jail, and if convicted, to suffer death, but legislation grew gradually milder against this evil from the experience gained that severe penalties did not diminish it. Licenses were now permitted for beggars on condition that they begged only in their own parish and for food alone, and in the manner directed by the churchwardens and overseers. In the time of Charles II. the more modern condition of settled pauperism had begun to take the place of mendicant vagrancy. The poor-law of Elizabeth did indeed succeed in diminishing mendicancy, but it again appeared in alarming proportions.

Legislation in France was quite as severe as in England against vagrancy, and the result was much the same. When the cruel French laws, enacted before 1550, failed to check vagrancy and begging, the authorities, gradually discovering how useless such legislation was, in the seventeenth century made trial of more humane methods of repression. In 1627 the law required beggars to be forced into the service of commercial companies or into the French naval service, and to embark for the Indies. At the same time there were ordered to be founded in the different provinces "hospital workshops" or workhouses, which were the beginnings of the French system of "dépôts of mendicity." Again, in 1688, an ordinance was passed expelling every pauper and beggar from Paris, under penalty of being sent to the galleys. Nothing, however, seemed to check mendicity in France, and in 1698 it was calculated that one-tenth of the whole population of the country was reduced to beggary. In the eighteenth century, although the progress of manufacturing, industry, and commerce checked the evil, yet in 1790 a decree was passed ordering the opening of workshops for able-bodied beggars. The poor who were impotent or sickly were to be sent to the hospitals, and strangers to the kingdom were to be expelled. Another law organized workhouses and almshouses for ordinary beggars, while those were sentenced to transportation who persisted in begging

after their punishment, or who committed other offenses. Under the First Empire the principle seems to have been recognized that before punishing mendicity as an offense work must be offered. A decree of 1808 ordered that a workhouse or "dépôt of mendicity" be established in every department. In four years eighty of these were founded. Many complaints against them, however, arose on account of their large expenditures and their industrial competition with non-pauper laborers. It was hoped that these establishments would nearly support themselves by the labor of the inmates, but this proved illusory, and they gradually became refuges of incurables. Under the Restoration they were nearly all suppressed, and at present there are very few "dépôts of mendicity" in France. Several workshops were substituted for the "dépôts," and some provinces founded houses of refuge for beggars, but none of these succeeded. Thus during five centuries every species of penalty and punishment has been tried in vain in France to suppress mendicity. Humane legislation has been equally a failure, and the sum of experience in that country is that all legal means fail to reach this great evil.

Poor-laws and Pauperism in France.—The English poor-law of Queen Elizabeth has never been formally introduced in France, but pauperism has long existed there, and has been met by a system of public relief, somewhat different from the English "workhouse test." An eminent French economist, Émil Levasseur, in his great work on *Population* (finished in 1892), has much to say of public charity in France. Malthus, in 1818, declared that the division of landed property which took place in France at the Revolution, and was further promoted by the laws of inheritance then adopted, would turn France into a rabbit-warren of paupers. Instead of verifying this prediction, Levasseur shows that pauperism is proportionately much less under the third republic than under the first. The statistics cited by him are confessedly imperfect, but they establish this fact beyond doubt. Since 1850 France has had a much smaller percentage of paupers in its population than England, but more than Germany, with the exception of Prussia, in which pauperism seems to have been greater before the Franco-German war than in France. After an examination of the statistics of pauperism, Levasseur concludes: "It can not be argued that pauperism has increased in Paris during the last hundred years; the contrary is true. The growth of population, the increasing emigration from country to city, the attractive force of a great city on the pauper class, have not, as some writers conjectured, resulted in the aggravation of pauperism." He calls attention, however, to what has been noticed in all other cities and countries since 1791, adding: "What has increased is the cost of relieving the poor. In 1804 the revenue accruing to hospitals, infirmaries, charity bureaus, and the support of foundlings was less than 8,500,000 francs in Paris; but in 1887 the public charities of the city expended 52,658,000 francs. The increase of wealth has allowed Paris to furnish more efficacious relief, to take care of the sick poor in their homes, to procure for them greater comforts in the hospitals, to establish sanitary measures which have decreased the death-rate, to watch with more solicitude over the education of neglected children, to ameliorate the management of infirmaries, and to give an easier existence to old people and chronic invalids." An earlier French writer, Baron, who in 1882 published an elaborate work on French pauperism (*Le Paupérisme, ses Causes et ses Remèdes*), lays great stress on inducing the workingmen to practice life-insurance, deposit in savings-banks, and in other ways raise themselves above the common level of poverty, from which he says it is but a step, in illness, old age, or vice, to the gulf of pauperism. Since then, in France, as well as in Great Britain, an agitation has begun in favor of giving to old people pensions drawn from a fund provided either by taxation or voluntary contribution, and administered by the Government. The cost of public charity has increased, especially in France, where the poor-law expenditure of cities greatly exceeds that of rural districts in France. Concerning the latter Levasseur says: "Wealth in general is less in the country than in the cities and large towns, but, in return, poverty also is less felt there, and pauperism, strictly speaking, rarely occurs in small country districts. Public relief is also much less abundant in such places; only about a third of the communes in France with less than 500 people keep up a charity bureau, while this form of relief exists in more than two-thirds of the communes which have 1,000 people or more."

France practically has a poor-law, and recognizes the duty of public aid, although it has never been carried so far, nor with such injurious results, as the poor-law system of England. In fact, the French system closely resembles in many particulars that which has grown up naturally and almost universally in the U. S. The first step in this system is the creation of a local board, called in France a charity bureau (*bureau de bienfaisance*) and in the U. S. a board of overseers, guardians, supervisors, etc., according to the usage in different parts of the country. These boards, both in France and the U. S., first distribute "family aid" (*secours à domicile*), which is what the English rather absurdly have termed "outdoor relief." They mean relief given outside the workhouse door—it having been a theory at one time in England that all the public poor, with a few exceptions, could be thrust into workhouses, but experience, in the British islands as well as in France, has shown that this theory is unfounded. Extending his observation from Paris to France as a whole, Levasseur says that increase of wealth has not aggravated pauperism in that country, although the cost of relieving the poor is so much greater than formerly. This is true in Great Britain, in the U. S., and in all civilized countries. Thus in Great Britain, where the cost in 1847 was only about $30,000,000, it is now (1894) considerably above $40,000,000, although the number of paupers is actually less than in 1847. Mr. Goschen, when president of what is now the Local Government Board, said in 1870: "It can not be denied that the more humane views which have prevailed during the last few years as to the treatment of the sick poor have added most materially to the poor-law expenditures. Workhouses, designed originally mainly as a test for the able-bodied, have, especially in the large towns, been of necessity gradually transferred into infirmaries for the sick; and the higher standard for hospital accommodations has had a material effect upon the expenditures." The process here mentioned has been going on more rapidly in Great Britain, in France, in Germany, and in the U. S. since 1870 than before; but previous to 1833 it had shown itself abundantly in France. In 1800 France expended less than 65,000,000 francs in public charity; in 1833 170,000,000; and since the latter date the cost of public charities has greatly increased. It is impossible to obtain in France such accurate returns of the poor as in England, where the paupers are counted twice a year; but there is reason to suppose that the number of paupers is now less, in proportion to the whole population, than it was in 1887. This is also true in England and Wales, where there has been a noticeable decrease both in indoor and outdoor relief since 1870, and still more since 1845, when pauperism was about at its maximum. In 1870 the number reported in a given day in England and Wales, both indoor and outdoor, was 1,047,662, but four years later it was only 784,006, and in 1894, although the whole population had increased to 30,000,000, the paupers enumerated on a given day were less than 840,000. The U. S. census of 1890, though far from accurate, indicates the same diminution of pauperism when compared with the whole population of the republic.

Indoor and Outdoor Relief.—This decrease of the public poor in England and Wales is due in part to the cutting off of "outdoor relief." Many British authorities attribute the pauperism now existing in the United Kingdom to the outdoor relief granted there still, and some hold that if outdoor relief were entirely cut off there would be a marvelous diminution of pauperism. This is a theoretical view which facts do not wholly sustain. The system followed in the U. S. is to mingle outdoor and indoor relief, since both are needful and their conjoint use is more judicious than the absolute exclusion of either. It often happens that a little relief given in a small community will keep a family from absolute dependence, while residence in an almshouse degrades and pauperizes. Outdoor relief in large communities by public authorities is, however, dangerous, because it is especially liable to misuse through want of vigilance or as a means of bribery or corruption. The principles which should govern almsgiving may be summed up in the words of Malthus: "It is in the highest degree important to the general happiness of the poor that no man should look to charity as a fund on which he may confidently depend." The application of this requires that outdoor relief should in no case be given to able-bodied men; that in cities it should be left as far as possible to organized private charity, lest the poor fall into the habit of believing in a right to relief at the hands of the public authorities; and that where given it should be bestowed in such a manner and under

such conditions as would tend to prevent future pauperism. The "workhouse test," however, to which Malthus was firmly attached, will not meet the exigencies of the case in Britain or anywhere else. The old-fashioned workhouse has been expanded since Malthus wrote, so that its door, originally but one, has become the manifold doors of infirmary, hospital, school for paupers, asylums for the blind, for the idiot, and for the insane, schools for the deaf, etc. "Indoor relief" now includes, or should include, support by the public in all establishments for the poor and suffering; while "outdoor relief" means "household aid" to those persons—much the larger number—who do not need the restraint or the special care of a public establishment, whether asylum, hospital, poorhouse, or by whatever other name. One reason why family aid has been carried, especially in cities, so far as to prove an abuse, was the desire to prevent the breaking-up of families, the corruption of the young, and the unspeakable distress of the old and virtuous by throwing them into forced association with the dregs of mankind in a so-called charitable establishment. This same desire counts for much in the present movement to pension the aged poor, which Charles Booth and other English writers strongly support, and which has already produced a pension-law, guarded by many restrictions, for the aged poor of Denmark. If experience can teach anything it is that both indoor relief and family aid (outdoor relief) properly practiced are indispensable in any complete system of public charity. Where to draw the line in individual cases is a matter only to be determined by the wise discretion of the poor-law officers. Indoor relief will generally be found more costly in proportion to the number relieved than family aid; and it will also, in general, apply to a much smaller number of cases, but so far as it can be rationally and humanely used it should be made to cover as many cases as possible. Family aid, on the other hand, should be restricted as much as possible, except for classes of the poor to whom indoor relief is (presently or prospectively) likely to be injurious. The public generally prefer, for reasons of sentiment and oftentimes of good sense, the use of "family aid" rather than the separation of households and the sequestration of persons in great establishments where individuality is lost in the mass.

Pauperism in the United States.—The national census chiefly takes account of the indoor poor of the U. S., but by no means includes them all in its tabulations, while it omits almost entirely the much more numerous class of the outdoor poor. The census of 1890 exhibits as the aggregate of paupers in almshouses in the whole republic 73,045; and this is probably less than 10,000 short of the actual number at any one time in 1890, which may be estimated at 80,000. The outdoor poor, which the census sets down as only 25,000, were in fact, upon careful estimates based on State returns, not less than 250,000 at any one date—that is, the average number. If we add to the almshouse poor the number of the insane poor supported by the public in hospitals, asylums, etc., which may be estimated at 30,000, and other classes of the indoor poor who are supported in establishments other than poorhouses and asylums for the insane, we shall probably find the whole number of the indoor poor of the U. S. rising toward 150,000. Assuming these estimates to be approximately correct, we should then have 400,000 as the constant or average number of paupers in a population of a little less than 63,000,000. At this rate the number of English paupers at any given date should be less than 200,000, for the population of England and Wales is less than half that of the U. S. The actual number of the English paupers in 1894 exceeded 800,000, so that, viewed in this proportion alone, pauperism is more than three times as common in England as in the U. S. There is, however, another consideration affecting this problem. How many paupers in the course of a year are represented by the single pauper who appears in the aggregate average number? Mr. Charles Booth, the most accurate calculator on this element of the question, finds that in England the total of pauperism during the year is to the average number as two and a half is to one. In the U. S. this proportion is no doubt smaller.

Settlement Laws and Poor-law Systems.—In the fifty States and Territories of the U. S. the poor-laws, including laws for the "settlement" or definite fixing of the pauper in a given locality, vary so much that no general statement can well be made. A poor-law may be said to exist almost everywhere in the U. S.—that is, the localities are everywhere expected to support their own poor by taxation; but the prevalence of the county system in many States, of the township system in others, and of a combination of township, county, and State systems in some localities, makes it extremely difficult to say what usages prevail in the republic as a whole. In the older Atlantic States the law of pauper settlement is derived from the English statutes of Charles II. and earlier reigns; yet the American laws all differ materially from the English statutes, and were never precisely the same, even in the provincial period. The period requisite for gaining a pauper settlement varies from one year to ten, or even more under some circumstances; but mere residence does not always confer this right without the payment of taxes or some other qualification. Marriage with a person who has a pauper settlement generally carries settlement with it for the wife and children; legitimate children follow the settlement of the father, if any, otherwise of the mother; illegitimate children follow the settlement of the mother; and this provision applies to women who have married a husband insufficiently divorced from a former wife. The complications which may arise from the article of marriage alone are numerous, and the whole body of settlement laws has given room for infinite litigation between towns, counties, and States; but an incidental advantage, springing even from obscure and complex pauper laws, has appeared in New England, and particularly in Massachusetts, where these laws have less simplicity, perhaps, than anywhere else. Their very complexity requires the official who acts under them to investigate every case of poverty brought to his notice, and in this way the condition of families, the existence of kindred, the nature of maladies, and all the numerous circumstances needing to be investigated are brought under examination. The formation in nearly a hundred cities of the U. S., since 1870, of charity organization societies (see CHARITY ORGANIZATION), has also promoted these inquiries into the state of the poor—guarding against much imposture, and bringing those truly in need under the eye of public or private charity. An important question arising under the immigration laws of the U. S. concerns "interstate migration," a subject which was brought before the national conference of charities in Denver, June 28, 1892. This national body passed a resolution to memorialize Congress for the regulation by national authority of the migration of poor, vagrant, insane, diseased, and criminal persons from one State to another. Such an exercise of the Federal authority, it was thought, would lead to a more systematic code of laws and a more uniform administration of public charity throughout the U. S. and would incidentally promote the collection of more exact statistics of pauperism.

F. B. SANBORN.

Paur, EMIL: See the Appendix.

Paurop'ida: name applied to a group of MYRIAPODA (*q. v.*), containing a few minute species, formerly placed between the Chilopods and Chilognaths, but shown by the researches of Schmidt (*Zoologischer Anzeiger*, 1894) to be degenerate members of the Chilognathous group. The genera *Pauropus* and *Eurypauropus* occur in the U. S.

Pausa'nias (in Gr. Παυσανίας): the Periegete or "conductor," of Magnesia in Asia Minor, who wrote toward the close of the second century A. D. a *Guide to Greece* (Περιήγησις τῆς Ἑλλάδος) in ten books. In this work, which is beyond price for archæology and mythology, especial attention is paid to monuments of art, in which the writers of the Greek Renaissance took great interest. The preference shown for temples and votive offerings is also explicable from the tendencies of the century. Pausanias doubtless compiled his manual from earlier guides, among whom POLEMON (*q. v.*), 150 B. C., is conspicuous; but this does not exclude personal vision any more than the free use of an old Murray or Baedeker would do to-day, and the absence of allusion to the great monuments of the period in which the compiler lived is of a piece with the antiquarian unreality of the age. The work has been edited by Siebelis (5 vols., Leipzig, 1822); Schubart and Walz (Leipzig, 1838; English translation by Thomas Taylor, 3 vols., London, 1793–94); and by Shilleto in Bohn's Library (2 vols., 1886). See also Kalkmann, *Pausanias der Perieget* (Berlin, 1886), and Gurlitt, *Pausanias* (Gratz, 1890).

B. L. GILDERSLEEVE.

Pausanias: a son of Cleombrotus and regent of Sparta during the minority of his cousin, Plistarchus, the son of Leonidas; commanded the confederate Greeks at Platæa 479 B. C., and achieved several brilliant victories during the following years; but, elated by these successes and led astray by an exorbitant ambition and vanity, he entered

into treasonous negotiations with the Persians. He desired to bring the whole of Greece under his sway, and he hoped to realize this plan by the aid of Xerxes, which he proposed to buy by placing his future kingdom under Persian authority. Meanwhile he assumed Persian dress, surrounded himself with a body-guard of Persian and Egyptian troops, and introduced Persian ceremony and Oriental luxury in his household. The Athenians denounced him and the Spartans suspected him. Twice he was recalled from the army and arraigned before the ephors, but no proofs could be presented and he was acquitted. He continued the negotiations with Xerxes, and even began to form a conspiracy with the Helots. At last a letter from him to Xerxes was delivered over to the ephors by the slave intrusted to carry it to the Persian camp, and when he learned that his treason was discovered and his plan frustrated, he took refuge in the temple of Athene Chalcioecus, where the people shut up the entrance by a pile of stones, to which his own mother carried the first, and he died of hunger about 468 B. C.—His grandson PAUSANIAS was King of Sparta from 444 to 394, when he fled the country to escape condemnation to death for treason. He died in Tegea in 385 B. C. The murderer of Philip, King of Macedonia, was still another person of the same name. Revised by J. R. S. STERRETT.

Pauw, pŏw, CORNELIS, or CORNELIUS, de: author; b. at Amsterdam, 1739. He was educated at Göttingen; entered the Franciscan order; became canon of Xanten, near Cleves, and for a time represented the Bishop of Liège, at Berlin; but most of his life was spent in literary labors. Like his celebrated nephew, Anacharsis Clootz, he was very eccentric, and he was insane before his death. De Pauw's writings were intended to explode the sentimental theories then in vogue respecting the American Indians and the Orientals; they show much research, and their spirit of criticism was valuable, though unduly violent, resulting in hot controversies. The principal ones are *Recherches Philosophiques sur les Américains* (Berlin, 1768–69; translated into English), and similar works on the Egyptians and Chinese (1774), and on the Greeks (1788); collected edition 1795. D. at Xanten, July 7, 1799. HERBERT H. SMITH.

Pavements: coverings of wood, stone, brick, or asphalt, laid firmly on a street in order to give a smooth and convenient surface for travel. The coverings of gravel and broken stone used for macadam roads in country and suburban districts, and also in small towns, are described under ROADS, while this article deals with the pavements for streets in larger towns and cities; such road surfaces, although well adapted to park drives, become so covered with mud and dust under the wear of heavy traffic, and require such a heavy expense for maintenance and renewal, that they can not be used in the thickly settled parts of cities. A street pavement should be durable, be readily cleaned and kept in repair, give a secure foothold for animals and easy traction, not become slippery from use, and be as noiseless as possible. It should also be of such material and construction that the original cost plus the expense of maintenance may be a minimum.

Foundation.—A good foundation is essential for the stability of a street pavement. The most common foundation is sand or gravel, laid in a thickness of from 3 to 6 inches upon a sub-grade surface, which is made nearly parallel to that of the pavement itself. Cobblestones set firmly in sand or gravel, rubblestones set on edge in contact, and rubblestones set on edge but not in contact with the voids filled with concrete, are also used. The best foundation is one of hydraulic concrete, 6 or 8 inches in thickness, but this is the most expensive, its cost being about $1.50 per square yard of surface. The surface of an old road sometimes makes a good foundation for a new pavement; for instance, in Brooklyn, N. Y., asphalt pavements have been laid on top of old cobble pavements, and in New York an asphalt pavement was laid in 1892 on the old macadam surface of the Boulevard.

Wooden Pavements.—The cheapest wooden pavement is made of round blocks sawed from small trees in lengths of 6 inches, the diameters of the blocks ranging from 2 to 12 inches. The earth is first excavated to the curve of the finished pavement and 2 or 3 inches of sand laid; on this boards are placed which are covered with hot coal-tar. The blocks are then set on end in contact, the interstices filled with sand, the surface coated with hot tar, and covered with a thin layer of sand. The cost of such a pavement is about $1.25 per square yard, and for a year or two it gives good satisfaction, being smooth, clean, and noiseless; it then begins to wear in ruts, and also to decay rapidly, so that renewal is necessary in a few years. The best wooden pavement is composed of rectangular blocks, 3 to 4 inches in width, 6 to 14 inches in length, and 6 inches deep, which are laid in courses across the street with an open joint three-quarters of an inch wide between the courses. This is also laid on a foundation of sand covered with boards, and the open joints are filled with coal-tar and gravel. The wooden blocks should be creosoted to prevent decay. There are many patented details of construction in wooden pavements, but experience indicates that none of them secures durability and economy. The rapid wear and decay necessitates a heavy expense for renewals; the odor arising from the noxious liquids, held in absorption by the wood or retained in the joints between the blocks, is sometimes offensive; and the dust resulting from wear and decay is often found to be injurious to health.

Stone Pavements.—The layer of cobblestones formerly in common use scarcely deserved the name of pavement; it was noisy, rough, hard to clean, and unpleasant for traffic, and it can now be said to be almost entirely abandoned. The best stone pavements are made of rectangular blocks set in contact in rows running across the street, and resting on a foundation of concrete. The Belgian pavement is formed of blocks nearly cubical in shape, the edge of the cube being from 5 to 7 inches long; trap-rock is generally employed on account of its toughness. The Gnidet pavement, which may be seen on Broadway, in New York, is formed of granite blocks from 4 to 5 inches wide, 10 to 15 inches long, and 8 to 10 inches in vertical depth. The blocks are set in close contact on the foundation, over which a layer of sand is laid, and are then rammed with heavy wooden rammers. The joints are filled with sand, or sometimes with asphalt. This pavement costs on a sand foundation from $4 to $5 per square yard. Stone pavements are durable, and when well made require little repair. They are open to the objection that they collect and retain the surface liquids between the joints, and in addition are noisy. Where the traffic is very heavy, however, stone seems to be the most advantageous material for a street pavement.

Brick Pavements.—The brick used for this purpose are hard burned, usually without being vitrified, and should be of uniform hardness and low porosity. A foundation of sand or gravel is first made and compacted by rolling, and upon this a course of brick is laid upon the flat side. A layer of sand an inch thick is next spread, and on this the top course of hardest and toughest bricks is laid, the bricks being set on edge with their longest dimension running across the street. This is covered with sand and well rolled until the pavement is brought to the assigned form of surface. Another method of construction is to omit the lower layer of bricks, using tarred boards instead, and sometimes the top layer has its courses laid diagonally across the streets. The first successful brick pavements were those built in Illinois and Ohio between 1875 and 1880, and they are now extensively used in the western parts of the U. S. With a good quality of brick and a traffic not heavy good results have been obtained, the pavement being clean, not noisy, durable, and the traction being easy. With brittle or soft bricks, however, cracking and wearing into ruts occurs. The cost of brick pavements has generally been between $1.50 and $2.50 per square yard on a sand foundation, and the construction of them is constantly increasing in large towns and smaller cities where the traffic is not severe.

Asphalt Pavements.—The bituminous limestone or asphalt rock of Switzerland, when heated, crumbles into a sandy powder, which, when spread on a good foundation in a sheet 2 or 3 inches thick and compacted by ramming with heated pestles, makes an excellent road covering. The bitumen from Trinidad mixed with heated sand makes a compound closely resembling that derived from the natural asphalt rock. It is also used in the form of rectangular blocks or bricks, which are made under heavy pressure. Such pavements when well made are very durable, the wear compacting the material instead of grinding it away. They are dustless, noiseless, smooth, and easy of traction, and do not absorb or retain noxious liquids. It does not become slippery from continual wear, although in wet weather it sometimes fails to give sufficient foothold to horses. It is adapted to all streets except those having steep grades and those crowded with traffic, and its use has become very extensive in the U. S., particularly for residence streets. The cost has usually ranged between $2.50 and $4 per square yard on a concrete foundation.

The comparative merits of the different kinds of pavements would be differently estimated, according to the character of the traffic. For a very heavy traffic nothing but stone blocks will prove satisfactory, while for lighter traffic brick or asphalt may be preferred. Stone is the most durable and wood the least, while asphalt and brick lie between the two. Wood is the cheapest in first cost, brick next, followed by asphalt, while stone is the dearest. Regarding maintenance and repairs probably asphalt stands first, stone second, and wood last. In the important matter of cleanliness and hygienic considerations asphalt stands first, brick second, and stone third, while wood is liable to many grave objections.

Statistics.—In a paper read in 1892 before the Commercial Club of Kansas City, Mo., Robert Gillham collected statistics of street-paving from fifty-one principal cities of the U. S. Stone pavements are divided into two classes—(1) dressed stone blocks of regular dimensions, and (2) cobblestone, rubblestone, or undressed irregular blocks. The number of miles of each kind of pavement for different groups of States is given in the following table:

STATES.	Stone. (1.)	Stone. (2.)	Brick.	Wood.	Asphalt.
New England States, 9 cities	177	20	..	...	5
Middle and Central States, 22 cities	879	1,079	56	480	323
Southern and Southwestern States, 9 cities	163	31	7	85	60
Northwestern States, 6 cities	38	....	25	170	29
Pacific States, 5 cities	31	2	..	1	4
Totals, 51 cities	1,288	1,132	88	736	421

New York had 321 miles of stone pavement of class (1) and only 3 miles of class (2), 16 miles of asphalt, less than 1 mile of wood, and none of brick. Philadelphia had 120 and 491 miles of the two kinds of stone pavement, 20 miles of brick, 43 of asphalt, and none of wood. Chicago had 23 miles of stone, 410 of wood, 9 of asphalt, and less than 1 mile of brick. It will be seen that the use of brick for street-paving is as yet limited in comparison with other materials. More than half of all the wood pavement in the U. S. is in Chicago. Buffalo, N. Y., takes the lead in regard to asphalt, having 125 miles, or more than one-fourth of the total, while Washington, D. C., stands next with 60 miles.

Planks, slag bricks, and gravel concrete are used to a very limited extent for street pavements. Granolithic paving is a kind of artificial stone, composed largely of hydraulic cement, which is made in place; the use of this, however, is mostly confined to sidewalks and court-yards. See Gillmore's *Roads, Streets, and Pavements* (1876); Love's *Pavements and Roads* (1889); and Byrne's *Highway Construction* (1892).

MANSFIELD MERRIMAN.

Pavia, pää-vee'ää (anc. *Ticinum*; med. *Papia*): city of Northern Italy; on the left bank of the Ticino, 2 miles above its junction with the Po; 21 miles by rail S. of Milan, with which it is also connected by a canal (see map of Italy, ref. 3–C). Pavia is still for the most part surrounded by walls, which form a circuit of 3½ miles. It was formerly called the city of the hundred towers. It is connected with the suburb of Ticino by a brick-built covered bridge which dates from the fourteenth century. The churches of Pavia are of great historic and architectural interest; among them are San Michele Maggiore, of the sixth or seventh century, perhaps the finest specimen of Lombard architecture existing; the cathedral of San Stefano (founded in 1488), containing the monument (fourteenth century) to St. Augustine and the remains of Boethius, which were brought thither from the ruined church San Pietro in Ciel d'Oro. Of the old castle, on the site of the ancient Lombard royal palace, little of interest is left except the half-ruined gateway. The University of Pavia, the *alma mater* of many illustrious men, is said to have been founded by Charlemagne, though not formally constituted until 1361. In 1891 there were 1,095 students and 56 teachers; attached to it are two colleges and a library with 185,000 volumes. The Museo Malespina contains some good pictures and a fine collection of engravings. Near Pavia is the picturesque old church Beato Lanfranco; but the great attraction of the neighborhood is the magnificent CERTOSA DI PAVIA (*q. v.*). Pavia is of very ancient, probably Ligurian, origin. It was of some importance under the Romans, and had a Christian church in 326. In 573 it became the Lombard capital, and for 200 years was a rich and great city. In 1524 Francis I. of France suffered a terrible defeat under the walls of Pavia, and was taken prisoner by the troops of Charles V. Three years later the town was barbarously sacked by the French, but it soon afterward fell into the hands of Austria. Bonaparte having taken Pavia (1796), at the prayers of the citizens limited his soldiers to a sack of three hours, so that the town was not totally destroyed. By the Peace of 1814 it returned to Austria, and after the battle of Solferino became a part of the kingdom of Italy. Pavia has some trade in rice, hemp, silk, wines, etc. Pop. (1893) 37,000.

Revised by R. A. ROBERTS.

Pavlov', NIKOLAÏ FILIPPOVICH: writer; b. in Moscow, Russia, in 1803; d. Mar. 29, 1865. He was brought up for the stage, but abandoned it two years after his *début*, and devoted himself to literature, although in order to acquire a better education he had first to prepare for the University of Moscow, and go through the courses there. He also was obliged to support himself by serving for some years as a government official. Some of the poems which he published in the newspapers were of merit, but he was more successful with his tales and essays, especially his *Four Letters to Gogol* (1847); *Vopros o Evreakh* (The Hebrew Question, 1858); *Mr. Chernyshevskiĭ and his Time* (1861). From 1860 to 1863 he was editor of the paper *Nashe Vremĭa* (Our Time) which was a failure.

A. C. COOLIDGE.

Pawcatuck' River: a stream formed in Washington co., R. I., by the union of the Charles and Wood rivers. It is navigable for small vessels for several miles, and forms the southern portion of the eastern boundary of Connecticut.

Pawn: See BETEL.

Pawnbroking [from O. Fr. *pan*, pledge, assurance, identical in form with *pan*, cloth, skirt (< Lat. *pannus*), but connected in meaning with *paner*, rob; Germ. *pfand* is probably a loan-word from O. Fr. *pan*]: the loaning of money upon the security of goods or chattels pledged by the borrower with the lender as security for the repayment of it. The word pawn is often applied in a broad sense to goods or chattels pledged as security for the performance of a contract, or the fulfillment of an obligation, or to the contract by which it is so pledged. The contract of pawn or pledge is a species of BAILMENT (*q. v.*), and differs from a hypothecation in that the latter does not require the actual delivery of the property, and from a chattel mortgage in that the mortgagee acquires the legal ownership. A pawnee has a larger right than a lienor, who does not have the right to sell on failure of payment.

The history of the practice of pawnbroking is lost in antiquity. The earliest records, however, of all civilized nations show that the practice existed among them, and that it was early regulated by laws which uniformly aimed to suppress extortion by the lender and to protect the borrower by strict regulations. Thus there is frequent mention in the Bible of laws among the ancient Hebrews forbidding lenders to keep or receive as security chattels the want of which exposes the borrower to great hardships or privations, as where it is forbidden to keep a man's coat over night or to take "nether or upper mill-stone to pledge," etc. See Exod. xxii. 26, 27; Deut. xxiv. 6, 11, 12, 13, 17.

Among the Chinese pawnbrokers are very numerous, and are kept under strict regulations, and any one acting without a license is severely punished. Pledges are usually redeemable for three years, and 3 per cent. per month is the highest rate of legal interest; and in the winter the monthly interest on pledges of wearing apparel may not exceed 2 per cent. These regulations have been enforced among the Chinese for at least 1,500 years. Interesting facts with regard to the practice are also found in the early records of the Hindus and Arabs and other nations of the East.

In modern times among European nations the first professional pawnbrokers were probably the Jews. The oppression and the hardships caused by the practice of the pawnbrokers early led to the passage of laws by which pawnbroking was exclusively intrusted to public institutions of a quasi-benevolent nature, now called *monts-de-piété*. The first of these was established at Padua, and from there the institutions were introduced into many states in Europe, and some of them still exist, as at Paris, Madrid, Brussels, Antwerp, etc. They were originally intended to be supplied with funds by contribution, and to loan upon with little or no interest; but this was found impracticable. Attempts have been made to introduce them into Great Britain, but they have met with no success; and several schemes that were started resulted in great loss of capital and the ruin of many interested. The *mont-de-piété*

at Paris may be described as giving a general idea of them all. It was opened in 1777, destroyed by the Revolution, opened again in 1797, and obtained a monopoly of pawnbroking in Paris in 1804, since which time it has continued with some minor changes. There is a central office and a number of commissioners who receive pledges in the various arrondissements. These commissioners make provisional loans on goods and then forward them to the central office, where they are appraised by the valuers of the *mont-de-piété*, the practice being to advance four-fifths on the value of gold and silver goods and two-thirds on that of other non-perishable goods. Since the *mont-de-piété* has a monopoly, the advances made are less liberal than where there is competition, so that the local commissioners make advances over the amount and recoup this by taking 2 per cent. of each pledge, 1 per cent. on redemption, and interest on the excess of advance. These charges have to be added to the 9 per cent. interest and ½ per cent. for valuation made by the central office. The trading capital of the *mont-de-piété* is obtained by the issue of promissory notes at 2½ per cent. for money deposited, by cash reserves, and by profit on the redemption and sale of pledges.

In England, as elsewhere in Europe, the first professional pawnbrokers were probably Jews, who, at and after the time of the Conquest, for more than two centuries charged from 45 to 65 per cent. per annum. This led to restrictive legislation, and in 1275 they were forbidden to take interest on pain of death, and in 1290 were expelled from the kingdom. Pawnbroking then fell into the hands of the Lombards, who throve upon it, although interest was unlawful until 1646, when it was fixed at 10 per cent. See USURY.

The taking of goods and chattels as security for the redemption of money lent thereon was first regulated by statute in England in 1757 (25 George III., c. 48, sec. 6). The provisions of this act were amended and re-enacted in several temporary statutes which were superseded by the Pawnbrokers' Act of 1800 (39 and 40 George III., c. 99). This act was also subsequently amended by various acts, but nevertheless grew unpopular, until in 1871 a committee was appointed by the House of Commons to investigate the matter of pawnbroking. In 1872, on their recommendation, a general act was passed regulating the business and repealing all previous laws. This act (35 and 36 Vict., c. 93) applies without qualification to every loan of a pawnbroker of not more than 40*s.*, and to loans of from 40*s.* to £10, unless the parties by special contract, in statutory form, agree to exclude the operation of the act as to profit and certain other particulars. Books of account of all transactions must be kept in a prescribed manner, and a pawn-ticket briefly stating the contract must be given with each pledge. The lawful profit is now a halfpenny per florin, or $2\frac{1}{12}$ per cent., per month, on loans up to 40*s.*, and a halfpenny per half-crown, or $1\frac{2}{3}$ per cent., on loans from 40*s.* to £10. The act also contains numerous other provisions, as for the liability in case of fire, for the prevention of the making of unlawful pawns, etc.

The system of pawnbroking as it exists in the U. S. is borrowed directly from that of England, and the subject is generally regulated by statutes or legal ordinances, the general effect of which is to restrict the interest that may be charged, and in other ways provide for the protection of the borrower, as by restricting the hours of business, requiring tickets to be given for each pledge, etc. See Jones on *Bailments*; Tyler on *Usury, Pawns, and Loans* (Albany, 1873); Turner's *Contract of Pawn* (London, 1883).

F. STURGES ALLEN.

Pawnee City: village (founded in 1856); capital of Pawnee co., Neb. (for location, see map of Nebraska, ref. 11–H); on the Burlington Route and the Chi., Rock Is. and Pac. railways: 75 miles S. of Lincoln. It is in an agricultural and stock-raising region, and has 6 churches, college, graded high school, 2 national banks with combined capital of $110,000, a State bank with capital of $15,000, and 2 weekly newspapers. Pop. (1890) 1,550; (1900) 1,969.

Pawnee Indians: See CADDOAN INDIANS.

Pawtucket: city; Providence co., R. I.; on both sides the Blackstone river and at head of navigation on the Pawtucket river; on the N. Y., N. H. and Hart. railway and leased lines; compact part of city 4 miles from compact part of Providence, which it abuts on the north; 39 miles S. S. W. of Boston (for location, see map of Rhode Island, ref. 7–H). It was the birthplace of the cotton manufacturing industry in the U. S., which was initiated in 1790 by SAMUEL SLATER (*q. v.*). The Blackstone river here has a fall of about 50 feet, furnishing abundant power for manufacturing, and is spanned by several bridges of iron and stone. The city, with an area of 9 sq. miles, presents a picturesque appearance, and has several public parks, system of waterworks introduced in 1878 at a cost of $1,333,000 and enlarged at a cost of $500,000, 23½ miles of electric street-railway, 46 miles of sewers, electric-light and gas plants, a public library (founded in 1876) containing over 19,500 volumes, public-school property valued at $597,000, 2 trust companies with a combined capital exceeding $1,000,000, 3 savings-banks with deposits in 1900 aggregating over $6,300,000, and 1 daily and 1 weekly periodical. It receives annually large quantities of coal, lumber, lath and shingles, brick, cement, lime, stone, and cotton. In 1900 the assessed valuations were: real property, $29,326,820; personal, $5,330,100—total, $34,656,920; and the net debt was $4,191,128.50, which included a water debt of $964,286.53. The census returns of 1890 showed that 371 manufacturing establishments (representing 73 industries) reported. These had a combined capital of $16,693,984, employed 9,508 persons, paid $4,079,579 for wages and $9,415,654 for materials, and had products valued at $16,303,729. The principal industry was the manufacture of cotton goods, which had 15 establishments, combined capital of $7,431,004, and products valued at $3,954,960. There were 7 hosiery and knit-goods mills, yielding a product valued at $745,712, and 9 textile dyeing and finishing factories, yielding a product valued at $1,417,971. Other important industries were the manufacture of foundry and machine-shop products, which had 13 establishments, $979,404 capital, and $1,110,852 receipts for products; and slaughtering and meat-packing, 3 establishments, $495,000 capital, and $2,895,191 receipts for products. Pawtucket was settled about 1655, was included in Bristol co., Mass., till 1861, and was incorporated as a city in 1885 (March 27). Pop. (1880) 19,030; (1890) 27,633; (1900) 39,231.

JOHN C. MINKINS.

Paxton: city (founded in 1858); capital of Ford co., Ill. (for location, see map of Illinois, ref. 5–F); on the Ill. Cent. and the Lake Erie and West. railways; 49 miles E. of Bloomington, 103 miles S. by W. of Chicago. It is in an agricultural region; contains 8 churches, Rice Collegiate Institute (founded in 1878), a national bank with capital of $50,000, and 2 weekly newspapers; and has water-works, electric-light plant, flour-mills, and various manufactories. Pop. (1890) 2,187; (1900) 3,036. EDITOR OF "RECORD."

Paxton, Sir JOSEPH: architect and horticulturist; b. at Milton-Bryant, Bedfordshire, England, Aug. 3, 1803, of humble parentage; educated in the free school at Woburn; obtained employment at Chiswick as a gardener in the service of the Duke of Devonshire, where he displayed such remarkable talent for landscape-gardening that the duke made him manager of his Derbyshire estates and commissioned him to remodel the grounds at Chatsworth. Under his care that mansion soon became the most renowned country-seat in Great Britain, the great conservatory especially being regarded as a wonderful triumph of art. This building became the germ of the idea which culminated in the plans for the Crystal Palace, the vast edifice of iron and glass erected from his designs for the great Universal Exposition of 1851. For this service he was knighted and received honors from several European sovereigns. He removed the buildings to Sydenham; erected a magnificent mansion for Baron James Rothschild; entered Parliament 1854; and published several works on botany, horticulture, and floriculture. D. at Sydenham, June 8, 1865.

Payment [from O. Fr. *payement*, deriv. of *payer*, pay < Lat. *paca're*, pacify, satisfy, deriv. of *pax*, *pa'cis*, peace]: a mode of discharging an obligation by the delivery and acceptance of money, or of something substituted for money by agreement of the parties. The original obligation may impose the liability to make payment. In such a case payment discharges it by performance. In other cases payment is made not in performance of the original obligation of the payer, but of one which the parties have substituted therefor—for example, one who is bound to transfer property or render services may prefer to pay a sum of money in lieu of performance. If the other assents to this, the original obligation is discharged by the substitution of the new agreement, and the latter is discharged by payment. A debtor often gives to his creditor a negotiable instrument instead of money. If the instrument is a genuine bill of a bank which has not failed, it will operate as money. A

forged bank bill, or, in most jurisdictions, the bill of a bank which has suspended payment, is treated as a nullity, and its delivery and acceptance are not payment. If the bill, note, or check of the debtor or of a third person be received by the creditor instead of money, it will have the effect of an absolute payment, provided the parties actually agree that such shall be its effect. In the absence of an actual agreement, however, the general rule is that it will operate as conditional payment only. If the condition is broken by the non-payment of the paper at maturity, the obligation is not discharged, but the creditor is remitted to all his original rights. See APPROPRIATION OF PAYMENTS and NEGOTIABLE INSTRUMENTS. FRANCIS M. BURDICK.

Payn, JAMES: novelist; b. at Cheltenham, England, in 1830. He was educated at Trinity College, Cambridge, and graduated in 1854; in 1858 became editor of *Chambers's Journal*, and in 1882 of *The Cornhill Magazine*. His published books, chiefly novels, are more than 100 in number, and include *Richard Arbour* (1861); *Lights and Shadows of London Life* (1867); *Won, not Wooed* (1871); *What he Cost her* (1877); *Under one Roof* (1879); and *The Eavesdropper* (1888). D. Mar. 25, 1898. H. A. BEERS.

Payne, CHARLES HENRY, D. D., LL. D.: minister and educator; b. at Taunton, Mass., Oct. 24, 1830. He was educated at East Greenwich Academy, Rhode Island, Wesleyan University, Middletown, Conn., and at the School of Theology of Boston University. He joined the Providence Conference in 1857; was pastor 1857–76, serving several of the leading churches in Brooklyn, Philadelphia, and Cincinnati; president of Ohio Wesleyan University 1876–88; elected corresponding secretary of the board of education 1888, and re-elected in 1892. He prepared a plan of federation of Methodist institutions of learning, which, with some modifications, was adopted by the General Conference of 1892. He published *The Social Glass and Christian Obligation* (1868); *Shall our American Sabbath be a Holiday or a Holy Day?* (1872); *Daniel, the Uncompromising Young Man* (1873); and *Guides and Guards in Character-building* (1884). D. in Clifton Springs, N. Y., May 5, 1899.

Payne, JOHN: poet; b. in London, 1842. He is a solicitor, and is known especially as a translator and a poet of the neo-romantic school, like Marzials and O'Shaughnessy, greatly influenced by Baudelaire and the French romanticists; author of *The Masque of Shadows* (1870); *Intaglios* (1871); *Songs of Life and Death* (1872); *Lautrec* (1878); *New Poems* (1880); *François Villon: a Biographical Study* (1881); and of the following translations: *The Poems of François Villon* (1881); *The Book of the Thousand Nights and One Night* (the first complete English version 1882–84, 9 vols.); *Tales from the Arabic* (1885); and *The Decameron of Boccaccio* (1886). H. A. BEERS.

Payne, JOHN HOWARD: dramatist and actor; b. in New York, June 9, 1792; began to edit a weekly paper, *The Thespian Mirror*, when thirteen years of age; two years later published twenty-five numbers of a periodical called *The Pastime*; made a successful *début* as an actor at the Park theater, New York, Feb. 26, 1809, in the character of Norval; appeared on the stage at Boston and other cities, also in London 1812–13, where he produced many new dramas, chiefly imitated from the French, for one of which, called *Clari, or the Maid of Milan*, he wrote the song *Home, Sweet Home*; published a volume of juvenile poems, *Lisping of the Muse* (1815); successfully produced his tragedy *Brutus* at Drury Lane 1818; was a friend and correspondent of Coleridge and Charles Lamb; edited in London a dramatic paper called *The Opera-glass* 1826–27; returned to the U. S. 1832; was U. S. consul at Tunis, Africa, 1841–45; again appointed 1851. D. there Apr. 10, 1852. Among his best writings were the plays *Virginius* and *Charles the Second*. His remains were removed from Tunis, Africa, to Washington, D. C., in 1883. A volume of his collected works, with a memoir, was published in 1875. See Brainard's *John Howard Payne*, a biographical sketch with narrative of removal of his remains to the U. S.

Payne, JOSEPH: See the Appendix.

Payne, WILLIAM HAROLD, A. M., Ph. D., LL. D.: educator; b. at Farmington, N. Y., May 12, 1836; educated in common schools in New York and at Macedon Academy; superintendent of public schools in Three Rivers, Niles, Ypsilanti, and Adrian, Mich., 1858–79; Professor of Science and Art of Teaching, University of Michigan, 1879–88; became chancellor University of Nashville and president Peabody Normal College, 1888; author of *School Supervision* (1875); *Outlines of Educational Doctrine* (1880); *Contributions to the Science of Education* (1887); translated and edited *Compayré's History of Pedagogy* (1884); *Compayré's Lectures on Teaching* (1888); *Compayré's Elements of Psychology* (1890); *Rousseau's Émile* (1892).

Payne, WILLIAM HENRY: See the Appendix.

Paysandú, pī-săn-doo′: a town of Western Uruguay, the third in size in the republic; on the river Uruguay; 214 miles N. W. of Montevideo; pop. about 14,000 (see map of South America, ref. 8–E). It is the center of a rich grazing region and has a large trade, by the river, in cattle and hides; above it, at Guaviyú, is an extensive meat-packing establishment. During the war of 1864–65 between Brazil and Uruguay, Paysandú was taken by the Brazilians, Jan. 2, 1865, after an engagement of fifty-two hours. It is the capital of the department of Paysandú, which has an area of 5,116 sq. miles, and a population (1887) of 28,417. HERBERT H. SMITH.

Payson, EDWARD, D. D.: clergyman; b. at Rindge, N. H., July 25, 1783; was a son of Rev. Dr. Seth Payson (1758–1820); graduated in 1803 at Harvard; was three years teacher of an academy at Portland, Me., where he was in 1807 ordained to the Congregational ministry and was colleague pastor with a Mr. Kellogg until 1811, when he became sole pastor. Here he remained till his death, Oct. 22, 1827. He was a man of great zeal and of saintly devotion. It is a curious misconception which generally prevails that he was a "hell-fire preacher." He was tenderness itself, and the hold he had upon the esteem of New England is shown by the number of children to whom his name was given in baptism. He was a faithful, considerate pastor, a zealous and impassioned preacher. He was at times melancholic, probably because dyspeptic, and morbid, but ordinarily he was a most agreeable companion. His sermons, etc. (3 vols., Portland, Me., 1846; new ed. Philadelphia, 1859), have been published, together with a *Life*, by Asa Cummings, D. D.—His uncle, PHILLIPS PAYSON, D. D. (1736–1801), for many years Congregational minister of Chelsea, Mass., was one of the most scholarly and influential divines of the Revolutionary period. Revised by S. M. JACKSON.

Pāzand: a form of language. See under PAHLAVĪ.

Paz Soldan, paath′sōl-daan′, MARIANO FELIPE: geographer, historian, and publicist; b. at Arequipa, Peru, Aug., 1821. He graduated in law at Arequipa 1847; took up his residence in Lima, held judicial positions, and was secretary of the Peruvian legation in Colombia; in 1853 he studied prison systems in the U. S., making an elaborate report. He was Minister of Foreign Affairs under Castilla, and of Justice under Balta; was long director of public works, and introduced important reforms in the Peruvian prisons. During the Chilian occupation of Peru he lived in exile at Buenos Ayres. His geographical and historical works are numerous, and are standard authorities. They include *Atlas geográfico del Perú* (1861); *Historia del Perú independiente* (1866); *Diccionario geográfico estadístico del Perú* (1877); *Diccionario de la República Argentina* (1884); and *Historia de la Guerra del Pacífico* (1884). D. at Lima, Dec. 31, 1886.—His brother, MATEO PAZ SOLDAN (b. 1814; d. about 1872), published several mathematical works and a *Geografía del Perú* (1861). HERBERT H. SMITH.

Pea [recently formed as sing. to *pease* (regarded as a plur.) < M. Eng. *pese*, from O. Fr. *peis* (> Mod. Fr. *pois*) < Lat. *pisum* = Gr. *πίσον*; the word appears also by direct borrowing from Lat. in O. Eng. as *pise*]: a plant of the family *Leguminosæ*, much prized in temperate countries for its seeds. The pea is known to botanists as *Pisum sativum*. It is native to Asia. The field pea, *P. arvense*, thought by de Candolle to be a native of Italy, is probably not specifically distinct. This latter is much grown in the northern parts of the U. S. and in Canada as a forage plant. The garden peas fall into two general categories, the common or shelling sorts and the sugar or edible-podded varieties. The shelling peas are those which are commonly grown in the U. S., the edible product being the seeds alone, which are shelled from the pod. In the U. S. these seeds are generally eaten when fresh and green, but dry peas are much used in parts of Europe. The edible-podded peas are those which possess a soft pod which does not burst open when the seeds are ripe. The pod, with the inclosed seeds, is eaten in the green state, much as "string" beans are used. Like the common peas,

the varieties are either dwarf or climbing. The common or shelling peas may be again divided into smooth-seeded and wrinkled-seeded varieties, the latter being considered of the better quality. Each of these classes is again divided into dwarf and climbing varieties. The peas now sold by the seedsmen of the U. S. number about 150 varieties, of which the Extra Early, or Philadelphia, strain includes the greater number of forms, strains, or sub-varieties. In the census year 1890 there were 56,162 acres devoted to peas upon the larger truck-farms of the U. S., and the aggregate of the plantations in smaller market gardens and home gardens must have been half as much more. In that year, 7,971 acres were used in growing peas for seed. The pea industry has increased rapidly because of the demand for the canned product. The plant thrives best in the Northern States and in the cooler months. It will endure light frost, and the seeds are therefore generally sown for the main crops just as soon as the soil can be worked in spring. The half-dwarf varieties are generally preferred for field culture, as they do not need poles or brush upon which to climb, and they are more productive than the very early and very dwarf varieties. The cow-pea, now much grown in the Southern States for forage, is *Vigna* (or *Dolichos*) *sinensis*. It is native to China and Japan. The black pea, gray pea, and others are varieties of it. L. H. Bailey.

Peabody: city; Marion co., Kan. (for location, see map of Kansas, ref. 6–H); on the Atch., Top. and S. Fé and the Chi., Rock Is. and Pac. railways; 36 miles N. of Wichita, 118 miles S. W. of Topeka. It is in an agricultural region: contains 6 churches, public library, a national bank with capital of $50,000, a State bank with capital of $50,000, several flour-mills, creamery, windmill-factory, and 2 weekly newspapers; and has a large business in exporting cattle, hogs, poultry, eggs, wheat, flour, butter, etc. Pop. (1880) 1,087; (1890) 1,474; (1900) 1,369. Editor of "Gazette."

Peabody: town (formerly South Danvers); Essex co., Mass. (for location, see map of Massachusetts, ref. 1–I); on the Boston and Maine Railroad; 2 miles W. of Salem, of which it was once a part. It contains 9 churches, 9 public-school buildings, public-school property valued at over $140,000, Peabody Institute (founded by George Peabody in 1852), 2 libraries (Peabody Institute and the Eben Dale Sutton Reference, founded in 1867), 2 national banks with combined capital of $400,000, a savings-bank, and 2 weekly newspapers. The principal industry is the manufacture of plain and morocco leather. The town was named after George Peabody, who was born there. Pop. (1880) 9,028; (1890) 10,158; (1900) 11,523. Editor of "Reporter."

Peabody, Andrew Preston, D. D., LL. D.: clergyman and author; b. at Beverly, Mass., Mar. 19, 1811; graduated at Harvard in 1826; was three years a teacher; studied divinity at Cambridge, Mass.; was tutor at Harvard College 1832–33; was minister of the South parish (Unitarian), Portsmouth, N. H., 1833–60, and was Plummer Professor of Christian Morals and preacher to Harvard University 1860–81; edited *The North American Review* 1852–61, and was long a leading contributor to the religious periodical press. Author of *Lectures on Christian Doctrine* (1844); *Sermons of Consolation* (1847); *Conversation* (1856); *Christianity the Religion of Nature* (1864); *Sermons for Children* (1866); a book of European travel (1868); *Christianity and Science* (1874), besides many published sermons, translations from classic authors, reviews, personal reminiscences, etc. One of the most conservative of his sect, he was equally admired and loved by all parties. D. in Boston, Mass., Mar. 10, 1893. Revised by J. W. Chadwick.

Peabody, Elizabeth Palmer: educator; b. at Billerica, Mass., May 16, 1804; spent her childhood in Salem; became a teacher at Boston 1822; wrote articles, chiefly on educational topics, for *The Journal of Education*, *The Christian Examiner*, *The Dial*, and *The Democratic Review*; translated de Gerando's *Moral Self-Education*; edited *Æsthetic Papers* (1849), *Crimes of the House of Austria against Mankind* (1850); published *R. G. Hazard's Essay on Language, and Other Papers* (1857), *Records of a School*, *First Steps to History* (1833), *Chronological History of the United States* (1856), *Letters to Kindergartners* (1886), *Last Evening with Allston, and Other Papers* (1887), and other works; and with her sister, Mrs. Mary (Peabody) Mann, published *Moral Culture of Infancy* and *The Kindergarten Guide* (1863). Her special service was in the promotion of the kindergarten in the U. S. D. at Jamaica Plain, Mass., Jan. 3, 1894. Revised by C. H. Thurber.

Peabody, Francis Greenwood, A. M., B. D., and D. D., Harvard University, and D. D., Yale: clergyman and theological professor; b. in Boston, Mass., Dec. 4, 1847; graduated at Harvard College in 1869, and from Harvard Divinity School in 1872; shortly became pastor of the first parish church in Cambridge, Mass., and after a brief ministry, remarkable for its high character and success, resigned on account of ill-health; has been for some years overseer and preacher of Harvard University, Parkman Professor of Theology, and Plummer Professor of Christian Morals. To connect the study of sociology with the study of ethics and religion has been his most characteristic aim. Both as a writer and speaker he is attractive and persuasive to a high degree. He is a frequent and valued writer for the reviews and magazines. John W. Chadwick.

Peabody, George, D. C. L.: philanthropist; b. at South Danvers, Mass., Feb. 18, 1795, of poor parents; received a scanty education; was a clerk in stores at Thetford, Vt., Newburyport, Mass., and at Georgetown, D. C., where he became partner with Elisha Riggs in the dry-goods business 1814; removed to Baltimore 1815; soon afterward opened branch houses at New York and Philadelphia; made several voyages to Europe on commercial business; became head of the firm 1829; removed to London, England, 1837; withdrew from the house of Peabody, Riggs & Co., and established a banking-house 1843; accumulated a large fortune; aided Mr. Grinnell in fitting out Dr. Kane's Arctic expedition 1852; founded in the same year the Peabody Institute in his native town, the endowment of which he subsequently increased to $200,000; visited the U. S. in 1857; gave $300,000 for the establishment at Baltimore of an institute of science, literature, and the fine arts; in 1862 gave $2,500,000 as a fund for building lodging-houses for the poor in London; gave in 1866, during another visit to the U. S., $150,000 to establish at Harvard College a museum and professorship of American archæology and ethnology, an equal sum for a department of physical science at Yale College, and created a Southern educational fund of $2,100,000, subsequently increased to $3,500,000, besides devoting $200,000 to various objects of public utility. In 1867 he gave $140,000 to trustees who established the Peabody Academy of Science at Salem, Mass. In recognition of his munificence, Queen Victoria offered him a baronetcy, which he declined, and gave him her portrait; the corporation of London conferred on him the freedom of the city, and the citizens ordered a statue by W. W. Story, which was unveiled in the Royal Exchange July 23, 1869, by the Prince of Wales, during Mr. Peabody's absence on a final visit to the U. S. On this occasion he raised the endowment of the institute at Baltimore to $1,000,000; gave $60,000 to Washington College, Virginia, $50,000 for a Peabody Institute at North Danvers, $30,000 to Phillips Academy, Andover, $25,000 to Kenyon College, Ohio, and $20,000 to the Maryland Historical Society, besides making large gifts to various charities. In the previous year he had endowed an art school at Rome. D. in London, Nov. 4, 1869, less than a month after returning from the U. S. His remains, after funeral honors in Westminster Abbey (Nov. 12), were taken to the U. S. in a British vessel of war and buried in his native town, now called Peabody. Several other bequests to objects of public utility were made by his will, in which his remaining fortune, about $5,000,000, was left to his relatives. See the *Life*, by Phebe A. Hanaford (Boston, 1882), and Cochrane's *Beneficent and Useful Lives* (1890).

Peabody, Gen. Nathaniel: soldier; b. at Topsfield, Mass., Mar. 1, 1741; settled at Plaistow, N. H., as a physician 1761; became lieutenant-colonel of militia; was one of the captors of Fort William and Mary at Newcastle, Dec., 1774; was an active and influential member of the legislature, of several conventions, and of the committee of safety during the Revolutionary war; became adjutant-general of the State militia 1777; delegate to the Continental Congress 1779–80; filled nearly every State office during a long course of public service, including those of Speaker of the House 1793 and major-general 1793–98, and was one of the founders of the New Hampshire Medical Society 1790. D. at Exeter, N. H., June 27, 1823.

Peabody, Oliver William Bourne: biographer and reviewer; b. at Exeter, N. H., July 9, 1799; graduated at Harvard College 1816; practiced law at Exeter 1819–30; edited *The Rockingham Gazette* and *Exeter News-Letter*; removed to Boston 1830; aided his brother-in-law, Alexander

H. Everett, in editing *The North American Review*; was for several years an editor of *The Daily Advertiser*; was Professor of English Literature at Jefferson College, Louisiana, 1842–43; wrote the *Lives* of Gens. Putnam and Sullivan in Sparks's *American Biography*; published an edition of Shakspeare, with a *Life* and notes (7 vols., 1844); became pastor of the Unitarian church at Burlington, Vt., in Aug., 1845. D. at Burlington, July 5, 1848.

Revised by H. A. Beers.

Peabody, William Bourne Oliver, D. D.: clergyman and scientist; twin-brother of O. W. B. Peabody; b. at Exeter, N. H., July 9, 1799; graduated at Harvard College 1816; was assistant instructor at Exeter Academy 1817; studied theology at the Cambridge Divinity School under Dr. Henry Ware; was licensed as a preacher 1819, and ordained in Oct., 1820, pastor of the Unitarian church at Springfield, Mass., where he remained through life. Dr. Peabody was a man of extensive knowledge, of gentle nature, and winning manners. He wrote much on various branches of natural history; was one of the commissioners of the Massachusetts zoölogical survey, for which he prepared a *Report on the Birds of the Commonwealth* (1839); wrote the *Lives* of Alexander Wilson, Cotton Mather, David Brainerd, and James Oglethorpe in Sparks's *American Biography*; was well versed in landscape-gardening, and was an able lecturer upon scientific topics. D. at Springfield, May 28, 1847. His sermons, with a prefatory memoir by his brother, were published in 1849, and his *Literary Remains* in 1850.

Revised by J. W. Chadwick.

Peace [M. Eng. *pees*, from O. Fr. *pais*, *pes* (> Mod. Fr. *paix*) : Ital. *pace* : Provenç. *patz* : Span. *paz* < Lat. *pax*, *pacis*, peace]: a suspension of war and a return to a state of intercourse such as existed before war, and to *amnesty*, or the oblivion, the waiving, of all future claims on account of those particular acts of injury for which a war was initiated. For the existence of peace a treaty is necessary, unless, indeed, complete conquest and absorption of an entire country has taken place, when there would be no one to negotiate with. Such a treaty, if there be a number of belligerents, may be made by all the parties on one side with all on the other; or each on one side may make a treaty with every other. The great treaties, such as the Treaty of Westphalia and the final act of the Congress of Vienna, are complicated documents: the first combining in two separate treaties—one between France and the German powers, and the other between Sweden and the same powers—the results of negotiations in two separate places; while the other contains the results of a great number of special treaties with powers not properly parties to the congress, or of such powers with one another, as well as of treaties between the parties to the congress themselves. If any question of ownership is left unsettled by the treaty of peace, the rule of *uti possidetis* applies, i. e. property of every kind remains legally in the hands of that state which at the close of hostilities actually was master of it. The effects of a treaty of peace, in particular the cessation of all war operations, begin at once upon its signature, even if ratification still remains necessary, unless the contrary is specified.

Revised by T. S. Woolsey.

Peace is also good order among the members of a state. Blackstone declares that "the common law hath ever had a special care and regard for the conservation of the peace; for peace is the very end and foundation of civil society." The primitive state, however, makes little pretense to the maintenance of public peace. On the other hand, private war between its members is not only tolerated but legally sanctioned. In English legal history the first attempts by the state to keep the peace appear to have been confined to the citizen's homestead. "Every man was entitled to peace in his own house. The brawler or trespasser in another's homestead broke the owner's peace, and owed him special amends." The grade of the offense varied with the owner's rank. Breaking the peace of an earl, or of a church, was a serious matter, while the peace of the king's house was broken at the risk of the wrongdoer's life. The domain of the king's peace was extended as his power increased. Under the later Saxon kings it covered the four great roads of the realm and all waterways on which provisions were carried. It was also given by the king's hand as a special privilege to individuals, and was to be enforced throughout the kingdom during certain periods, such as Christmas, Easter, and Whitsuntide weeks. After the Norman conquest the king's peace soon became synonymous with the peace of the kingdom. It was proclaimed at his accession as extending to all his loyal subjects, and after the adoption of the fiction that the king never dies, in legal contemplation it was never suspended. Royal officers were appointed to maintain it, notably the justices of the peace, and forms of legal procedure were devised for its more effective enforcement. One who had reasonable fear of harm to his person or property was allowed a writ *de securitate pacis*, by which the person threatening could be made to give security to the complainant to keep "our strict peace according to the custom of England." With the institution of this writ the king's peace became a well-defined common-law right of every law-abiding citizen. Thereafter breaches of the peace included not only public assaults and riots, but all unlawful acts which tended directly to produce public disorder, such as challenges to fight and the publication of libels. Modern statutes carefully define criminal breaches of the peace and regulate their punishments. See Bill of Peace.

Francis M. Burdick.

Peace, Breach of: See Peace.

Peace River: a river of British America, which rises in the Coast Range Mountains N. of British Columbia, and flows N. E. through the Rocky Mountains to near Athabasca Lake, more than 600 miles, where it turns N., and under name of Slave river enters Great Slave Lake. It is navigable for most of its extent, and passes through a fertile valley.

Peach [from O. Fr. *pesche* > Fr. *pêche* < Late Lat. *persica* (whence Germ. *pfirsich*, peach), for Lat. *persicum* (sc. *ma'lum*, apple), Persian apple, peach, the peach having once been supposed to have come from Persia]: one of the most delicious of all fruits of temperate climates, a member of the rose family, and closely allied to the apricot and plum. Most botanists now agree in referring the peach to the genus *Prunus*, which includes the plum, and its botanical name is then *Prunus persica*. There are some writers, however, who prefer to retain the old genus *Persica*, and who call the peach *Persica vulgaris*. It is now considered that the peach is native to China, although it is not known to have been found truly wild. The opinion of Knight, cited by Darwin and others, that the peach is derived from the almond is not generally accepted. The species is a small tree, usually under 25 feet in height at maturity, with a brittle wood, and narrow, willow-like, lanceolate leaves. The tree is usually short-lived, rarely living beyond fifty years, and under the strain of high cultivation and heavy production it usually perishes or becomes unprofitable before the twentieth year. The flowers are sessile and borne singly upon the branches of the previous year's growth, and appear in early spring in advance of the leaves. They have a five-parted calyx, five pink or blush petals, about twenty stamens borne upon the throat of the calyx, and a single superior ovary containing a pair of ovules. When ripe the ovary becomes a fleshy drupe with a hard rough pit or stone, which, by suppression of one ovule, generally contains but a single seed, and a soft fuzzy skin. A type of peach has arisen, however, with a perfectly smooth plum-like skin, and this is known as the Nectarine (*q. v.*). The peaches proper, exclusive of the nectarines, fall into two general classes, the clingstones, or pavies, and the freestones, these terms referring to the manner in which the flesh joins the pit. These classes grade into each other, especially in the early peaches of the Hale Early type, which are pronounced clingstones in ordinary or dry seasons, but which may become nearly free in moist seasons. The clingstones are now little prized in the Eastern States because they are difficult to prepare for culinary uses, but they comprise the chief California peaches which are now shipped to the eastern markets. Each of these classes may be again divided into white-fleshed and yellow-fleshed peaches, of which the former are, in general, of the better quality, but the latter are much more popular in the market, and are therefore mostly grown in the U. S. There are also various red-fleshed or blood peaches, but they are little grown. The flat peaches, sometimes considered a distinct species (*Prunus platycarpa*), are really only modifications or varieties of the common peach. They are sometimes flattened to little more than the width of the stone. The Peen-to is the chief representative of this class in the U. S.

The peach thrives in those warm or mid-temperate climates which abound in warm days and bright suns. It is scarcely grown in England in the open air because of the cool and humid climate. There is no country in which the peach is cultivated so commonly and with such great success as in

the U. S. Its range is from the Gulf of Mexico to Southern New England and the shores of Lake Ontario, in both New York and Canada, and Lake Michigan, and upon the Pacific coast it again finds congenial climate over a wide extent of territory. In the Northern States the peach thrives only in favored localities, as in Southern Connecticut, along the western end of Lake Ontario and about the lakes of Central New York, along Lake Erie, and on the eastern shore of Lake Michigan. In the north only those areas within the influence of bodies of water are safe for peaches, because they there escape the late spring frosts which destroy the fruit-buds. Large areas in Southern Illinois, in Missouri, and other of the Mississippi and plains States are devoted to peach-culture. While the peach grows upon a variety of soils, it thrives best in a loose sand. Some of the best peach regions are those with even poor and leachy sandy soil. The trees are set from 16 to 20 feet apart in the orchard, and they should be given clean cultivation, and annual crops should not be grown among them after the third year. The trees may be expected to bear a crop the third year from planting. Peach-trees are always sold and planted when a year old or less, from the bud. That is, the seed is planted in the spring, and the resulting seedlings are budded the following August or September. These buds grow the next spring (see GRAFTING), or a year from the time the seeds were planted, and the trees are ready for sale the following fall, by which time the tree has grown from 4 to 7 feet tall. In the southern parts of the U. S. this process is sometimes hastened by "June budding," which consists in budding the stocks the June or July following the sowing of the seeds. The buds grow at once, and in the fall of the same year the trees are ready for sale. The varieties of peaches are very many. The Melocoton tribe is still the most popular in the northern parts of the U. S. The Red-cheek Melocoton was a famous peach of American origin, which is now scarcely, if at all, known in its original form. It was a firm, yellow-fleshed peach, with a red-splashed cheek and a prominent tip-like projection upon the apex. It is now represented by the Early and Late Crawford and many others of the same type; and the Elberta, which is now the leading peach of the Southern and Middle States, is undoubtedly an offshoot of the same type. The Hale Early type, represented in many varieties, is still prominent. This class is characterized by rather small or medium-sized fruits, with white flesh of indifferent quality and clinging more or less tenaciously to the stone. These are chiefly valuable for their earliness and productiveness. The best account of them is Stoll's *Amerikanische Frühpfirsiche* (Klosterneuburg, near Vienna, 1889). Other important varieties are Mountain Rose, Old Mixon, Hill's Chili, Stump, Smock, Salway, Stevens's Rareripe, Chinese Cling, Honey, the two last being chiefly grown in the Southern States. The leading peach shipped from California is the Lemon Cling or similar varieties.

There are many serious diseases and insect enemies of the peach. The chief of these is the yellows, a disease of unknown origin, which always terminates fatally. It is characterized by a red-spotted and usually prematurely ripening fruit, the putting forth of short stiff-leaved shoots from the tips or upper buds of growing twigs, the pushing out of slender and generally bunched growths from the larger limbs or trunk, and finally by the general sickening and death of the tree. It is now known that this disease is not due to any peculiarities of soil or climate, nor to injuries, insects, or parasitic fungi. It is communicable from tree to tree, although its method of spread is unknown. An affected tree lives from three to six years. There are laws for the suppression of the disease in many peach-growing States. Rosette is a somewhat similar but more virulent disease occurring in Georgia and Kansas.

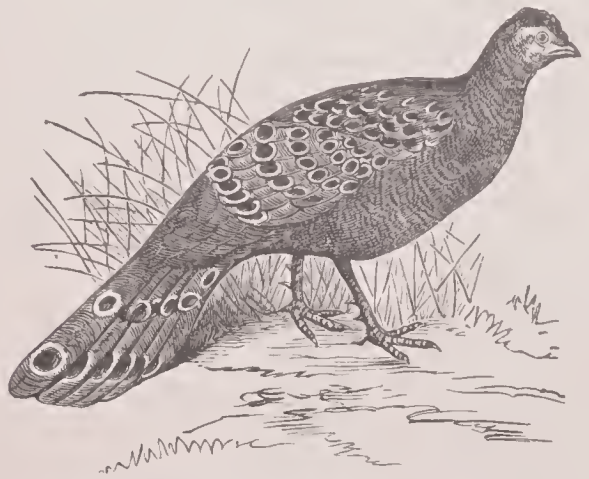
Fungous diseases of the peach are several, of which the most destructive is the twig-blight and fruit-rot, conditions caused by a fungus, *Monilia fructigena*. Spraying with Bordeaux mixture (see FUNGICIDE) in spring before the flowers appear is considered to be the best preventive. The curculio is the best known of the insect enemies of the peach. This beetle lays its eggs in the young fruit, and the larvæ are the "worms" of the stone fruits. The beetles are usually caught upon sheets or in a large canvas-covered hopper by jarring the trees in the morning before the insects begin to fly. Some success has been attained in spraying cherries with Paris green (see INSECTICIDE) to destroy the curculio, but the foliage of the peach is so tender that such treatment often injures it, and it is also doubtful if the practice is generally efficient. Borers are very troublesome in the trunks of peach-trees, especially near the base. These should be dug out in spring and fall. The stunted and yellow condition of trees injured by borers is often mistaken for the yellows. For fuller information on peaches in America, see the fruit manuals; also the special works of Fulton, Rutter, and Willcox. L. H. BAILEY.

Peach-curl: a fungous disease of peach leaves and twigs, in which they become somewhat swollen and much curled and deformed. It is caused by a minute parasitic fungus, *Exoascus deformans* (family *Gymnoascaceæ*), which penetrates the tissues of the leaf and finally produces spore-sacs upon the surface. In the latter eight or more spores are produced. Scribner recommends the early removal and destruction of all the diseased leaves and shoots, and suggests spraying the trees in early spring with a 30 to 40 per cent. solution of iron sulphate. C. E. BESSEY.

Spore-sacs of peach-curl. Highly magnified.

Peach-yellows: a contagious disease of peach-trees characterized by the yellowish-green foliage, dwarf shoots, and prematurely ripened, often reddish-stained fruits. A year or two after the first attack the trees die outright, or languish for several years, gradually dying from the extremities downward. It is common in most peach-growing districts in the eastern parts of the U. S. The cause of this disease is not certainly known, but is thought by some investigators to be due to the presence of bacteria. It is readily propagated by inoculation. No cure is known; all that can be done is to remove and burn the affected trees. CHARLES E. BESSEY.

Peacock [*pea-* < O. Eng. *pēa*, *pāwa*, peacock, from Lat. *pā'vō*, peacock, a loan-word, like Gr. *ταῶς*, from Semit.; cf. Arab. *tāwūs*]: any bird of the genus *Pavo* and family *Phasianidæ*. The several species are remarkable for the long and showy tail-coverts of the male. Three species are now recognized: 1, The common peacock (*Pavo cristatus*); 2, the black-shouldered peacock (*Pavo nigripennis*); and, 3, the Jason peacock (*Pavo muticus*). The common peacock is a native of Southern and Southeastern Asia, but is now naturalized in many parts of the world. Its flesh was formerly employed for food; but, except when young, it is scarcely palatable. The white peacock is an albino of the ordinary



Tibet peacock (*Polyplectron tibetanum*).

species. The name peacock is also sometimes applied to the species of the allied genera, *Polyplectron* and *Crossoptilon*. Revised by F. A. LUCAS.

Peacock, THOMAS BROWER: See the Appendix.

Peacock, THOMAS LOVE: author; b. at Weymouth, England, Oct. 18, 1785; entered the civil service of the East India Company 1818; was employed in the London office of that corporation until 1856; was a friend of Lamb and Shelley, and wrote a memoir of the latter. He was author of several volumes of poems and romances which met with favor at their first appearance, were forgotten for many years, and obtained a renewed popularity on their republication in 1875 by Lord Houghton, accompanied by a biographical sketch. Among his novels are *Headlong Hall* (1815); *Nightmare Abbey* (1818); *The Misfortunes of Elphin* (1829); and *Gryll Grange* (1860). His principal poems are *Palmyra* (1806); *The Genius of the Thames* (1810–12); and *Rhododaphne* (1818). D. in London, Jan. 23, 1866.

Peacock-pheasant: any pheasant of the genus *Polyplectron*; so called from the fact that the plumage, and especially the tail-feathers, of the males are adorned with large eye-like spots, suggesting those of the peacock. The generic name is given on account of the two or more spurs which arm the tarsus of the males. F. A. L.

Peale, Charles Willson: painter and inventor; b. at Chestertown, Md., Apr. 16, 1741; was successively a saddler, silversmith, watchmaker, and carver; studied painting under Copley at Boston and at the Royal Academy, London, under Benjamin West; painted the first portrait of Washington as a Virginia colonel 1772; commanded a company at the battles of Trenton and Germantown; was a member of the Pennsylvania convention of 1777; painted the portraits of the most prominent officers of the Revolution; was a leading promoter of the Pennsylvania Academy of Fine Arts; opened the first American museum; was the first American manufacturer of enamel teeth; invented a great variety of machines, and published a number of scientific essays. D. in Philadelphia, Feb. 22, 1827.
Revised by Russell Sturgis.

Peale, Rembrandt: artist; son of Charles W. Peale; b. in Bucks co., Pa., Feb. 22, 1778; received an artistic training from his father; painted a portrait of Washington Sept., 1795; studied under West at London 1801–04; spent several years at Paris; returned to Philadelphia 1809; achieved eminence as a portrait-painter; executed the well-known pictures *The Roman Daughter* and *The Court of Death* (the latter was profitably exhibited in the chief cities of the U. S. for a number of years); lectured on the portraits of Washington, and published a *Biography of Charles W. Peale*, *Notes on Italy* (1831), *Portfolio of an Artist* (1839), and other works on art. D. in Philadelphia, Oct. 3, 1860. Revised by Russell Sturgis.

Peanut: See Goober.

Pear [O. Eng. *peru*, from Lat. *pi'rum*, pear; cf. *pi'rus*, pear-tree, probably akin to Gr. ἄπιος, pear-tree]: a fruit of the rose family, widely cultivated in temperate climates. The common pear is *Pyrus communis*, and is native to Europe. In recent years the Chinese and Japanese pears, belonging to the species *Pyrus sinensis*, have been introduced into the U. S. in several varieties. This species is distinguished from *P. communis* by a more vigorous growth, larger and darker-colored leaves which are very sharply serrate, and especially by the long-stemmed apple-like fruits, which generally have a distinct depression about the stem. The fruits of this Oriental species are very much inferior to the common pears, being very hard and gritty, and lacking in agreeable flavor. The tree makes a good stock upon which to bud or graft other pears, however, and the hybrids with *P. communis*, like the Kieffer, Le Conte, and Garber, combine the vigor of the Chinese type with some of the edible qualities of the common type. *Pyrus nivalis*, the perry or snow-pear of Europe, is not grown in the U. S. The Russian pears recently introduced into the U. S. are simply very hardy and usually somewhat inferior types of the common *P. communis*. Dwarf pears are produced by grafting the common pears upon the quince-root. While all varieties of pears can be made to grow upon the quince, there are comparatively few which are considered to be profitable when so grown. Dwarf pear-trees are esteemed because they bear when young, and are usually very productive, and the small size of the tree renders the labor of picking and pruning easy. Pears can also be dwarfed by grafting them upon the thorn-trees (various species of *Cratægus*), but experience in this direction is so limited that the practice can not be recommended.

Pears are successfully grown over a wide territory in North America. In the southern parts of the U. S. derivatives of the Oriental stock, particularly the Le Conte, are now chiefly grown for commerce. Much of the Pacific slope is admirably adapted to pear-culture, and in that region the fruit attains a much greater size than it can be made to acquire in the older States. Of the Eastern States it is generally considered that New England and New York are best adapted to pears. The best pear lands are those which contain a liberal amount of clay. Standard pears—those grown upon pear-roots, in distinction from dwarfs—are commonly planted from 20 to 30 feet apart each way, and they are trained and pruned in essentially the same manner as apple-trees. The varieties of pears are very various in habit of growth, however, and the methods of pruning should be carefully adapted to the particular variety in hand. Dwarf pears are set about 12 to 15 feet apart, although the distance should be adjusted to the method of trimming. If the trees are kept in a narrow form and allowed to grow rather high they may be set as close as 10 feet, but if they are trimmed in the flat-topped fashion a rod apart each way is not too great. It is essential to success in the culture of dwarf pears that the trees be kept low. The tops should never rise above 10 or 12 feet. This is accomplished by shortening in the annual growth a third or half its length every winter. Trees kept to this stature do not become top-heavy and break off at the union with the quince, and they do not make greater demands than the quince-root can meet. It is also important that the point of union between the pear and quince should be placed from 3 to 6 inches in the ground, in order to prevent the breaking apart of the two, and to protect the quince-stock from borers. If attention is given to these essentials dwarf pear-trees, contrary to the general notion, will continue to thrive and bear for more than half a century. The pear, whether upon the roots of pear or quince, is budded in the nursery during the summer season. Nurserymen in the U. S. commonly import pear-stocks or seedlings from France, because seeds are more easily obtained there, the labor required in growing them can be procured more cheaply, and the leaf-blight, which is a serious disease in the U. S., is not present. These stocks are commonly imported when a year old—that is, in the fall succeeding the sowing of the seeds. These are set in nursery rows, and are budded the following summer, when the stocks are in their second year. These buds start the following spring in the North, and when they have grown two or three years the trees are ready for sale. Dwarf pears are propagated in much the same manner. About 3,000 varieties of pears are described, but the number in general cultivation in the U. S. will not greatly exceed fifty. The most popular of all pears in North America is the Bartlett, which originated in England about 1770, and which is there known as Williams's Bonchretien, from one Williams, a nurseryman of Turnham Green, who obtained it from Wheeler, who raised it. This is nearly always grown as a standard. Other leading sorts are Howell, Sheldon, Flemish Beauty, Anjou, Clairgeau, Lawrence, Summer Doyenne, Seckel, Louise Bonne. Kieffer is also gaining rapidly in favor, because of its vigor and productiveness, although the fruit is low in quality. Le Conte, of the same type, is the most popular pear of the southern parts of the U. S. For dwarfs, Duchesse d'Angoulême is the most popular, although several other varieties thrive upon the quince. Pears improve in quality if picked before full maturity—but when fully grown—and are ripened in a dry, cool room.

The most serious disease of pears is the pear-blight, or fire-blight. This is a germ disease, the microbes residing in the wood, usually of the smaller limbs, and breaking down the starch contents of the cells. The germs probably enter the tree through the growing or expanding tips, as the apex of a shoot or the flowers. They do not enter through the roots. The symptoms of the disease are a uniform browning and finally blackening of the leaves and young shoots, and the death of the bark along the branches where the injury has proceeded. The only treatment is to cut off the affected parts and burn them. Pear-blight is peculiar to North America. This disease must not be confounded with the pear-leaf blight, which causes the leaves to become spotted and to fall, and which, when it attacks the fruit, makes the pears crack. This leaf-blight is caused by a parasitic fungus (*Entomosporium maculatum*), and it can be readily overcome by the use of Bordeaux mixture. (See Fungicide.) The fungus which renders pears scabby is practically the same as that which produces the similar condition upon the apple, and the treatment is the spray of Bordeaux mixture. Among insects, the codlin-moth is probably best known. Its larva is the "worm" of apples and pears. This insect is combated by sprays of arsenites. (See Insecticide.) There are also various borers in pear-trees, which should be dug out as soon as discovered. There are other insects which occasionally do great damage in certain localities or in particular years. For further information, the reader should consult the fruit manuals; also Field's *Pear-culture*; Quinn's *Pear-culture for Profit*; Parry's *Forty Years' Experience in Pear-growing*; and Waite's *Pollination of Pear Flowers* (*Bull.* 5, Div. Vegetable Pathology, Dept. Agr., Washington). L. H. Bailey.

Pearce, Charles Sprague: figure and portrait painter; b. in Boston, Mass., Oct. 13, 1851; pupil of Bonnat in Paris;

member Society of American Artists 1886; received honorable mention, Paris Salon, 1881; third-class medal, Paris Salon, 1883; Temple gold medal, Pennsylvania Academy, Philadelphia, 1885; medal of honor, Ghent Exhibition, 1886; second-class medal, Munich Exhibition, 1888; member of the international jury of awards, Paris Exposition, 1889; grand diploma, Berlin Exhibition, 1891. His works are notable for fine drawing and cleverness of execution. His *Fantaisie* is in the Temple collection, Pennsylvania Academy, Philadelphia, and pictures by him are in the Art Institute, Chicago, Boston Art Club, and the Massachusetts Charitable Mechanics Association, Boston. Studio at Auvers-sur-Oise, France. WILLIAM A. COFFIN.

Pea Ridge: a range of hills in Benton co., Ark., near the northwest corner of the State, noted for the important battle fought there Mar. 6–8, 1862, between the Union forces under Gen. Curtis and the Confederates under Gen. Van Dorn, resulting in the defeat of the latter.

Pearlash: a term often applied to the commercial potassium bicarbonate. Pearlash, however, is properly the same substance as commercial potash, which has merely been subjected to a somewhat more careful preparation. The black salts, or crude black potash obtained by the boiling down of lye from wood-ashes, instead of being simply fused, is stirred for some time with an iron rod upon the hearth of a furnace in which a flame is made to play over the mass. The carbonaceous impurities are thus burned out, and the mass becomes of a more or less bluish-white color. See POTASSIUM.

Pear-leaf Blight: See BLIGHT.

Pearl-fisheries: the business or practice of taking shellfish which produce pearls, especially the pearl oyster, *Margaritiphora margaritifera*, Lam., a species widely distributed throughout tropical seas, and subject to considerable local variation, some authorities recognizing three species instead of one. While originally prosecuted for the pearls alone, pearl-fisheries are now carried on equally for the sake of the pearl oyster shells, from 12,000 to 15,000 tons of these being annually employed for the manufacture of various articles. The earliest recorded fisheries were those carried on in the Persian Gulf and on the coast of Ceylon. Later the Red Sea furnished pearls for the Egyptians, and after the discovery of America large numbers were taken from the Gulf of Panama and along the northern coast of South America. At present the most important fisheries are in the Persian Gulf, the Gulf of Manaar—between Ceylon and the mainland—the Gulf of California, the Sulu Archipelago, and on the tropical coasts of Australia. The Gulf of Manaar has always been a famous ground, and as early as 1330 8,000 boats were engaged there. The extensive Australian fisheries are carried on principally for the sake of the shells, and have their headquarters at Thursday island, in Torres Straits, where the best shells are found. Before the discovery of the Australian grounds the price of the best pearl shell had reached $2,000 per ton, but their immense yield has reduced the price to $900 per ton for the best, the value ranging from that down to $300. For a long time the only means of obtaining pearls was the primitive one of divers working from open boats without other equipment than a stone to aid them in their descent, and this method is still pursued. These divers stayed under from fifty to eighty seconds, gathering such shells as were at hand, and placing them in a basket to be pulled up by men in the boat above. A boat carried usually ten divers, who worked in pairs, the one above pulling up the sinkstone when his partner was at the bottom, and later on pulling him up also. At present the DIVING-DRESS (*q. v.*) is extensively employed, and by its aid the oysters can be taken in water 120 feet deep, although the majority are gathered in water from 40 to 50 feet deep. This apparatus necessitates the use of somewhat larger boats than were employed in the old style of fishery, and on the Australian coast the favorite boat is a lugger of about 10 tons burden. Dredging is also employed to gather shells in Australia. The use of the diving-dress temporarily increases the yield of pearl shells, but depletes the beds rapidly, and considerable attention is being given to the problems of regulating the fisheries and cultivating the pearl oyster. In Ceylon there has long been a close time, and the hours during which fishing may be carried on are also fixed by law. Information concerning the pearl-fisheries and statistics of their products are meager and not very reliable. The annual yield of the Gulf of California is said to be about $350,000, that of the Persian Gulf not far from $2,000,000. In 1887 30,947,905 shells, value not given, were taken in Ceylon, and the product of the shell-fishery of Queensland averages £69,000. Some gathering of unios for pearls has been done in the U. S., principally in Ohio, and there have been fisheries for these shells in Scotland. The industry is systematically carried on in parts of Europe, notably in Germany, and to a greater extent in China, where considerable attention is also given to the production of what may be termed sacred shells. This is done by introducing small figures of Buddha, or other divinity, stamped from tin or copper, between the shell and mantle. The mussel is then returned to the water, and in the course of from six months to two years retaken, when the figures are found coated with pearl uniform with the lining of the shell. F. A. L.

Pearl Harbor: See the Appendix.

Pearl River: a river formed by several head-streams which unite in Leake co., Miss. It flows in a general S. course for 250 miles into the Mississippi, and is for some distance the eastern boundary of Louisiana. Its navigation is impeded by snags and sand-bars.

Pearls: secretions of the "mantle" or lining membrane of various kinds of shellfish, consisting, like the shell itself, of carbonate of lime united with animal matter. They are of the same color as the interior of the shell in which they are found—white, black, pink, etc., but generally "pearly," or *nacreous*, as it is termed, i. e. with a play of delicate tints. The quality of a pearl is termed its orient. They are often attached to the inside of the shell, or are irregular or distorted in form, and have then but little value, only those of finely rounded shape or pear-shaped being employed in fine jewelry. The pearls of commerce come chiefly from a large shellfish known as the pearl-oyster (*Meleagrina*), and are procured mainly in the Persian Gulf and on the west coast of Mexico. The shells themselves yield "mother-of-pearl." Along the California coast the brilliant pearly green *abalone* shells (*Haliotis*) are gathered in like manner for inlaid work and ornaments, and in them are found green pearls. Pink pearls, not nacreous, are obtained from the large pink conchs (*Strombus*) of the West Indies. The river-shells, or "fresh-water mussels" (*Unios*), yield pearls also, and they abound in the rivers of the U. S. Some fine pink, cherry-colored, and other "fancy" pearls have been found in the rivers of Ohio and other States. GEORGE F. KUNZ.

Pearse, CARROLL GARDNER: See the Appendix.

Pearson, Sir CHARLES JOHN: See the Appendix.

Pearson, JOHN, D. D.: theologian; b. at Great Snoring, England, Feb. 28, 1613; educated at King's College, Cambridge, where he became fellow 1635; was afterward divinity professor and master of Trinity College (1662), and became in 1672 Bishop of Chester. D. at Chester, July 16, 1686. Author of *An Exposition of the Creed* (1659). His *Minor Theological Works* were published in 1844.

Peary, ROBERT E.: Arctic explorer; b. at Cresson Springs, Pa., May 6, 1856; educated at Bowdoin College; entered the civil engineer corps of the U. S. navy 1881. In 1886, with one companion, he penetrated the Greenland ice-cap for 100 miles in lat. 69° 30′ N.; went, with six companions, to McCormick Bay, N. W. Greenland, 1891, to study the Eskimos; in 1892, in a brilliant sledge journey of 1,300 miles, discovered Independence Bay on the N. E. coast (lat. 81° 37′ N.); partly outlined Peary Channel, supposed to be the northern limit of Greenland, which he proved to be an island; reached Independence Bay again in 1895 (after defeat by prolonged storms in 1894), but was unable, on account of failing supplies, etc., to explore the archipelago to the N. of Greenland. In 1898 he again went to Greenland, intending to ascend Smith Sound with his steamer. He described his Aretic work in his book *Northward Over the Great Ice* (1898).

Peary Land: See the Appendix.

Peasants' War: the revolutionary rising of the peasants of Southern and Central Germany in 1525. The Reformation was the immediate occasion of this movement, but not its real cause. Similar risings were frequent before the Reformation, and the real cause of all these risings was the miserable social condition of the peasants. They were serfs; that is to say, they belonged to the soil on which they were born, and through that to the lord who owned the soil. The latter often appropriated for his own use the common pasture-grounds of the village, forbade his tenants to fish in the streams and hunt in the woods, and increased the ground-rent, the tithe, and the socage service to an op-

pressive degree. While these were the causes of the revolt the Reformation, with its sudden enkindling of religious fanaticism in crude and ignorant minds, supplied the occasion. In spite of the warnings, and even denunciations of Luther and Melanchthon, several of the Reformers, such as Karlstadt, and many of their adherents among the nobility, aimed at once at a social and religious Reformation of the most radical nature. In 1524 a general fermentation spread among the German peasantry; and when, Jan. 1, 1525, the convent of Kempten was captured and plundered by a swarm of revolting peasants, this event became the signal for a general rising of the peasantry from the Alps to the Hartz and from the Rhine to the Bohemian frontier. With the exception of a few cases (as Thomas Münzer and Götz von Berlichingen) the peasants had no leaders and no organization. They gathered together in multitudes of from 8,000 to 30,000. Castles were burned, monasteries destroyed, cities plundered, and the most atrocious cruelties committed. As soon, however, as they fell in with regular armies—in the S. under Truchsess von Waldburg, in the N. under Philip of Hesse—they were routed or massacred in spite of their fierce resistance; and the revenge which the ruling classes took upon them was as cruel and as barbarous as their own behavior. Though the war lasted only a few months, it resulted in an enormous loss of life and property. The social position of the peasantry remained the same, or became even worse. See Oechsle, *Beiträge zur Geschichte des deutschen Bauernkriegs* (1829); Wachsmuth, *Der deutsche Bauernkrieg* (1834); Bensen, *Geschichte des Bauernkriegs in Ostfranken* (1840); Zimmermann, *Allgemeine Geschichte des grossen Bauernkriegs* (1841–43); Cornelius, *Studien zur Geschichte des Bauernkriegs* (1862); Schreiber, *Der deutsche Bauernkrieg* (1864).

Revised by F. M. Colby.

Peaslee, Edmund Randolph, M. D., LL. D.: gynæcologist; b. at Newton, N. H., Jan. 22, 1814; graduated at Dartmouth College in 1836, and in medicine at Yale in 1840; was appointed lecturer at Dartmouth in anatomy and physiology in 1841, and was professor of the same 1842–70; at Bowdoin College was lecturer on anatomy and surgery in 1843, and professor 1845–57, when he gave up anatomy, and remained Professor of Surgery till 1860; was Professor of Physiology and General Pathology in 1851 in New York Medical College, and Professor of Obstetrics 1858–60; was Professor of Gynæcology at Dartmouth in 1872, at the Bellevue Hospital Medical College in New York in 1874. In 1858 he took up his residence in New York. The degree of LL. D. was conferred upon him by his *alma mater* in 1859. He had been president of the New Hampshire State Medical Society and of several other medical associations, and was an honorary member of gynæcological or obstetrical societies in Boston, Berlin, Philadelphia, and Louisville. He published *Human Histology* (1857); *Ovarian Tumors and Ovariotomy* (1872); besides numerous articles in the medical journals. D. in New York, Jan. 21, 1878.

Revised by S. T. Armstrong.

Peat: See Fuel.

Peat-mosses: See Mossworts.

Pea-weevil, or **Pea-bug**: a small dark beetle (*Bruchus pisi*), well known for its ravages among dried peas. It may be destroyed by scalding the peas before planting. The insect lays her egg in the flower, and the grub passes into the pea while it is still growing.

Pebble [O. Eng. *papol-stān*, liter. (in form), *pebble-stone*, probably a loan-word from Latin *pa'pula*, pimple]: a small water-worn stone of any variety. Scotch pebble is simply agate. Brazilian pebble is a very transparent rock-crystal sometimes used by spectacle-makers as a material for their lenses. It is, however, much inferior to good glass. Most of the so-called pebble-spectacles are of common glass.

Pecan' (Fr. *pecane*): a tree, the *Carya olivæformis* (also known as *Hicoria pecan*), a species of hickory growing on river-banks from Indiana to Texas. The pecan is well known for its fine, delicious nuts, also called pecans, which constitute a considerable article of commerce. The tree is tall, slender, and has a hard timber. In the States bordering on the Gulf of Mexico it is planted in orchards for its nuts, and a score or more of named varieties are grown.

Revised by L. H. Bailey.

Pec'cary [from native S. Amer. name; cf. Fr. *pécari*, Span. *pecar*]: any one of certain swine-like, artiodactylate ungulates, composing the family *Dicotylidæ*. The peccaries are of two species, both American. The collared peccary (*Dicotyles tajacu*) ranges from Arkansas southwestward through Mexico and over a great part of South America. It is 3 feet long and sometimes weighs 60 lb. It is of a dark-gray color, and has a gland upon the loins which secretes a fetid substance. It is gregarious, and is a dangerous animal to attack, as the herd often assails the offending huntsman most vigorously and persistently with their strong tusks. The white-lipped peccary (*Dicotyles labiatus*) is a larger South American species. Both kinds are very destructive to growing crops, both are swine-like in habits and appearance. Their flesh is somewhat like pork, but not so good.

Revised by F. A. Lucas.

Pecchio, pek'ki-ō, Giuseppe, Count: publicist; b. at Milan, Italy, Nov. 15, 1785; d. at Brighton, England, June 4, 1835. After taking his degree in law at Pavia he returned to Milan, and in 1810 was given an important administrative post. In 1814 the overthrow of the old political conditions led to his retirement into private life. In 1819, however, he was elected to the provincial assembly; but he became implicated in the revolutionary movement, and the unhappy insurrection of Mar., 1821, caused him to flee to Switzerland. Thence he went to Spain, where he wrote down his impressions in his *Sei mesi in Ispagna nel 1821* (Madrid, 1821). Having made the acquaintance of the English Dr. Bowring, he went with him to Portugal, writing there his *Tre mesi in Portogallo* (Lisbon, 1822). Thence he went to England and became a teacher of Italian in Nottingham. In 1825 he and Count Gamba were intrusted by the friends of Greece with the delivery of £60,000 that had been raised to help the cause of Greek independence. This mission resulted in his book, *Relazione degli avvenimenti della Grecia nella primavera del 1825* (1826). Returning to England, Pecchio became Professor of Modern Languages at Manchester (1826); but in 1828 he married a wealthy lady and went to Brighton to live. Besides the works already mentioned, we have from him: *Saggio storico sull' Amministrazione finanziera dell' Ex-Regno d'Italia del 1802 al 1814* (1820; 2d ed. 1826); *L'anno 1826 dell' Inghilterra* (1827); *Storia dell' Economia Pubblica in Italia* (1829); *Vita di Ugo Foscolo* (1830); *Osservazioni semi-serie di un Esule sull' Inghilterra* (1831); *Storia critica della Poesia Inglese* (unfinished, 4 vols., 1833–35). See Ugoni, *Vita e Scritti di G. Pecchio* (Paris, 1836).

A. R. Marsh.

Pecht: See Bubastis.

Peck, George, D. D.: clergyman and author; b. in Middlefield, N. Y., Aug. 8, 1797; traveled and preached extensively; was principal of Oneida Conference Seminary 1835–39, then editor of *The Methodist Quarterly Review* (1840) and of *The Christian Advocate* (1848); wrote *Wyoming, its History*, etc. (1858); *Universalism Examined*; *History of the Apostles and Evangelists*; *Scripture Doctrine of Christian Perfection*; *Rule of Faith*; *History of Methodism within the Bounds of Old Genesee Conference*; and *Life and Times of George Peck* (1874). D. at Scranton, Pa., May 1, 1876.

Revised by A. Osborn.

Peck, Jesse Truesdell, D. D.: bishop; b. at Middlefield, N. Y., Aug. 4, 1811; joined the Oneida Conference in 1832; became principal of the Methodist seminary at Gouverneur, N. Y., in 1837, and of Troy Conference Academy at West Poultney, Vt., in 1841; in 1848 he was elected president of Dickinson College, Carlisle, Pa., but after four years' service returned to the pastorate. He occupied Foundry pulpit in Washington, D. C., 1852–54, and was secretary and editor of the tract society of his Church 1854–56. He subsequently served several years in pulpits in New York city and California, Peekskill, Albany, and in Syracuse, N. Y., where he was active in founding the Syracuse University. In 1872 he was elected bishop. He was author of *The Central Idea of Christianity* (New York, 1855); *The True Woman* (1857); *What must I do to be Saved?* (1858); and *The History of the Great Republic* (1868). D. at Syracuse, N. Y., May 17, 1883.

Revised by A. Osborn.

Peck, John Mason, D. D.: preacher; b. at Litchfield, Conn., Oct. 31, 1789; became a licensed Baptist preacher in Greene co., N. Y., in 1811; was ordained in 1813; removed in 1817 to St. Louis; was for forty years a successful pioneer preacher of Illinois and Missouri; organized in 1826 the first church of his denomination in St. Louis; was one of the founders of Shurtleff College, Upper Alton, Ill., and of the theological school at Covington, Ky.; received in 1852 the degree of D. D. from Harvard College. Author of

Guides for Emigrants (1831 and 1836); *Gazetteer of Illinois* (1834); *Life of Boone*, in Sparks's collection; *Father Clark, the Pioneer Preacher* (1855). D. Mar. 15, 1858.

Peck, Tracy, A. M.: classical scholar; b. at Bristol, Conn., May 24, 1838; graduated at Yale 1861, and Berlin University; Professor of Latin, Cornell University, 1871–80; became Professor of Latin in Yale College 1880; editor, with Prof. C. L. Smith, of Harvard, of a College Series of Latin Authors; author of philological and critical papers, especially in the line of restoring to Latin its ancient pronunciation; president American Philological Association 1885–86.

Peck, William Guy, LL. D., Ph. D.: soldier and mathematician; b. at Litchfield, Conn., Oct. 16, 1820; graduated at the U. S. Military Academy in 1844; was promoted to the U. S. Corps of Topographical Engineers, and served on the survey of Portsmouth harbor, in Western explorations under Fremont, and at the Military Academy as Assistant Professor of Philosophy, till the breaking out of the war with Mexico. He was then assigned to duty with the Army of the West under Gen. Kearny, and after the war became assistant instructor in mathematics at the Military Academy. He resigned his commission in Oct., 1855, and was for two years Professor of Physics and Civil Engineering in the University of Michigan. In 1857 he was called to Columbia College, New York, where he served as Professor of Mathematics, Mechanics, and Astronomy. He was engaged with Prof. Charles Davies in compiling a dictionary and encyclopædia of mathematics; he was the author of a treatise on mechanics, and the American editor of Ganot's popular *Physics*, besides which he wrote a course of mathematical text-books. D. Feb. 7, 1892.

Peck, William Henry: See the Appendix.

Peckham, Rufus William: See the Appendix.

Peckham, Stephen Farnum: See the Appendix.

Peckham, Wheeler H.: See the Appendix.

Pecos: See Tañoan Indians.

Pecos River: a stream of New Mexico and Texas; rises in San Miguel co., N. M., and flows in a general S. S. E. course, falling into the Rio Grande del Norte after a course of 800 miles. It flows through a broken country, and in summer is dry the greater part of its length.

Pecquet, pā'kā', Jean: anatomist; b. at Dieppe, France, about 1620; studied medicine, and especially anatomy, at Montpellier; discovered and demonstrated the course of the lacteal vessels in the body; wrote *Experimenta Nova Anatomica* (1651); *De Circulatione Sanguinis et Chyli Motu* and *De Thoracis Lacteis* (1651). Pecquet's discovery, which soon proved to be of the greatest practical importance, and has exercised a great influence on the development of physiology, immediately found many ardent adherents, but also many vehement opponents. D. in 1674.

Pectase: a substance of the class of ferments found in association with Pectose (*q. v.*) in the tissues of fruits and vegetables. The special function of pectase is to transform the pectose of unripe fruits, in the process of ripening, to Pectin (*q. v.*). Pectase is producible from the fresh juice of a plant—the carrot, for example—by precipitating with alcohol. This converts it into an insoluble modification, without, however, depriving it of its peculiar fermentive action upon pectosic substances. It has not been obtained in a crystalline form, being doubtless a colloid substance, like diastase, synaptase, and ferments generally.

Revised by Ira Remsen.

Pectic Acid: an insoluble gelatinous substance produced by the action of alkaline solutions upon the Pectin (*q. v.*) of ripe fruits and vegetables. Frémy calculates its composition as $C_{16}H_{22}O_{15}$, but this is not regarded as settled. The pectates of the alkalies are soluble, but all other bases form jelly-like insoluble masses, almost impossible to wash pure. Pectic acid, pectosic acid, and pectin are the principal constituents which give the gelatinous character to preserved fruits, fruit and vegetable jellies, etc.

Revised by Ira Remsen.

Pectin, or **Plant-jelly** [*pectin* is from Gr. πηκτός, curdled, congealed, deriv. of πηγνύναι, make fast or stiff]: a substance existing naturally in ripe fruits and vegetable juices generally, being a product, during the ripening, of the peculiar ferment called Pectase (*q. v.*) on the Pectose (*q. v.*) of unripe vegetables and fruits. It was obtained by Braconnot, its discoverer, by precipitating ripe-apple juice with alcohol, after boiling to coagulate the albumen, and filtering. Frémy improved upon this by first precipitating lime with oxalic acid. Pure pectin is white, amorphous, and soluble in water. The composition of pectin is somewhat uncertain. Frémy computes the formula $C_{16}H_{24}O_{16}$, but others have obtained figures differing a little from his.

Revised by Ira Remsen.

Pectinibranchia: See Monotocardia and Gasteropoda.

Pectoril'oquy [Lat. *pec'tus*, *pec'toris*, breast + *loqui*, speak]: in auscultation of the chest, a preternatural distinctness in the sound of the patient's speech, as propagated to the auscultator's ear through the air-passages and pulmonary tissues. Pectoriloquy is either cavernous or amphoric, according to the quality or timbre of its sound. It does not always, however, indicate a cavity in the lung, as was once supposed. It may arise from the solidification of a portion of the lung.

Pectose [deriv. of *pectin*]: a highly important proximate principle of vegetable bodies, from which proceed all the gelatinous constituents of fruits and vegetables. It exists largely in unripe fruits and roots, being, like cellulose, one of the "plastic" constituents, and giving, for instance, the hardness to green fruits. It is, however, a substance not only wholly insoluble, like cellulose, but, unlike the latter, extremely perishable or easily alterable. Therefore we have found no way of isolating and purifying it, so as to determine its composition. It is surmised to be a carbohydrate, like cellulose—that is, containing its hydrogen and oxygen in the proportions that form water. It exists in all parts of vegetable bodies, and is always accompanied by a peculiar ferment substance called Pectase (*q. v.*), which has the power to transform it, during the ripening of the fruit or maturation of the plant, into the plant-jelly or Pectin (*q. v.*). This substance and its derivatives are of great interest, and demand much further investigation—an investigation surrounded, however, with great difficulties, from the non-crystalline or colloid nature of these compounds.

Revised by Ira Remsen.

Pectosic Acid: an intermediate product of the action of the ferment pectase upon Pectose (*q. v.*). Like pectin, the principal product, it is highly gelatinous in its character, forming a frequent constituent of artificial fruit-jellies. Its composition is yet uncertain.

Peculiar, or **Peculiars**: the name given to a church or churches exempt from the jurisdiction of the bishop of the diocese in which the peculiar is situated: (1) as being subject to the jurisdiction of some other bishop, or (2) entirely exempt from episcopal jurisdiction. Chapels royal were exempt from episcopal jurisdiction. Battle Abbey, Bocking, Guernsey, Jersey, and Stamford are peculiars, and are entitled to their respective deans. Westminster Abbey and St. George's chapel, Windsor, are royal peculiars. W. S. P.

Pedagogics [from Gr. παιδαγωγός, a slave who acted as attendant and protector of a child, and instructed him in behavior and good manners; he attended him especially when he went to the school or palæstra. In Rome later the title was applied to the Greek slave who while acting as an attendant also taught the child Greek. Hence the transfer of signification]: the science of education; a body of educational doctrine pertaining to the mental and moral training of the young. Being a derived science, however, and depending mostly upon psychology for guidance as to ends and means, it is developed in various ways according to the psychological standpoint of the author. Some writers make much of what may be called the *a priori*, or rational, phase of psychology, deducing maxims for instruction and moral training from the original constitution of mind. Rosenkranz, in his *Philosophy of Education*, is perhaps the best exponent of this method of treatment. He deduces the laws or principles of education from a formal consideration of man as a self-realizing being in a process of development. The nature, form, and limits of education are all discussed from this standpoint, as are the special phases of physical, intellectual, and moral education. The subject-matter of the studies is assumed, but not discussed in detail. Dr. Harris, U. S. commissioner of education, points out the fact that there are five windows of the soul to be opened by these studies. In the elementary school arithmetic and physics open the soul to a quantitative knowledge of inorganic nature; geography and natural history to organic nature. History gives the mind an insight into the will of man as it has manifested itself in institutions: literature, drawing, and the like cultivate the æsthetic or emotional

sides of the soul; while grammar helps the mind to look within at its own processes, since in grammatical study the distinctions of thought are objectively examined. Thus three windows reveal what is within, viz., intellect, sensibilities, and will, while two reveal what is without, viz., organic and inorganic nature.

Another class of educational writers ignore largely the necessary and original laws of mind, as seen in rational psychology, adopting as their standpoint the *a posteriori* or concrete phase of mental life. They inquire, not what is the original equipment of the mind, but how does it grow? with what contents is it and ought it to be filled? In this view all the facts revealed by rational psychology and the self-realization of the mind are assumed but scarcely mentioned, attention being focused upon the concrete studies, their choice, sifting, sequence of topics, and co-ordination; also their treatment as to methods of presentation. Everything is examined from the empirical, or experience, side of psychology. There is little interest in the abstract terms arising from the refinement of psychological distinction, but a great deal of interest in the contents of children's minds, their natural interests and dispositions, their capacities in the acquisition of knowledge; in short, in the *growth* of their minds. Education, viewed from the standpoint of rational psychology, deals more with *static* relations of faculty and knowledge, whereas the same subject, seen from the standpoint of empirical psychology, concerns itself mostly with knowledge processes, hence is chiefly *dynamic* in its tendencies. *Apperception*, or mental assimilation, furnishes in this case the key to matter and methods for all departments of education.

A third standpoint from which to investigate educational questions is child-study upon a physiological basis. The senses are the medium through which the child gains his experience of the outer world, and the physical side in general is a constant factor in mind-growth. It follows, therefore, that a large number of important topics in education have a physiological aspect. The tonic and quantitative relations between external stimuli and the corresponding response of the mind in sensations are carefully investigated by hundreds of experiments in the domain of touch, taste, smell, hearing, and vision. The contents of children's minds are determined, as are also their fancies, falsehoods, tastes, ideas of justice, powers of graphic representation, conceptions of religion, and the like. Their capacities for apperception, association, memory are investigated by experimentation. Likewise, on the other hand, the conditions of health and disease for the various senses and the nervous system, as well as for digestion, circulation, and respiration, are carefully studied, and deductions made as to light, temperature, ventilation, size of type for books, bodily position, etc. It is chiefly from these three standpoints—rational psychology, the psychology of experience, and child-study upon a physiological basis—that the specific problems of education are examined. To some of the most important of these we may now turn our attention.

1. *What shall Constitute the Subject-matter of Education?*—This question is answered by each age and race according to the varying standard of civilization. The Persian taught his son to ride the horse, shoot with the bow, and tell the truth. The Greek taught his son literature and gymnastics; the Roman boy had to learn the tables of the law and how to swim. Education for gentlemen and for the professions may be quite different from the curriculum designed for the masses. Till late in the nineteenth century higher education was confined mostly to classic languages and mathematics. Herbert Spencer, however, in his *Education*, asks earnestly what knowledge is of most worth, and finds the answer in science. For the most part, American schools teach the studies that have become traditional, reading, writing, spelling, arithmetic, grammar, geography, and history, together with such branches as social or professional pressure may force upon them, such as scientific temperance and bookkeeping or stenography. Dr. Harris, as shown above, has sought to demonstrate that the standard studies now found in the common-school curriculum have a right to their place, because of their value in opening up the windows of the soul. It is only in recent times that any serious attempt has been made to determine upon rational grounds what subjects shall be selected and upon what principle the sequence of their various parts shall proceed. Concerning the latter topic Prof. Ziller, of Leipzig, pointed out the fact that there are two general methods of sequence for the parts of a study, one being the concentric method and the other the historical method, or progress according to *culture-epochs*. By the concentric method he means the selection of a few central facts of a subject, which are to be learned in the early grades, and then expanded like a series of concentric rings each succeeding year. Thus in Bible history a few facts about the life of Christ would be first taught, and this knowledge widened year by year by the addition of new facts. The other or historical method assumes that the child's mind in its development goes through in miniature substantially the same culture-epochs that the race passed through in its progress to the present stage of civilization, and that, consequently, if we would adjust the matter of our instruction most perfectly to the child's understanding and spontaneous interests, we must let him pass through ideally the stages that the world passed through really. For all subjects, therefore, having a human element, like Bible history, profane history, literature, art, languages, we must arrange our topics according to the important culture-epochs. The latter are sufficiently indicated by the great authors who have treated them. "Periods which no master has described, whose spirit no poet breathes, are of little value for education" (Herbart). Ziller claims that the concentric method sacrifices the interest of the pupils to a considerable degree, and that it produces educational waste, in that the same things have to be learned over again year after year in new combinations, whereas the historical method according to culture-epochs promotes natural interest through the freshness of material and its ideal adaptation to the growing mind of the child. Furthermore, he would avoid tediousness by presenting these topics as treated by masters, just as Greek boys were inspired by the writings of Homer. As for non-culture subjects, like the sciences, it may be pointed out that here we find two principles of advance, the first being that of the logical development of subjects as completed sciences, for instance, the order of evolution in biology from monera to man, and the psychological development as determined by the ability and knowledge of the child at any given stage. The latter order is the true one for the school, because knowledge exists for the child, not the child for knowledge.

2. *How shall Studies be Articulated or Co-ordinated?*—This question is supplementary to that of sequence of topics in the various subjects, for before studies can be intimately associated there must be some definite order of sequence established. This query, like the other, is a new one in American education. In the past it has hardly been raised, except perhaps in connection with the specific training of the "faculties." It has been assumed, for example, that "memory studies" precede "reason studies," but these faculties were not regarded as having any very intimate relations, so that the problem of the co-ordination of studies could hardly arise under these conditions. Each study developed its own independent line of ideas. Even history and geography, reading and spelling, were often taught as quite distinct and separate subjects, while efforts to find natural and easy associations between geography and science or history and literature were unheard of. Active interest, however, now exists for this phase of education, it being held that such associations as lead the studies to re-enforce one another enhance the pupil's interest in his work, promote his understanding, and develop his volitional power. The numerous plans for the co-ordination of studies may be reduced to three types, as follows: (1) The subordination of most branches to a few important ones. Ziller says that since the dominating ends of education are the moral ones we should select the culture studies, literature and history (profane and biblical), as the core of concentration around which the other studies should cluster like iron filings to a magnet. Others say that *real* knowledge as contained in the sciences is more important, and that these should be the central subjects for correlation. (2) The acceptance of universal scientific law, or philosophical unity of knowledge, as the guide to the concentration of studies. (*Talks on Pedagogics*, Col. I. W. Parker.) According to this plan the central, or knowledge, subjects are mineralogy, geology, geography, astronomy, meteorology, biology, zoölogy, anthropology, ethnology, and history. Out of these real studies all formal ones, like reading, writing, drawing, painting, modeling, number-work, and the like, are to grow. The central subjects being logically connected, and formal studies growing out of the concrete ones, it will be seen that there is a basis for weaving all series of ideas arising from the various branches into a connected whole. As may be seen, the emphasis falls upon the science studies, yet civilization developed without

science; it is, moreover, open to question whether the logical philosophical unity of the separate sciences is one that the teacher can see, or seeing teach. (3) The co-ordination of equal or independent branches through their natural relations. This plan grants to every important group of subjects its own principle of development. Thus culture subjects may follow the historical sequence where that seems advantageous without subordinating natural history to a principle of sequence not its own. Natural science, on the other hand, is free to develop according to its own laws, without dragging literature and history out of their natural channels. Dr. Frick (see *Herbart and the Herbartians*) presents a skeleton programme for a classical school with pupils ranging from ten to nineteen or twenty years of age. In this programme the historical interest is the backbone of the whole body of higher education, but not history as taught by the culture-epochs. This principle of Ziller is here modified on the ground that the environment of the pupil furnishes as good a bridge to his understanding and interest as the culture-epochs can furnish. Consequently, interest in national history comes first, and that in ancient history second. This is in accordance with the declaration of William II., that he wanted from the schools young Germans, not young Greeks and Romans. The reading-matter in the mother-tongue is depended upon to preserve the unity of the course through the studies touching the home environment of the child. There is the literature of culture and history (biography), and that of nature and occupation. Judicious selection will bind the studies together through close associations. In a similar manner these unions may be strengthened through art and music, which may emphasize now the natural, now the human elements. Geography touches three great realms, history, science, and economic occupation. It is the seat of history, the condition of animal and plant life, and in commercial geography the revelation of the modern commercial world. Frick agrees with Ziller and Herbart that only the important epochs of history should be studied. There are enough such to occupy the attention of children without wasting their time on non-essentials. Co-ordination is still further promoted by preserving within each important subject or group of subjects a unity of treatment. Thus, for instance, the whole of natural science is to be taught with its manifold relations clearly in view, a technical isolation of the various topics, like botany, zoölogy, geology, etc., being avoided. Furthermore, the search for and selection of organic bodies of knowledge pertaining to individuals, to communities, and states are to be constant; so, too, emphasis must be laid upon middle or turning points in the events pertaining to individuals or communities, to whole historical epochs, or to the development of important ideas.

3. *How shall Subjects be Taught?*—It may be well at the outset to make a distinction between that phase of method which can ignore the subjective or psychological element and proceed upon strictly logical lines to the exposition of knowledge, and that phase, mostly belonging to elementary education, which must take full account of limitations in knowledge, aptitude, and interest. The first method is seen in its perfection in the university, the latter in the primary school. Were the second phase of method not a real and necessary one the normal school would hardly have an excuse for existence. This is the department of method brought to view most clearly by empirical psychology and physiological child study. Here again we must distinguish between special and general methods—between devices for individual subjects or topics and the laws for all sound methods. The science of education can hardly busy itself with devices whose name is legion, but must content itself with an exposition of fundamental principles. With the apperception of the child in view (see Lange's *Apperception*) we may distinguish three grand phases in every sound method: (1) That of the assimilation of individual facts; (2) that of inductive approach to generalization, or rules and principles; and (3) the practical application of these principles, or the return from general principles to individual facts. This exposition gives rise to what the Herbartians call the *Formal Steps of Instruction*. (See McMurry, *General Method*, or De Garmo, *Essentials of Method*.) The term *formal* as here used signifies *universal*, since these steps must be recognized more or less clearly in all devices.

4. *How shall Moral Training be Effected?*—Some educators regard religious instruction as essential to this end; others try to engraft an ethical system more or less objectified upon the minds of the pupils, while Herbart advances the thought that through the school studies themselves, provided they are well selected, well articulated, and well taught, we may reveal to the child the moral order of the world, both as it will appeal to him as an individual and as a member of a social, family, civil, or business group. This thought is one of the most fruitful of modern pedagogics, and well worthy the closest attention of every teacher. (See *Herbart and the Herbartians*.)

The following-named works in English are of importance to the student of pedagogics: Lange, *Apperception* (Boston); Parker, *Theory of Concentration* (New York); Rosenkranz, *Philosophy of Education* (New York); Bain, *Education as a Science* (New York); Rein, *Outlines of Pedagogics* (Syracuse, N. Y.); Herbart, *Science of Education* (Boston); De Garmo, *Essentials of Method* (Boston); De Garmo, *Herbart and the Herbartians* (New York); Ufer, *Introduction to the Pedagogy of Herbart* (Boston); Rosmini, *Method in Education* (Boston); Spencer, *Education* (New York); McMurry, *General Method* (Bloomington, Ill.); Preyer, *The Development of the Intellect* and *The Senses and the Will* (New York); Pickard, *School Supervision* (New York); Froebel, *The Education of Men* (New York); Radestock, *Habit and Education* (Boston). CHARLES DE GARMO.

Pedee River: See GREAT PEDEE RIVER.

Pedersen, KRISTIERN: writer; b. in Svendborg, Denmark, about 1480; studied in Paris; returned (1517) and settled in Lund; became Christian II.'s secretary, and followed him into exile (1526). After the king's imprisonment he received permission (1532) to settle in Malmö, where he established a printing-office. Some time after this he joined the Lutheran Church. He is the first Danish prose-writer of prominence, and well deserves the title of father of Danish literature. His style is pure and direct, and all his writings are filled with a true national spirit. His translation of the New Testament (1529) and of the Psalms (1531) is superior to any then produced. His publication of *Saxo* (1514) undoubtedly saved that work from destruction, as no MS. has been preserved. His works, historical and religious, have been edited by C. J. Brandt and J. F. Fenger (5 vols., Copenhagen, 1850–56). D. Jan. 16, 1554. D. K. DODGE.

Pedianus: See ASCONIUS PEDIANUS.

Pedicula'ti [Mod. Lat., plur. of *pedicula'tus*, pedicled, deriv. of *pedi'culus*, stem, pedicle, from Lat. *pedi'culus*, dimin. of *pes*, *pe'dis*, foot]: an order of fishes whose representatives are distinguished by their grotesque forms. The skull is constructed in nearly the same manner as in the typical fishes; the epiotics united behind the supraoccipital; the intermaxillary and supramaxillary bones well developed and distinct; the first vertebra is united to the cranium by suture; the scapular arch is, as in ordinary fishes, composed of a great external bone (proscapula) and two internal bones (hypercoracoid and hypocoracoid), but coalescent with the proscapula; with these are articulated the actinosts, which are remarkable for their length; between the proscapula and the skull intervenes a post-temporal, which is not bifurcate, but connects by a squamous suture with the skull; the branchial aperture is thrown backward in or near the axilla of the pectoral fin; the ventral fins are more or less jugular; the dorsal fin is divided into a spinous and a soft portion; the latter is normal; the former modified, and in some of the representatives of the order represented by a filament in or near the nasal region. The order thus distinguished is composed of several families—viz., *Maltheidæ*, or the batfishes; *Lophiidæ*, or the anglers; *Ceratiidæ*; and *Antennariidæ*. Revised by F. A. LUCAS.

Pediment: See GABLE.

Pedipal'pi [Mod. Lat., from Lat. *pes*, *pedis*, foot + Mod. Lat. *palpus*, tactile organ, from Lat. *palpare*, to feel]: an order of Arachnida embracing a few tropical forms for which the common names of whip-scorpions and scorpion-spiders have been proposed. As these terms imply, they present general resemblances to both scorpions and spiders. Thus they have the second pair of appendages strong and sometimes furnished with pincers, the abdomen is plainly jointed, and in *Thelyphonus* is terminated with a many-jointed whip-like tail. In all the first pair of true legs terminates with a many-jointed whip-like portion. About thirty species are known. Comparatively little is known of their habits, but they have the reputation of being very poisonous; but a single species of *Thelyphonus* has been reported from the U. S. J. S. KINGSLEY.

Pedometer: See ODOMETER.

Pedra'rias: the name commonly given by historians to Pedro Arias Dávila or de Ávila; soldier and governor; b. in Spain about 1442. He was of good family, and served with distinction in the conquest of Granada and in Africa. In 1513 he was nominated governor of Castilla del Oro, on the coast of the Isthmus of Panama, including the colony of Darien, where Balboa had come into power. (See Balboa and Darien.) Pedrarias sailed from San Lucar Apr. 12, 1514, with a large fleet and 1,500 men. On his arrival at Darien (June 30), Balboa readily acknowledged his authority, but Pedrarias, a man of suspicious and violent character, imprisoned him on various charges. Subsequently, through the interposition of the bishop, the rivals were reconciled. Pedrarias promised Balboa his daughter in marriage, and lent his aid for the exploration of the South Sea; but on reports (probably false) of Balboa's treachery, he seized and executed him (1517). In 1519 he founded a new capital at Panama. Under his rule Spanish power was rapidly extended on the isthmus. He did all he could to prevent the exploration of Nicaragua by Gil Gonzalez Dávila (1522), and endeavored to forestall him by sending Córdoba to colonize that country. Córdoba rebelled, and Pedrarias captured and beheaded him (1526). In consequence of numerous complaints Pedrarias was superseded in 1526, but he was made governor of Nicaragua, where he died at Leon, Mar. 6, 1531. Herbert H. Smith.

Pedro I. (Dom Antonio Pedro de Alcantara Bourbon): first Emperor of Brazil; b. near Lisbon, Portugal, Oct. 12, 1798. He was the second son of Dom João, afterward John VI. of Portugal; was taken with the royal family to Brazil (1807), received a somewhat limited education there, and in 1818 was married to the Archduchess Leopoldina of Austria. His father was crowned King of Portugal at Rio de Janeiro in 1816, but returned to Lisbon in 1821, leaving Dom Pedro as regent. The prince was now heir to the throne, his elder brother having died. At this time the movement for the separation of Brazil from Portugal assumed active form, and the prince regent favored it more or less openly. He at length sent a refusal to the peremptory order of his father to return to Portugal, and on Sept. 7, 1822, he definitely declared for independence. He was proclaimed emperor in October, and crowned Dec. 1. The Portuguese authorities made little active resistance, except in the northern provinces, where they were soon driven out. At first the emperor was enthusiastically supported; but in 1823 he assumed a reactionary policy, dismissed and banished the liberal Andrada ministry, and forcibly dissolved the constituent assembly. In Mar., 1824, he promulgated the constitution (prepared by a council of state) which was in force during the empire. The empress died in 1826, and in 1829 he married Princess Amelia of Leuchtenberg. Uruguay, which had been attached to Brazil, became independent, after a rebellion of several years, in 1828. The opposition to the emperor increased when, in 1826, he fell heir to the Portuguese throne. In the impossibility of reuniting the two countries he transferred his claim to Portugal to his daughter, Donha Maria da Gloria, but the distrust continued, and at length broke out in popular tumults. To prevent bloodshed, the emperor abdicated in favor of his son on Apr. 7, 1831, and soon after sailed for England. On his arrival there he at once assumed the leadership of a movement for the restoration of his daughter, who had been deprived of the Portuguese throne by the usurpation of Dom Miguel. The latter was deposed after a civil war, and Donha Maria was crowned. Dom Pedro died two days after, in Lisbon, Sept. 24, 1834. Herbert H. Smith.

Pedro II. (Dom Pedro de Alcantara): son of Pedro I. and Emperor of Brazil; b. at Rio de Janeiro, Dec. 2, 1825. As he was a child when his father abdicated in his favor, Brazil was governed by regents until July 23, 1840, when his majority was proclaimed at the request of the parliament. He was crowned July 18, 1841, and in 1843 married Thereza Christina, sister of the King of the Sicilies. From the first he proved himself an intelligent, liberal, and humane ruler, and during his reign Brazil made great advances in civilization and material prosperity; he was the honored protector of science, the arts, and literature, for which he had marked tastes, and he was universally respected at home and abroad. On the other hand, important questions were sometimes neglected for minutiæ, and he showed, perhaps, a want of strength in great crises. He was strongly attached to constitutional forms, and governed entirely through his ministers. Rebellions in São Paulo and Minas Geraes, 1842, in Rio Grande do Sul, 1842–45, and in Pernambuco, 1849, were suppressed. In 1864–65 Brazil successfully supported the revolutionist Flores against the Government of Uruguay, which had refused satisfaction for injuries done to Brazilian subjects. Lopez, president of Paraguay, made war on Brazil, ostensibly on account of the Uruguayan question, Dec., 1864; this led to the Triple Alliance between Brazil, the Argentine Republic, and Uruguay, May 1, 1865, and a bloody war of five years. (See Lopez, Francisco Solano.) The emperor took a personal part in the first campaign. Traveling as a private gentleman, he visited Europe 1871–72, attended the Centennial Exposition in the U. S. 1876, going thence to Europe and the East, and in 1886–89 again went to Europe. By a law passed in Sept., 1871, children born of slave parents were freed under certain conditions, and an emancipation fund was established. Subsequently the abolition movement became a popular uprising, and culminated in the law of May 13, 1888, by which all slaves were freed. The emperor personally favored emancipation, and early freed the crown slaves, but he did not lead the movement nor greatly influence it; and it excited unfavorable comments that the laws of 1871 and 1888 were passed during his absence. Republican principles had been slowly but steadily gaining ground, and were fostered by the perfect freedom of the press; in 1885 republican deputies were first elected to parliament. The Princess Isabel was heir to the throne, and during her father's trips abroad had acted as regent; the republicans opposed her for alleged subserviency to the Church, and because she was married to a foreign prince, the Count d'Eu. It was generally supposed that a decided republican movement would be deferred until the emperor's death; but it was precipitated by discontented army officers, who excited a mutiny of the troops at Rio de Janeiro, and proclaimed a revolution Nov. 15, 1889. The emperor abdicated without resistance, and was at once sent with his family to Portugal; there the empress died from the effect of the excitement and shock, Dec. 28, 1889. The ex-emperor declined a pension which was offered to him by Brazil. D. in Paris, Dec. 5, 1891.
Herbert H. Smith.

Pee'blesshire: an inland county of Scotland; on both sides of the Tweed (hence sometimes called *Tweeddale*); consists mostly of low, well-wooded mountains. Area, 354 sq. miles. Pop. (1901) 15,066. Rearing of sheep and cattle is the chief occupation; coal is mined, and manufactures of woolens are carried on. The only royal burgh in the shire is Peebles, on a peninsula at the confluence of the Eddleston with the Tweed, 22 miles S. of Edinburgh, and the seat of a county administration (see map of Scotland, ref. 12–H). It is the birthplace of William Chambers, who in 1859 made a gift to the town of a spacious suite of buildings for educational purposes, the Chambers Institution. Pop. of town (1891) 4,704. The counties of Peebles and Selkirk send one member to Parliament.

Peekskill: village; Westchester co., N. Y. (for location, see map of New York, ref. 8–J); on the Hudson river, and the N. Y. Cent. and Hudson River Railroad; 43 miles N. of New York city. It contains 12 churches, 2 union public schools, St. Gabriel's boarding-school for young ladies (Protestant Episcopal), St. Joseph's Home and Franciscan Convent (Roman Catholic), a military academy, a House of the Good Shepherd (Roman Catholic), a free public library, several high-grade boarding-schools, a national bank with capital of $100,000, a savings-bank, and 4 weekly newspapers. There are water-works, electric-light and sewerage systems, and important manufactories, including iron-foundries, stove-works, cigar-factories, steam flour-mill, blank-book and book-binding establishment, and shirt-factories. The village has much scenic and historic interest. Pop. (1880) 6,893; (1890) 9,676; (1900) 10,358.
W. J. Charlton, board of trade.

Peel. Arthur Wellesley, D. C. L.: statesman; b. in 1829; youngest son of Sir Robert Peel (1788–1850): educated at Eton and Baliol College, Oxford; was secretary to the Poor Law Board 1868–71; secretary to the Board of Trade 1871–73: and secretary to the Treasury 1873–74. He was first elected Speaker of the House of Commons in 1884, and since then he has been re-elected three times. Retired Apr. 7, 1895. He was member for Warwick 1865–85, and since for Warwick and Leamington.

Peel, Sir Robert: statesman; b. near Bury, Lancashire, Feb. 5, 1788; was educated at Harrow and Christ Church, Oxford, where he passed B. A. as double first-class, the first

who ever had the distinction. In 1809 he entered Parliament for Cashel; was made Under-Secretary for the Colonies 1811, and was (1812–18) Chief Secretary for Ireland, where his Tory principles led to the most severe criticisms from the opposition. He established the Irish constabulary. Peel represented Oxford University in Parliament 1818–22; introduced and carried (1819) a bill to return to specie currency; was Home Secretary 1822–27, 1828–30; introduced and carried important reforms in the administration of criminal law; remodeled the London police; moved the bill for Catholic emancipation (1829), and thus broke with the Tory leaders. Previously Peel's name, with no special justice, had been associated with the leadership in the opposition to this cause, doubtless because he had held an important post in Ireland as a Tory. The University of Oxford rejected him in the new election; he re-entered Parliament for Westbury, and again represented Tamworth 1832–50; was First Lord of the Treasury and Chancellor of the Exchequer 1834–35, and afterward headed the Conservative opposition, having resisted the parliamentary reform of 1831–32 with all his power; was again Premier 1841–46, during which time his position drifted slowly from that of a protectionist and strict Conservative to that of a free-trader, and he at last supported the repeal of the corn-laws. He afterward acted generally with the Whigs. D. in London, July 2, 1850, in consequence of a fall from his horse. Peel was a man of thorough patriotism and high moral principle. His hereditary conservatism, although strengthened by a dislike of too hasty changes, was ever held subject to feelings of justice and humanity. He refused the Garter and the peerage, and was universally respected for honesty, truthfulness, and ability. See *Sir Robert Peel*, by Guizot (Paris, 1859), and *Sir Robert Peel*, by Henry Lord Dalling and Bulwer (London, 1874); and monographs by F. C. Montague (1888), Justin McCarthy (1891), and J. R. Thursfield (1891).

Peel, Sir ROBERT, G. C. B.: b. in London, May 4, 1822; was educated at Harrow and Christ Church, Oxford; was 1844–46 an *attaché* at Madrid; was secretary of legation 1846, and *chargé d'affaires* at Berne 1846–50; a lord of the admiralty 1855–57; Chief Secretary for Ireland 1861–65; was a Liberal member of Parliament for Tamworth 1850–80; was sworn of the Privy Council 1861; was made G. C. B. 1868; married in 1856 the eighth daughter of the Marquis of Tweeddale. D. at Brighton, May 8, 1895.

Peele, GEORGE: dramatist; b. in Devonshire, England, about 1553; graduated at Broadgate's Hall (now Pembroke College), Oxford, 1579; settled at London as a theatrical writer; was an associate of Nash, Marlowe, and Greene, and author of half a dozen plays, the best of which is *David and Bethsabe*. They were republished by Dyce, with his poems and miscellaneous writings (3 vols., 1828–39). D. about 1598.

Peele, JOHN THOMAS: See the Appendix.

Peepul: See BO-TREE.

Peerlkamp, PETER HOFMAN-: classical scholar; b. in Groningen, Holland, in 1786; professor at Leyden in 1822; retired in 1849. D. in Hilverzum, near Utrecht, Mar. 29, 1865. Peerlkamp may be called the father of a wanton method of textual criticism which rejects as spurious or emends whatever seems not to conform to a preconceived standard of poetic perfection and propriety. This perniciously subjective principle was rigorously applied by Peerlkamp particularly to the *Odes* of Horace, of which scarcely one remained intact. The ingenuity of his analysis, his fervor of conviction, and the brilliancy of his Latin style secured him many followers; but at the present time this athetizing mania possesses at best but a pathological interest. Among his writings may be mentioned: Horace, *Odes, Satires, Ars Poetica*; Tacitus, *Agricola*; Vergil, *Æneid*; Xenophon of Ephesus; and his own *De vita, doctrina et facultate Nederlandorum qui carmina composuerunt* (2d ed. 1838). ALFRED GUDEMAN.

Peers [Fr. *pair*, from the Latin *par*, equal]: noblemen having a special dignity or privilege. The meaning of the term has varied widely at different times. Thus in England the earlier usage, as in the phrase of Magna Charta, "judgment of his peers" (*judicium parium*), gives it merely the general meaning of equals, while at present it is used in a special sense to denote the members of the nobility and those prelates of the Church of England who are entitled to a seat in the House of Lords. The members of the nobility entitled to be called peers include dukes, marquises, earls, viscounts, and barons. In France Louis XVIII. created in 1814 a house of peers, but this peerage comprised only a very limited number of the whole class of the nobility. The attempt to make it hereditary failed, and in 1848 the Chamber of Peers ceased to exist.

Peet, STEPHEN DENISON, A. M., Ph. D.: anthropologist; b. at Euclid, O., Dec. 2, 1830. In 1837 the family removed to Green Bay, Wis., which was a center of trade for various Indian tribes. Young Peet entered Beloit College, and while a student had his curiosity awakened with respect to the mound-builders, whose mounds were numerous in Beloit and its vicinity. He studied theology at New Haven, Conn., and at Andover, Mass., where he graduated in 1851, and returned to Wisconsin, where he was a missionary for several years. Subsequently he took charge of important churches at Racine, Wis., and Ashtabula, O. From 1878 to 1888 he edited *The American Antiquarian*, and he was largely instrumental in organizing the Ohio Archæological Society and the American Anthropological Association. In 1878 he returned to Wisconsin, and held the pastorate at Clinton for eight years thereafter. His principal works are *The Ashtabula Disaster* (Chicago, 1879); *History of Ashtabula County, Ohio* (Cleveland, 1879); *Ancient Architecture in America* (Chicago, 1884); *Picture Writing* (1885); *History of Early Missions in Wisconsin* (Madison, 1886); *Primitive Symbolism* (Chicago, 1887); *The Effigy Mounds of Wisconsin* (1888).

Peewit: See LAPWING.

Peffer, WILLIAM ALFRED: See the Appendix.

Peg'asus (in Gr. Πήγασος): in Grecian mythology, a winged horse, who, together with Chrysaor, was begotten by Poseidon and the Gorgo Medusa at the sources of Oceanus, whence his name Pegasus (from πηγή, fountain). He sprang from the headless trunk of Medusa after she had been slain by Perseus. He first touched the earth on the Acropolis of Corinth, where Bellerophon caught him while he was drinking from the fountain Pirene. Mounted on his back Bellerophon performed many hazardous deeds (see CHIMÆRA), but when he attempted to fly to heaven he fell off and became lame and blind. Pegasus flew to heaven, where he thenceforward dwelt in the palace of Zeus. When Mt. Helicon, under the influence of the songs of the Muses, was soaring to heaven, its progress was stayed by a stamp of the hoof of Pegasus. On the smitten spot the spring Hippocrene (the fountain of the steed) burst forth, and hence he was called the horse of the Muses. J. R. S. STERRETT.

Pegmatite [from Gr. πῆγμα, anything fastened together]: a name originally suggested by Haüy for coarse-grained granitic rocks in which the quartz and feldspar are intergrown, each having a continuous crystallographic structure over considerable areas. The rocks have gradually come to be called *graphic granites* (Germ. *Schriftgranit*), although their characteristic structure, whether microscopic or macroscopic, is still called pegmatitic. The petrographical term *pegmatite* now includes all very coarse granites and granitic vein-stones. See GRANITE. G. H. WILLIAMS.

Pegu: a name of geographical and historical interest associated with the northwestern part of the Indo-Chinese peninsula, adjoining the Bay of Bengal, and especially about the Gulf of Martaban. It has sometimes been a separate kingdom, sometimes a dependency of Burma, and the territory covered has extended as far N. as Ava, sometimes as far S. as the Peninsula of Kra. It is now a British governmental division of Burma, occupying the lower valleys of the Irawadi and Salwen rivers from Tenasserim to Southern Arrakan. The town of PEGU, formerly a capital and important city, is now a small town and a railway station, 45 miles N. E. of Rangoon, on the Pegu river, an affluent of the Hlainy (see map of S. India, ref. 3–L).
MARK W. HARRINGTON.

Peh-chele, or **Pechili**: an old name for the province of China now known as CHIHLI (*q. v.*); also the shallow gulf which lies between Chihli and the Yellow Sea.

Peh-la, or **Pela** [Chinese; literally, white wax]: a kind of wax prepared by the Chinese from the secretions which an insect of the cochineal family (*Coccus sinensis*) deposits on the twigs of a species of ash (*Fraxinus chinensis*), called by the Chinese *lah-shoo*, or wax-tree. The insect resembles a louse, and is said to be taken indoors to be cared for during the winter, and put back on the trees in spring. The peculiar secretion which it voids about the end of summer is collected and melted by the natives, and forms a hard, white, translucent body, like spermaceti, which melts at a temper-

ature of 180° to 186° F., and is largely used for candle-making. It is extensively produced in Sze-chuen and in the northern provinces. R. Lilley.

Pehlavi Language: See Pahlavī.

Pei-ho, pī'hō, or pā'hō (literally, white river): the most important river of China N. of the Yellow River. It rises near the Great Wall, flows in a southeastern direction through the province of Chihli, and falls into the Gulf of Pechili at Taku. Its course is very tortuous, especially below Tien-tsin, which is 80 miles by water from its mouth, but only 35 by land. It is navigable for more than three-fourths of its course, but at its mouth there is a bar of stiff, tenacious clay, which makes the entrance very difficult.

Peine Forte et Dure [Fr. and O. Fr., hard and severe penalty], called also **Pressing to Death**: formerly, in England, the punishment of those who refused to plead or stood mute upon their arraignment for felony. The victim was stretched naked upon his back and had "iron laid upon him as much as he could bear and more," and he was so kept and fed on bread and stagnant water on alternate days (bread one day and water the next) until he yielded or died. The object in submitting to death by this penalty was not infrequently to avoid the forfeiture of lands consequent upon conviction for a felony. This punishment came into use about 1400, and is said to have been last employed in 1741. It was virtually abolished by 12 Geo. III., c. 20, which made standing mute in case of felony equivalent to a conviction. In 1827 (7 and 8 Geo. IV., c. 28, § 2) it was enacted that a plea of "not guilty" should be then entered. In 1692, at Salem, Mass., Giles Cory, a supposed witch, stood mute upon his trial, and was pressed to death. This is believed to be the only instance of the infliction of this penalty in America. See Stephen's *History of the Criminal Law of England*, and Pike's *History of Crime in England*.
Revised by F. Sturges Allen.

Pe'ipus: a large lake in Northwestern Russia, 87 miles long, 30 miles broad. It communicates with the Gulf of Finland through the Narova. It is deep, easy to navigate, and rich in fish, which are sent to the market of St. Petersburg. Its shores are low, marshy, or sandy, and in many places covered with forests. It occupies an area of about 1,500 sq. miles, and consists of two lakes connected with each other by a narrow strait. The southern lake is sometimes called Lake Pskow, after the city of Pskow, situated at its southeastern extremity.

Peirce, Benjamin, LL.D., F.R.S.: mathematician and astronomer; b. at Salem, Mass., Apr. 4, 1809; a son of Benjamin Peirce (1778–1831), librarian of Harvard University. The son was a pupil of Nathaniel Bowditch, and read the proof-sheets of the translation of Laplace's *Mécanique céleste* while yet a mere youth; graduated at Harvard in 1829; taught 1829–31 at Round Hill, Northampton, Mass.; became mathematical tutor in Harvard College 1831; Professor of Mathematics, etc., 1833–42; Professor of Astronomy, etc., 1842–67, and aided the construction and equipment of the observatory; superintendent of the U. S. Coast Survey 1867–74; became in 1849 consulting astronomer to the *Ephemeris and Nautical Almanac*; was a member of the leading American and foreign scientific societies; author of a series of mathematical text-books 1835–70, and of many scientific papers; prepared a volume of lunar tables in 1852 for the use of the American *Nautical Almanac*; published in 1857 his work *System of Analytical Mechanics*. His *Linear Associative Algebra* was reprinted in the *American Journal of Mathematics* in 1882. His work in pure and in applied mathematics is noteworthy for its novel, original, and remarkably direct and satisfactory methods. D. at Cambridge, Mass., Oct. 6, 1880. Revised by R. A. Roberts.

Peirce, Bradford Kinney, D.D.: author and journalist; b. at Royalton, Vt., Feb. 3, 1819; graduated at Wesleyan University 1841; entered the New England Conference 1842; was editor of *The Sunday-school Messenger* and the *Sunday-school Teacher*; was a State Senator for Norfolk County 1855–56; obtained the establishment of the State Industrial School for Girls at Lancaster, of which he became superintendent; was chaplain of the House of Refuge, Randall's island, N. Y., 1863–72, after which he returned to Boston, and was editor of *Zion's Herald* 1872–88. Author of Sunday-school question-books, a *Bible Scholar's Manual*, *The Eminent Dead*, *Notes on the Acts*, *The Word of God Opened* (1868); *A Half Century with Juvenile Delinquents* (1869); *Trials of an Inventor*, being an account of the career of Charles Goodyear, and *Audubon's Adventures* (1890). D. at Newton, Mass., Apr. 19, 1889. Revised by A. Osborn.

Peirce, Cyrus: educator; principal of the first normal school in the U. S.; b. at Waltham, Mass., Aug. 15, 1790; graduated at Harvard 1810; studied theology; pastor of Congregational church at North Reading 1819–27; turned from conviction to the work of teaching, and opened a school at North Andover; removed in 1831 to Nantucket, where his great achievement was the grading of the public schools. In June, 1839, he was engaged by Horace Mann as principal of the Normal School at Lexington, Mass., which had been established by the Massachusetts board of education Dec. 28, 1838. At the end of three years Mr. Peirce's health failed. He resigned, and was succeeded by Rev. Samuel J. May, who in turn resigned in 1844 to make way for the reappointment, Sept. 1, 1844, of Mr. Peirce, the school having meantime been moved to West Newton. Ill-health again led to his resignation in 1849. D. Apr. 5, 1860, at West Newton, Mass. To him more than to any one else is due the successful establishment of normal schools. See Barnard, *American Teachers and Educators* (New York, 1861); Gordy, *Rise and Growth of the Normal School Idea in the United States* (Washington, U. S. Bureau of Education, 1891). C. H. Thurber.

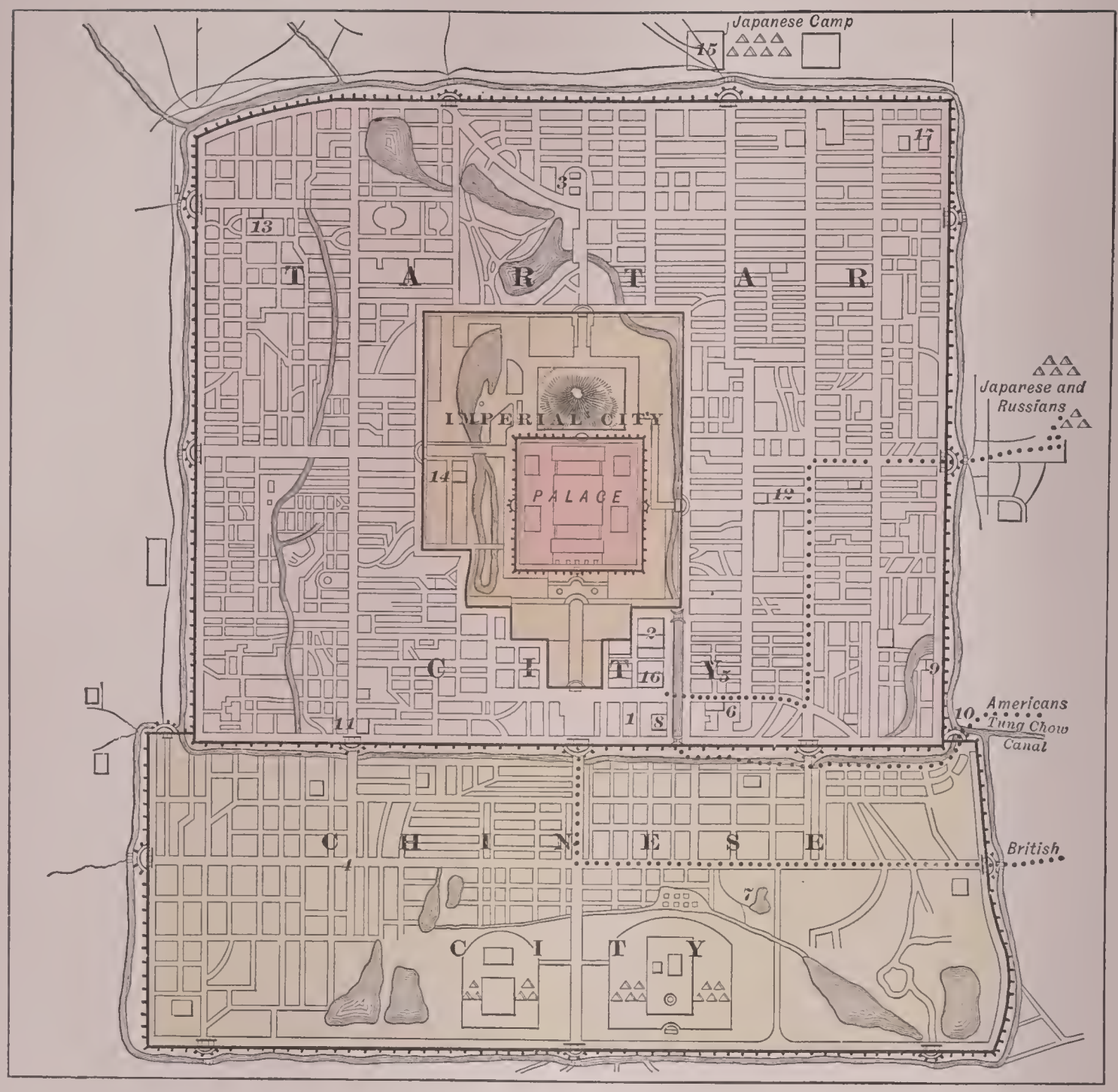
Peixoto, pā-shō'tō, Floriano: soldier and politician; b. in the province of Alagoas, Brazil, Apr. 30, 1842. He was one of the generals who supported Fonseca in the deposition of the emperor Nov. 15, 1889; was elected vice-president of the republic 1890; and by the resignation of Fonseca, Nov. 23, 1891, became president for the remainder of the term, or until Nov. 15, 1894. In 1893 he vetoed a bill which was intended to prevent his re-election; this, and the general opposition to a military president, caused much ill-feeling. A rebellion in Rio Grande do Sul gained ground, and a portion of the navy supported it, but was soon reduced to obedience. A more formidable revolt, involving the whole naval force, broke out in the Bay of Rio de Janeiro, Sept., 1893; the navy held the bay for many months and repeatedly bombarded Rio de Janeiro, besides taking Santa Catharina and other places on the coast. In this crisis President Peixoto showed much firmness; ships were ordered from Europe and North America, and on their arrival (Mar., 1894) the rebellion collapsed. Meanwhile the elections had resulted in the return of a civilian, Prudente Moraes, for the succeeding term. Marshal Peixoto died June 29, 1895.
Herbert H. Smith.

Peixoto, Ignacio José de Alvarenga: poet; b. in Rio de Janeiro about Dec., 1748. He graduated in canon law in Lisbon, and was appointed a judge in Minas Geraes, Brazil; there he was involved in the alleged revolutionary movement called the conspiracy of Tiradentes, was arrested in 1789, and in 1792 was condemned to death; the sentence was commuted to penal servitude at Angola, where he died Jan. 1, 1793. His odes and sonnets are esteemed among the finest in the Portuguese language. H. H. S.

Pekin': a form of the name *Peking*, derived from *Pékin*, the French spelling of the Chinese name.

Pekin: city; capital of Tazewell co., Ill. (for location, see map of Illinois, ref. 5–D); on the Illinois river, and the Atch., Top. and S. Fé, the Chi., Peoria and St. L., the Cleve., Cin., Chi. and St. L., the Peo. and Pekin Union, and the Peo., Decatur and Evansville railways; 10 miles S. of Peoria, 56 miles N. of Springfield. It is in an agricultural and coal-mining region, has large shipping interests by rail and water, and is an important grain-market. The city has a water front of over 3 miles, 2 national banks, with combined capital of $200,000, a private bank, and numerous industrial works, including 4 distilleries, 3 foundries and machine-shops, 2 grain elevators, 2 brick and tile works, organ-factory, 2 malt-houses, a roller-mill, marble-works, 3 lumber-yards, planing-mill, and header, wagon, plow, barrel, and soda-water factories. There are 13 churches, 4 public and several private schools, public library, and 2 daily, 4 weekly, and 2 monthly periodicals. Pop. (1880) 5,993; (1890) 6,347; (1900) 8,420. Editor of "Evening Post."

Pe'king', sometimes (but less correctly) **Pekin**, locally **Peiching** (literally, Northern Capital): the capital of China, and chief city of the department of *Shun-t'ien-foo*, in the province of Chih-li (but not within the jurisdiction of the Viceroy of Chih-li); in the basin of the Pei-ho river, but about 12 miles from that stream and 100 from Taku, at its mouth (see map of China, ref. 3–J). The latitude of the Russian ob-



MAP OF PEKING IN 1900.

SHOWING POINTS OF INTEREST AND THE ROUTES TAKEN BY THE ALLIED ARMIES ON ENTERING THE CITY FOR THE RELIEF OF THE BESIEGED LEGATIONS.

1. American Legation.
2. British Legation.
3. Drum Tower.
4. Execution grounnd.
5. French Legation.
6. German Legation.
7. Goldfish ponds.
8. Korean Embassy.
9. Kuang-sing-tai (Imperial Observatory).
10. Methodist Mission.
11. Nan-tang
12. Tung-tang } French Catholic Missions.
13. Si-tang
14. Pei-tang (Catholic Cathedral).
15. Russian Cemetery.
16. Russian Legation.
17. Russian Mission, Greek Church.

servatory, near the northeast corner of the city, is 39° 56′ 48″ N., its longitude 116° 28′ 36″ E. On the eastern wall of the Northern or Manchu city is the ancient observatory, sometimes considered the origin for Chinese longitudes. It is 2′ 17″ S. and 12″ E. of the Russian observatory. The altitude of the latter is 121 feet above sea-level. The length of the city from N. to S. is 5·2 miles, and its average breadth a little over 4 miles. The area within the walls is 24·5 sq. miles, but much of this is occupied by public buildings, parks, ruins, and, in the Southern city, open fields. The suburbs are small and unimportant. The population is not given by census, and has been variously estimated. The old estimates were very high, and were either greatly exaggerated or the city has decreased—perhaps both. Conservative estimates by foreign residents now put the population at only 500,000.

The city consists of three distinct parts or cities, each with its own walls—viz., the Northern, Manchu, or Tartar city, within this the Imperial city, and adjacent to it the Southern or Chinese city. The first, though called the Tartar city, is now largely occupied by Chinese; the second contains the palaces, and public offices, and temples. The Southern city to a great extent consists of open fields, or is occupied by ruins.

The Tartar city is a regular rectangle (except that its northeast angle is somewhat depressed), about 4 miles N. and S. and 3 miles E. and W. The wall is 30 feet high, 25 feet thick at the base, 12 feet across at the top, and surmounted by a parapet. It is made of earth, faced with large brick laid in lime and clay, or, near the gates, with stone. Square buttresses, surmounted by towers, occur at frequent intervals, and there is always one on each side of each gate. There are nine gates, two for each side, except into the Chinese city to the S., where there are three. The gates are surmounted by small forts. This great structure was practically impregnable to native modes of warfare, but offers no serious resistance to modern artillery. The whole is surrounded by a ditch, fed by the waters of the Tung-hwei creek, a branch of the Pei-ho; but it is neglected, and is partly filled up, and often dry. The Tartar city is the finer of the two (Tartar and Chinese), has more and handsomer dwellings, is better cared for, and is the part in which foreigners live. It is crossed from side to side by several very broad streets, along which the shops are arranged. From these branch out innumerable alleys, along which are the dwellings. These are always surrounded by high walls and entered through closed gates, so that there is on the street little sign of the wealth or comfort to be found within. An old and imperfect system of sewerage has been allowed to go to decay. There are no public water-works, and the streets are not lighted at night. Sanitary arrangements, or others devoted to public comfort, are practically unknown. The city is on an alkaline plain, over which rain falls only two months in the year, and the climate is fairly healthful.

The inner or Imperial city is guarded by a wall almost as high and elaborate as that of the Tartar city. It is about 2 miles long by 1 broad; is entered by three gates, one each on the E. and W., and one on the S. The gates are carefully guarded, and no one is admitted except those having business within. The temples and palaces within are roofed with yellow tiles, and this city is consequently sometimes called the Yellow city. It contains considerable parks, and at its northern end is a high artificial hill surrounded by its own wall—an imperial pleasure-ground. Inside the Yellow city, and occupying perhaps a quarter of its space, is again an inclosure surrounded by a wall and containing the imperial residence. It is tiled with red, and is called the Red or Prohibited city.

The Southern or Chinese city abuts on the Tartar city on the S. It was originally a suburb, but was later surrounded by a wall, which is lower than that about the Tartar city. It has ten gates, three of them in common with the Tartar city. It is of a rectangular shape, about 6 miles E. and W. and 2½ N. and S. It contains the Temple of Heaven and that of Agriculture, representing the early and patriarchal religion of the empire. The emperor, representing his people, worships here with much ceremonial once every year.

Outside Peking, and but a short distance E. and W., are the temples of the Sun and Moon, and on the N. that of the Earth. About 8 miles N. W. is a very fine imperial park, called Yuen-ming-yuen, containing about 12 sq. miles and having many pleasure-houses; put in ruins by the allies in 1860. In the environs of the city are many temples, convents, and tombs, generally in ruins.

Peking is thoroughly policed, and is very safe under ordinary circumstances. Its industries are small and unimportant. The country immediately around it is relatively infertile, and its provisions come from some distance. The chief trade-route is by the Pei-ho to Tungchow, 12 miles distant, thence by cart or porter to the city. From the S. and W. carriage is largely by camels.

A city has occupied from time immemorial the present site of Peking, or one near by. The Chinese believe that it is the city *Ki*, known 1,000 years before the Christian era, and from time to time a royal or departmental capital until the fourth century A. D. From that time the name was frequently changed. In 1264–67 A. D. it was rebuilt about 3 *li* N. E. of its previous site, and the Mongol emperors used it as a capital. In the latter part of the thirteenth century it was well known to Marco Polo, who called it Cambaluc (improperly written *Cámbalú*). It continued an imperial residence until the fall of the Mongols (1368). The new (Ming) dynasty first took up their residence at Nanking (i. e. South Capital), but the second emperor of that dynasty returned to the northern capital, which was now called Peking. It was restored and reduced in size in 1409, and the part then constructed is the present Tartar city. The walls were completed in 1437, and the Southern city inclosed in 1544. There has been little change since then. In 1860 it was captured by the Anglo-French army. During the Boxer disturbances of 1900, the foreign legations were destroyed and the representatives of the foreign powers besieged by Boxers and imperial troops in the compound of the British legation from June 20 till Aug. 14, when the city was taken by the allied forces. The Chinese court fled to Singanfu and the city was under the military control of the powers during the peace negotiations and till the summer of 1901. See CHINA.

M. W. HARRINGTON.

Pela'gianism: a system of anthropological doctrine which takes its name from Pelagius, but owes its shape rather to bolder if not abler men. Pelagius is spoken of by several of his contemporaries as a Briton, which is likely enough in spite of his familiarity with Greek authors. In 409, to avoid Alaric's siege of Rome, he escaped with his convert and pupil, Cælestius, to Northern Africa, and had gone from there to Palestine before the meeting of the Council of Carthage in 411 (some say 412), which condemned Cælestius. In Palestine two councils (at Jerusalem and at Diospolis, the ancient Lydda, in 415) declared him orthodox. He is not heard of after 418, but there is a tradition that he was seventy years of age when he died in some obscure town of Palestine. In the controversy to which his peculiar views gave rise he may not have acted quite frankly, but otherwise he appears to have been a very good man, of more than common moral strictness and purity, if not a man of any great spiritual depth or intellectual grasp. The impulse to his alleged heresy was a practical one. He had been scandalized by hearing Christians plead human infirmity as an excuse for shortcomings in the religious life. He is said to have been greatly roused by hearing a bishop repeat the well-known prayer of Augustine, *Da quod jubes, et jube quod vis* (Give what Thou commandest, and command what Thou wilt). His convert, Cælestius, who appears to have been more of a Pelagian than Pelagius himself, had been an advocate in Rome, and was, perhaps, an Irishman by birth. He was younger and more impulsive than Pelagius. It was his application for ordination as a presbyter at Carthage (in 411 or 412) which led to the council already referred to. His application was denied, on the ground of these seven heretical opinions: (1) Adam would have died if he had not sinned; (2) Adam's sin injured himself only, not the race; (3) children are born as pure as Adam was before he fell; (4) men neither die because Adam fell, nor rise again in consequence of Christ's resurrection; (5) unbaptized, as well as baptized, infants are saved; (6) the law, as well as the gospel, leads to heaven; (7) even before Christ's advent there were sinless men. The answer of Cælestius, that these were matters merely of speculation, availed him nothing; he was excluded from the fellowship of the Church. He then went to Ephesus for ordination, and was a presbyter there from 412 to 417, when he returned to Rome, and for a time had the Bishop Sozimus (417–418) on his side, but fled from Rome in 418, Sozimus having turned against him; was banished from Constantinople in 429; appears in Rome again in 430; and is not heard of after 431, when he was condemned by the œcumenical Council of Ephesus. Meanwhile, a still younger man, of still greater boldness, Julian, Bishop of Eclanum, in Italy, comes

upon the stage. Deposed in 418, with eighteen other bishops, for sympathy with the opinions of Cælestius, he literally carried the war into Africa, assailing the Carthaginian anthropology with all his might. Augustine had already entered the lists on the other side. Julian went to Constantinople in 418, spent some years with Theodore of Mopsuestia, was in Constantinople again in 428, sought restoration to the Church in 439, but was refused, and died a schoolmaster in Sicily at some time between 440 and 453. Pelagianism, which was understood to be a denial both of original sin and of supernatural grace, was everywhere condemned. Semi-Pelagianism, 100 years later, shared the same fate. By a curious blunder the principal writings of Pelagius were attributed to Jerome, and are found among his printed works (ed. Vallarsius, vol. xi.). See *The Anti-Pelagian Writings of Augustine*, in English (New York, 1887), with historical introduction by Prof. B. B. Warfield; *Jerome's Dialogue against the Pelagians*, in Eng. trans. by W. H. Fremantle in *St. Jerome: Letters and Select Works* (New York, 1893). See G. F. Wiggers, *Versuch einer pragmatischen Darstellung des Augustinismus und Pelagianismus* (1831–33), vol. i. on *Pelagianism*, translated by Prof. Emerson of Andover (1840); J. L. Jacobi, *Die Lehre des Pelagius* (1842); A. Dorner, *Augustinus* (1873); W. G. T. Shedd, *History of Christian Doctrine* (1863); F. Wörter, *Der Pelagianismus* (1866; 2d ed. 1874). See ANTHROPOLOGY; also see CALVINISM and REGENERATION. Revised by S. M. JACKSON.

Pela'gius: See PELAGIANISM.

Pelagius I.: pope; of Roman birth; archdeacon and legate to Constantinople under Vigilius, his immediate predecessor, and, like him, a mere creature of the Byzantine emperor, Justinian. He was with Vigilius when he died at Syracuse on his way home from Constantinople (where he had been since 547), June 7, 555, and at once assumed the pontificate, as he had previously been authorized to do by Justinian. He was suspected of having hastened the death of Vigilius, and after his consecration at Rome, by two bishops and a presbyter, he thought it necessary solemnly and publicly to deny the charge. He had a troubled pontificate, owing to the refusal of many of his bishops to accept the decrees of the fifth œcumenical council, convened by Justinian in Constantinople 553, upon the Monophysite controversy, which sanctioned the formula, "God was crucified," or "One of the Trinity has suffered." D. in Rome, Mar. 3, 560. His literary remains are in Migne, *Pat. Lat.*, lxix.—PELAGIUS II., also of Roman birth, the immediate predecessor of Gregory the Great in the papal chair, and the first independently elected pontiff after the Byzantine conquest of Rome in 536. He was consecrated Nov. 27, 578; and, in consequence of a plague which followed an inundation of the Tiber, died about the middle of January, and was buried Feb. 8, 590. His literary remains are in Migne, *Pat. Lat.*, lxxii.
Revised by S. M. JACKSON.

Pelargonic Acid [from Mod. Lat. *Pelargo'nium*, a genus of geraniums in which this acid is found]: a member of the fatty acid series, of the composition $C_9H_{18}O_2$. It occurs naturally in the volatile oil of rose-geranium, *Pelargonium roseum*, whence its name, and is obtainable artificially by several methods, one being the oxidation of essential oil of *Ruta graveolens*, or rue. It is a colorless liquid, oily, and freezing by cold to a fatty mass, which melts at 12·5° C.; odor like that of butyric acid; boils at 253°–254°; slightly soluble in water and very soluble in alcohol. By keeping it becomes yellow. Revised by IRA REMSEN.

Pelargonic Ether: the ethyl ether of pelargonic acid. It is a colorless oil, boiling at 216°–219° C. Quinces owe their characteristic odor to the presence of this substance. It can be made by treating pelargonic acid with alcohol.

Pelargonium: See GERANIUM.

Pelas'gians: a people uniformly spoken of by all ancient Greek authors as the oldest inhabitants of Greece. The detailed information which has come down to us about them is vague and contradictory. Some authors, Homer and Herodotus, describe them as an extensive race, the parent-stock from which sprung the Hellenes, occupying not only Greece proper, but Asia Minor to the E., Macedonia, Thracia, and Illyria to the N., and Italy to the W. Others, Thucydides and Strabo, consider them only one of the many kindred tribes which inhabited Greece, like the Leleges and Dolopes. Of the Pelasgian language nothing has been preserved. Certain names, such as Larissa and Argos, are considered as pertaining to it. A Greek tradition designated the Albanian dialect as directly descended from it. Herodotus speaks of it as barbarous, but whether that means foreign or corrupted is not evident. Of architectural monuments found in Greece, certain constructions of an enormous massiveness and strength are ascribed to them. They consist of huge blocks of stone placed one above the other, and held together by their own weight, without any mortar; on account of their size these structures are called cyclopean. Of the history of the Pelasgians not one fact has as yet been ascertained, even that of the transition from the Pelasgian to the Hellenic period. Some modern Egyptologists, however, have described them as a seafaring people in frequent communication with Egypt. Of the stocks settled in Italy, the Japygians and Etruscans are generally considered as branches of the Pelasgian race, but the hypothesis is at once hazardous and barren. Revised by J. R. S. STERRETT.

Pelecan'idæ [Mod. Lat., named from *Peleca'nus*, the typical genus, from Lat. *peleca'nus* = Gr. πελέκανος, woodpecker, also pelican, liter., hewer, deriv. of πελεκᾶν, hew, deriv. of πέλεκυς, ax]: a family of birds of the order *Steganopodes*, whose species are familiarly known as pelicans. They are of large size; have a rather long flexible neck, moderate head, a long, nearly straight, and rather broad bill, whose culmen is rounded at the base, and at the end produced into a strong hook; the lower mandible is broader than the upper, and provided with a naked membrane, which extends backward on the throat and is capable of great extension; nostrils lacking; wings long and pointed; tarsi short and robust; toes four, connected together by a membrane, the three anterior largest, the fourth interno-posterior and smallest. Revised by F. A. LUCAS.

Pelecyp'oda (Mod. Lat.; Gr. πέλεκυς, hatchet + πούς, ποδός, foot]: a term used by a few writers for the group of molluscs, better called LAMELLIBRANCHIATA (*q. v.*), in allusion to the compressed "foot."

Pe'leus (in Gr. Πηλεύς): in Grecian mythology, son of Æacus, brother of Telamon and father of Achilles by Thetis, a daughter of Nereus, and therefore immortal. He was King of Phthia in Thessaly; took part in the Calydonian boar-hunt and the Argonautic expedition. At his marriage to Thetis in the cave of the centaur Chiron the gods appeared and brought goodly gifts, only Eris threw among the assembled guests the golden apple inscribed, "To the Fairest," a circumstance which gave rise to the Trojan war, in which the issue of this marriage (Achilles) was to be the leading figure. J. R. S. STERRETT.

Pelew' Islands: a group of twenty-six little islands W. of the Carolines in the Pacific; also called the Western Carolines. They belong to Spain, and are hilly and surrounded by coral reefs. The soil is fertile, and produces breadfruits, bananas, sugar-cane, and oranges. Pop. about 10,000, of the Malay race. See Semper, *Die Palau Inseln* (Leipzig, 1873). C. C. A.

Pelican [O. Eng. *pellican*, from Med. Lat. *pelecanus*, a pelican]: any one of several water-birds of the family *Pelecanidæ*, having all four toes connected by a web, and distinguishable at a glance by their extremely long bill, beneath which is a large skinny pouch. The tail is short, and consists of numerous (twenty or more) feathers; the wings very long; the bones are all permeated by air, and numerous air-sacs are present about the body. Pelicans are gregarious, and dwell both on the seacoast and by inland waters in temperate as well as tropical countries. They nest on the ground or on low trees and bushes, and lay from one to three eggs, like chalk in appearance. There are ten or a dozen species. The pouch is used for catching fish, on which these birds feed. They either plunge down upon the fish, like the brown pelican, or drive them into shallow water and scoop them up. It has been denied that the pelican carries fish to its young in its pouch, but it certainly does this occasionally. The common pelican of Europe (*Pelecanus onocrotalus*) has black primaries, the rest of the body being white suffused with a rosy or salmon tint; the young are grayish. This bird reaches a length of 5 feet, with a spread of wing of nearly 9. The

White pelican (*P. trachyrhynchus*).

white pelican of North America (*P. trachyrhynchus*), a bird of the size of the common pelican, is remarkable from the fact that during the breeding season a horny ridge or excrescence is developed on the upper mandible. This bird is found on the Gulf coast and extends inland to Great Salt Lake. The brown pelican of North America (*P. fuscus*) extends along the coast of the U. S. from Carolina to Texas, and a similar species (*P. californicus*) occurs on the Pacific coast. These birds are striped with black and white, while the neck of the male is of a rich reddish brown. F. A. Lucas.

Pelides: See Achilles.

Pe'lion (in Gr. τὸ Πήλιον ὄρος): the ancient name of the modern Plessidi, a mountain on the eastern coast of Thessaly, in the province of Magnesia. On the summit of its highest peak stood the temple of Jupiter Aetæus, and near this was the cave of Chiron. It is still celebrated for its magnificent forests of oak, chestnut, elm, and pine, and the deep impression which the ancients received of its lofty peaks found a fit expression in the myth of the giant sons of Aloeus, who in their wars against the gods placed Ossa on the top of Olympus and Pelion upon Ossa; or, as Vergil relates, piled Ossa on Pelion and rolled Olympus upon Ossa. See Mezières, *Sur le Pélion et l'Ossa* (Paris, 1853); Tozer, *Researches in the Highlands of Turkey* (London, 1869, vol. ii., pp. 98–139). Revised by J. R. S. Sterrett.

Pélissier, pā'lēĕ'si-ā', Jean Jacques Amable: Duke of Malakoff, marshal of France; b. at Maromme, near Rouen, Nov. 6, 1794; was educated at Brussels, afterward at the military schools of La Flêche and St.-Cyr; entered the artillery as sub-lieutenant in 1814; served in Spain in 1823, in the Morea in 1828, and in Algeria in 1830. Commanding in 1845 a corps as colonel, he entered the territory of the Ouled Riahs, defeated them, and shut them up in a cave. As they refused to surrender, and even fired at his messengers, he applied burning fagots to the mouth of the cave, and about 600 Arabs were suffocated. This atrocity excited general indignation, and he was saved only by the declaration of Marshal Bugeaud, commander-in-chief in Algeria, that he had simply obeyed a positive order. In 1855 he was made commander-in-chief of the army in the Crimea, and took the Malakoff. He was governor-general of Algeria from 1860 to his death May 22, 1864.

Pel'la (in Gr. Πέλλα): the ancient capital of the Macedonian empire and the birthplace of Alexander the Great. It was a large and magnificent city in the days of Philip and Alexander, but lost its importance under the Romans, and disappeared altogether during the Middle Ages. Some few remains of it are still traceable near Pel. It is said to have had over 80,000 inhabitants. See Tozer, *Researches in the Highlands of Turkey* (London, 1869, i.. p. 153); Heuzey and Daumet, *Mission archéologique de Macédoine* (Paris, 1876). J. R. S. Sterrett.

Pella: city; Marion co., Ia. (for location, see map of Iowa, ref. 6–H); on the Chi., Rock Is. and Pac. Railway; 47 miles E. S. E. of Des Moines, the State capital. It is in an agricultural and stock-raising region, is the seat of the Central University of Iowa (Baptist), and has stone quarries, vineyards, lime-kilns, flour-mills, grain elevators, and other industrial works, and a monthly and three weekly periodicals. Pop. (1880) 2,430; (1890) 2,408; (1900) 2,623.

Pella'gra [Ital., deriv. of *pelle*, skin; cf. Gr. ἄγρα, a catching]: a form of nervous disease with a peculiar skin eruption. It occurs in Italy, especially in Lombardy, in Spain, and in other parts of Europe, and sometimes becomes extremely prevalent. The symptoms refer to the stomach, the nervous system, and the skin. The disease is apt to be chronic, growing in severity with succeeding years. It is likely that poverty, hunger, overwork, and filth combined are the causes alike of the scaly eruption and of the other attendant evils. Revised by William Pepper.

Pelletier, pel'ti-ā', Charles Alphonse Pantaleon, C. M. G.: Senator; b. at Rivière Ouelle, Province of Quebec, Canada, Jan. 22, 1837; graduated B. C. L. at Laval University in 1858, and was admitted to the bar in 1860. He represented Kamouraska in the Dominion Parliament 1867–77; was Minister of Agriculture 1877–78; president of the Canadian commission for the Paris Universal Exhibition of 1878; for his services was made (1878) a Companion of the Order of St. Michael and St. George; was called to the Senate in 1877, and became its Speaker in July, 1896. As a major, he commanded a battalion of volunteers during the Fenian raid of 1866. Neil Macdonald.

Pellico, Silvio: poet and writer; b. at Saluzzo, province of Coni, Italy, June 24, 1789. He studied at Turin, and then spent four years at Lyons, chiefly studying French literature. In 1810, his family having removed to Milan, he became Professor of French in the Milanese Collegio degli Orfani Militari. Here he made the acquaintance of Monti and Foscolo (whose *Carmi de' Sepolcri* had deeply stirred him), and was soon in the midst of the best spirits of the city. During this period he wrote the first of his tragedies, *Laodicea* and *Francesca da Rimini*, the latter of which, acted in 1819, was a great success. In 1819, with a group of friends, among them Manzoni and Berchet, he established a periodical, *Il Conciliatore*, intended to represent the new romantic and patriotic tendencies they all felt so strongly. The Austrian administration looked with great disfavor upon this; and Pellico had difficulties also about his new tragedy, *Eufemio di Messina* (1820). In this same year the periodical had to be abandoned, and not long after Pellico, with several others, was arrested. He was confined first at Milan, then at Venice, but in 1822, on a false charge of Carbonarism, he was condemned to death. The sentence was commuted by the emperor to fifteen years of confinement at the Spielberg in Moravia. At last, in 1830, stirred by the July revolution in Paris, the Austrian Government released him, broken in health and impaired in mind. He went at once to Turin, and passed the remainder of his life in retirement as secretary and librarian to the Marchioness Barolo. His tragedies, *Iginia d'Asti* and *Ester d'Engaddi*, had been the fruit of his confinement in Venice, while at the Spielberg he composed *Leoniero da Dertona*. On his release he prepared the book chiefly associated with his name, *Le mie Prigioni: Memorie, etc.* (Turin, 1832), which first revealed to Europe the iniquities of the Austrian rule in Italy, and powerfully aided the movement for Italian independence. The book was speedily translated into all the cultivated European languages, as was also the little treatise *Dei Doveri degli Uomini, discorso ad un giovane* (1834). Besides the tragedies mentioned above, he composed three others—*Tommaso Moro*, *Erodiade*, and *Gismonda da Mendrisio*—as well as a number of briefer dramatic pieces. (See his *Rappresentazioni dramatiche inedite*, edited by G. Lanza, Turin, 1886.) His master in the drama was Alfieri, but there is little strength and too much sentimentality in his style. D. at Turin, Feb. 1, 1854. There is no good complete edition of Pellico's works. The chief are in the so-called *Opere Complete* (2 vols., Leipzig, 1834–48; 3 vols., Paris, 1836–37; 1 vol., Milan, 1857). Other editions of importance are his *Opere* (2 vols., Padua, 1831) and *Opere inedite* (2 vols., Turin, 1837). His *Epistolario* has been edited by G. Stefani (Florence, 1856). See P. Giuria, *Silvio Pellico e il suo tempo* (1854); and *Nel Centenario della Nascita di Silvio Pellico. Sua vita, memorie, e componimenti inediti* (Turin, 1889). A. R. Marsh.

Pel'litory [M. Eng. *paritorie*, from O. F. *paritoire* < Lat. *parieta'ria*, pellitory, deriv. of *parieta'rius*, belonging to walls, deriv. of *pa'ries*, *parie'tis*, wall]: common name of an urticaceous herb. (1) The *Parietaria officinalis*, or wall pellitory of the Old World, resembling outwardly the common nettle. It is used as a diuretic in domestic practice. *Parietaria pennsylvanica* is its North American representative. (2) More commonly this name is given to *Anacyclus pyrethrum*, a composite plant the root of which is brought from the Levant. It is much used by dentists to relieve toothache and benumb the nerves of the teeth, and is a valuable and powerful sialagogue and local stimulant in tic douloureux and facial paralysis; is often incorrectly called Spanish pellitory.

Pelop'idas (in Gr. Πελοπίδας): a man of great wealth and an intimate friend of Epaminondas; b. at Thebes; was expelled in 382 B. C. from his native city by an oligarchic party supported by Sparta, but returned in 379 B. C., slew the Spartan leader with his own hand, established a thoroughly democratic government, and broke the Spartan influence not only in Thebes, but in Greece. He distinguished himself in the battle of Leuctra, 371 B. C., and on a diplomatic mission to Susa he baffled the Spartan and Athenian intrigues at the Persian court, and Thebes was acknowledged as the first city of Greece. Sent in 368 B. C. as ambassador to Alexander of Pheræ, he was seized and imprisoned by the tyrant, but rescued by Epaminondas. In the year 364 B. C. he defeated Alexander at Cynoscephalæ in Thessaly, but was killed while pursuing the enemy.
Revised by J. R. S. Sterrett.

Pelopium: See Columbium.

Peloponne'sus [= Lat. = Gr. Πελοπόννησος; Πέλοπος, of Pelops + νῆσος, island]: the ancient name for the southern division of Greeee, the peninsula, whieh now generally is called the Morea (*q. v.*). It was divided into six districts or states—namely, Achaia, in the N., along the Corinthian Gulf; Argolis, in the E., between the Saronic Gulf and the Gulf of Argolis; Laconia, in the S. E., between the Gulfs of Argolis, Laconia, or Colocythia, and Messenia or Koron; Messenia, in the S. W., on the Gulf of Messenia; Elis, in the W.; and Arcadia in the middle. See the artieles on Greece and its divisions; Curtius, *Peloponnesos* (Gotha, 1851–52); Clark, *Peloponnesus* (London, 1858); Beulé, *Études sur le Péloponèse* (Paris, 1875); Gell, *Itinerary of the Morea* (1827) and his *Journey in the Morea* (1823); Leake, *Travels in the Morea* (London, 1830) and his *Peloponnesiaca* (London, 1846); Blouet, *Expédition de Morée* (Paris, 1831–38); Ross, *Reisen im Peloponnes* (Berlin, 1841); Wyse, *Excursion in the Peloponnesus* (London, 1865); Bursian, *Geographie von Griechenland* (Leipzig, 1872, vol. ii., 1–343). For the Peloponnesian wars, sec Greece, History of Ancient.

Revised by J. R. S. Sterrett.

Pe'lops (in Gr. Πέλοψ): in Grecian mythology, the son of Tantalus (King of Phrygia), brother of Niobe and the father of Atreus and Thyestes; married Hippodamia, a daughter of King Œnomaus of Elis; became king after the death of his father-in-law; renewed the Olympian games, and gavc his name to the southern division of Greeee by sending a colony thither. Many and very different myths are eonnected with his name. Revised by J. R. S. Sterrett.

Pelo'tas: a town in the state of Rio Grande do Sul, Brazil; on the river São Gonçalo, which conneets the Lagoa dos Patos with the Lagoa Miri (see map of South America, ref. 8–F). It is built on flat ground, with wide, regular streets, and is one of the riehest and handsomest cities of Southern Brazil; railways connect it with Rio Grande do Sul and with the interior of the state, and vessels which can pass the Rio Grande bar ascend easily to this plaee. Pelotas is the principal cattle-market of the state and the center of the meat-drying industry, whence most of the states are supplied with jerked beef. The exports, besides jerked and salt beef, are hides, tallow, horns, ete. Pop. (1894) about 25,000. Herbert H. Smith.

Pels, Andries: Dutch poet and critic. Almost nothing is known of his life except that he lived at Amsterdam as a jurisconsult during the seeond half of the seventeenth century. He is, however, historieally a rather important figure in Dutch literature. The first production from his pen of which we know is his tragedy *Didoos dood* (1668). Soon after this he beeame the central figure of that group of men who undertook to regulate and diseipline the Dutch language and the forms of Dutch poetry. The group took for its motto the words *Nil volentibus arduum*, and is commonly known by this name. Its inspiration came from Franee, and it dreamed of a work like that of the recently established Aeadémie Française. The manifesto of the movement was written by Pels, and entitled *Horatius Dichtkunst op onze tijden en zeden gepast* (1677); and this was followed by a second treatise with a similar purpose, *Gebruik en misbruik des tooneels* (1681). The effect of the movement on Dutch letters was very unhappy. The would-be legislators had no real inspiration, and conceived of reform as a purely mechanical and exterior business. Henee their own works are now almost unreadable, as may be seen in Pels's *Minneliederen en Mengelzangen* (1684). A. R. Marsh.

Pelu'sium [= Lat. = Gr. Πηλούσιον; Egypt. *am*; probably identical with *Ha-uar*, Avaris or Abaris; Heb. *Sin*]: an Egyptian fortified city and outpost near the Mediterranean, on the Pelusiac branch of the Nile, at the northeast corner of the Delta region, on one of the main lines of travel to the East. Its history can not be traeed exeept in the geographical lists on temple walls, since the present remains are very few and much weatherbeaten. Avaris was the final stronghold of the Hyksos, from which they were driven by Ahmes I. (See Egypt.) It was also the scene of the overthrow of the native dynasty under Psammetichus III. by Cambyses. At present the site is nearly level with the surrounding marsh, the lowering of the mounds being due in part to denudation, but mainly to the gradual sinking of the northern portion of the isthmus. See Petrie, *Tanis* (part ii., p. 100 f.); Dümichen and Meyer, *Gesch. des alten Aegyptens*; Lipsius, *Letters from Egypt* (p. 429 ff.); Meyer; *Gesch. des Altertums*; Amélincau, *Géographie de l'Egypte* (p. 317 f.). Charles R. Gillett.

Pelvis [= Lat. *pel'vis*, basin, laver]: the lowest of the three great divisions of the trunk, or, more properly, the bony ring or framework, connecting the column of the spine with the lower extremities, and transferring the weight of the former to the latter. It consists of four bones. The front and sides are formed by the two *ossa innominata*, large irregular bones which have received their name from their not resembling any other body in form; behind, the circle is completed by the *sacrum* and *coccyx*. The pelvis varies somewhat in the male and female skeleton, and also in the skeletons of different races. See Osteology.

Pemberton, John Clifford: soldier; b. in Philadelphia, Pa., Aug. 10, 1814; graduated at the U. S. Military Aeademy, and became second lieutenant of artillery July, 1837; served in Florida against the Seminoles; in the war with Mexico on the staff of Gen. Worth, gaining the brevets of captain and major for Monterey and Molino del Rey; in Florida hostilities against the Seminole Indians, and in garrison principally in the Southern States until Apr. 29, 1861, when he resigned, being at the time a captain of artillery. Joining the Southern cause, he was appointed a colonel of cavalry, and attaehed to the staff of Gen. Joseph Johnston; rose to the rank of lieutenant-general, and in 1863 commanded in Mississippi, where he was defeated, May 16, at Champion Hills and Big Black (May 17); falling back on Vicksburg, he defended it against assault, but being besieged was compelled to surrender the city and garrison July 4, 1863. (See Vicksburg, Siege of.) He subsequently served as inspector of artillery; after the war farmed at Warrenton, Va., but in 1876 removed to Philadelphia. D. at Penllyn, near Philadelphia, July 13, 1881.

Revised by James Mercur.

Pembroke: town; in Pembrokeshire, South Wales; on an inlet of Milford Haven; 9 miles W. of Tenby (see map of England, ref. 12–C). At Pembroke Dock or Pater, 2½ miles N. W. of Pembroke, is a fortified dock-yard and arsenal. Pop. of Pembroke proper (1891) 14,978.

Pembroke: town; capital of Renfrew co., Ontario, Canada; on Allumette Lake, a part of Ottawa river; 100 miles above Ottawa (see map of Ontario, ref. 1–G). It is a great center of the lumber business. Water-power is furnished by the falls of Muskrat river. Beside the county buildings, Pembroke has several branch banks and mills. There are two weekly newspapers. Pop. (1890) 4,401.

Pembrokeshire: county of Wales; bounded N. and W. by the Irish Sea and S. by the Bristol Channel. Area, 617 sq. miles. The coast is rugged, but inland the surface is undulating, valleys alternating with hills, whieh reach a height of 1,754 feet in Cwm-Crwyn in the Precelly range. The prineipal rivers are the Teifi, the two branches of the Cleddan, and the Nevern. Mines of anthracite coal and lead are worked. In the southern part the soil is fertile, and barley, oats, and potatoes are raised; while in the more northerly regions more attention is given to cattle-rearing and dairy-farming. Over more than half its area English is spoken, though it is the farthest Welsh county from England. Pembrokeshire returns one member to Parliament. Pop. (1901) 87,856.

Pem'mican [the Cree Indian name]: a kind of concentrated food, originally made by the North American Indians by drying and powdering the lean meat of the buffalo or deer, mixing it with serviee-berries, stirring all into boiling fat, and making it into cakes. The name is also given to a very different form of meat-biscuit used by Arctic voyagers.

Pemphi'gus [Mod. Lat., from Gr. πέμφιξ, πέμφιγος, bubble]: a skin disease in which successive crops of watery or turbid blisters appear upon the patient. Two varieties are described: *P. vulgaris*, which may be acute or chronic, and *P. foliaceus*, which is always chronic. In the former the blebs are well distended, at first with clear serum, later with pus; in the latter, the vesicles are large, only partly filled, and purulent from the first. Moreover, they rupture early and leave a rough, red surface. Pemphigus often comes on suddenly, with chills and fever and great constitutional depression. It may be epidemic in certain localities, especially the form occurring in the new-born, *P. neonatorum*. The acute form lasts from two to six weeks, and may occasion severe constitutional symptoms, with the local heat or itching common to all forms. The chronic form

lasts from six months to a year or more, consisting, as a rule, of several distinct attacks, separated by an interval. The treatment consists in the internal administration of arsenic and of remedies to restore the general systemic tone, such as strychnia, quinine, and iron. Local treatment with dusting-powders or alkaline sedative lotions gives great relief, and in very severe cases patients have been kept in warm baths continuously for months. WILLIAM PEPPER.

Pen [viâ O. Fr. from Lat. *pen'na*, feather]: an instrument for writing. Among the earliest references to pens are those found in Judges v. 14, Psalms xlv. 1, Isaiah viii. 1, chiefly referring, no doubt, to the iron stylus which cut out characters in the tablets of limestone or soapstone. These may have been made of other metals, and were in some instances pointed with diamonds, as referred to in Jeremiah xvii. 1. Another reference is made in Jeremiah viii. 8, and if taken in connection with the mention of a penknife—xxxvi. 23—it would seem to imply that a reed was in use at that period. Later, tablets were made of the plastic clays of Central Asia, which, after receiving inscriptions, were dried in the sun or baked in ovens. The *style* used in Persia, Greece, and Syria was sharp at one end for writing and flattened at the other for the purpose of making erasures on the tablets, which were covered with wax, and were made of metal, bone, or ivory.

In the Third Epistle of John, 13th verse, written about A. D. 85, mention is made of "ink and pen," probably alluding to the custom of writing upon skins or other flexible material. Although the first reference in the Bible was made about B. C. 1296, Mariette discovered an inscription in one of the crypts of the Temple of Denderah in Upper Egypt which says that the great fundamental ordinance of Denderah was found written upon goat-skin in the inside of a brick wall during the reign of King Pepi (about B. C. 3650), and in the same crypt was another inscription stating that the restoration of the great fundamental ordinance of Denderah was made in accordance with what was found *written* in ancient writing of the time of King Khufu (about B. C. 3766).

At Bubastis, in Lower Egypt, Naville discovered on the walls of the Hall of Festival, among the processional subjects, the sacred scribe with *pen and palette*, and in the tombs of Gizeh, which are contemporaneous with the pyramids, the reed pen and inkstand, and scribes employed in writing, appear among the sculptures. In the supposed tomb of Aristotle, in Greece, a metal pen about 2 inches long was found, cut and slit like a quill pen, and a bronze one of undoubted Roman origin, made from sheet-metal bent and forged on a mandril, and with its point neatly cut and slit like a quill pen, was excavated in a field at Pré-Saint-Didier at a depth of 10 feet.

After the stylus, pens were doubtless made in tubular forms from sheet-metal of a required length for holding in the hand, the point being formed by filing away a portion of the tube or barrel; later, holders of many materials were introduced, and the metal part was of only sufficient length to give a flexibility to the point and to slip over the holder about 1½ inches. Metallic pens resembling modern patterns were generally supposed to have been unknown before the early part of the eighteenth century, but that theory was exploded when in excavating at Pompeii a pear or almond shaped one was found with a sort of ring at the stem, now preserved in the Museum at Naples, that certainly must be older than A. D. 79, when the city was buried by the eruption of Vesuvius.

Dr. Martin Lister, in 1698, in his *Journey to Paris*, describes an ancient writing implement of thick silver wound up like a screw, with both ends pointing one way and at a distance so that a man might easily put his forefinger betwixt the two points, one of which was sharp to write on wax tablets, the other shaped like the upper beak of a cock; the point was divided like that of our steel pens.

Quill Pens, etc.—In the far East, and perhaps in Egypt, the camel's-hair pencil was substituted for metal implements, and characters were painted on the bark of trees and skins of animals, very much as the Chinese draw them on paper, but the quills of geese and crows were discovered to be more useful than either the reed or brush, and were introduced, it is thought, about A. D. 56. For centuries the quill was the favorite instrument of the rapid writer, and continued to be so until the steel pen superseded it. Quills were most successfully prepared in Russia and Holland by clarifying them in hot sand and by dipping them in boiling alum-water or diluted nitric acid. Many writers made their own pens from these prepared quills, but the art was an acquired one after much instruction and practice. Every teacher was expected to be proficient in this part of his profession. Early in the nineteenth century they were made for sale, and boxes of them, also nibs for fastening upon holders, were vended by all stationers.

Notwithstanding the impression that the quill pen produces only coarse writing, as beautiful specimens of penmanship have been produced by it as by any other instrument in use, not excepting the engraver's tool. The demand for something more durable than quills led to a variety of experiments with horn, tortoise-shell, glass, steel, silver, and gold, resulting in the almost exclusive use of steel. The glass pen was more of a stylus than a pen, it being merely a ground stick. The horn and shell ones softened under the action of the ink and were no improvement on the quill, though they were pointed with diamonds and rubies. Silver pens, because of their elasticity and ductility, were thought to be a success, but their susceptibility to wear at the point and a failure to temper them properly caused them to be finally abandoned.

Steel Pens.—The invention of making steel pens from sheet-metal has so many claimants that it is difficult to decide to whom belongs the honor. The first manufacturer of steel pens is unknown. Arnoux, a French mechanic, made metallic pens with side slits in 1750. A New York city jeweler, working in Baltimore in 1800, made for his own use a steel pen with three slits. The Shakers, in 1819, made silver pens with one slit. Joseph Gillott, Sir Josiah Mason, John Mitchell, and James Perry, all Englishmen, began to manufacture by machinery about the same time. Patents were granted to Perry in 1830 and to Gillott in 1831, and the evidence of Perry's precedence seems to be cumulative.

The manufacture of steel pens is a delicate and laborious process. The raw material is produced in sheets 6 feet long, 17 inches in length, 23 wire-gauge thickness, which is cut into strips of convenient width and placed in air-tight iron boxes which are put in a muffle, where they remain until they gradually attain a dull-red heat, when the muffle is allowed to cool gradually. To rid the strips of an excrescence they are immersed in a vat of diluted sulphuric acid to loosen the scales, and then tumbled in a revolving barrel with pebbles and water. The steel is then rolled until reduced to the required gauge with such exactness that a variation of the one-thousandth part of an inch is not permitted. These strips are now punched into blanks of the same shape of the patterns of the pens desired, two-thirds of the material being used, one-third being scrap. Marking the blanks singly, with the name and number, by a stamp is the next process, and so dexterously are they handled that one girl can stamp 250 gross in a day. To obtain elasticity and to devise a method which shall cause the ink to attach itself to the smooth surface, the blanks are pierced by a delicate punch in a fly-press.

Before the blanks are shaped the dust and grease are removed by tumbling again; then to anneal or soften the metal the blanks are heated in a muffler once more to a dull red, and when cool moulded by a die into form, and then hardened by heating them to a bright-red heat in round pans, after which they are put into perforated buckets to be plunged into vats of oil, which drains from the buckets as they are raised. The oil is removed by rapid revolving in perforated, centrifugal cylinders, but as the pens are still greasy and as brittle as glass, they are cleansed in a bath of boiling soda-water and tempered by being rolled in cylinders over a charcoal fire. Another bath in a pickle of diluted sulphuric acid frees them from any extraneous substance, and another tumble for from five to eight hours in a revolving barrel with ground iron, followed by a tumble in a barrel of dry sawdust, gives them a bright silver color and points nicely rounded. They are then ground on leather buffs, dressed with emery, and made ready for slitting with a tool having the delicacy of the cutting edge of a razor. After slitting they are tumbled again with powdered iron for six hours to smooth the inside edges of the slit, then polished in sawdust and, after being colored, are varnished to prevent rust. First quality pens undergo a rigid examination, one at a time, by expert girls, who reject every pen that shows an imperfection; afterward the pens are counted and boxed, generally in one gross packages.

Pens are manufactured chiefly in Birmingham, England, thirteen firms, employing 4,600 persons, using about 56,000 lb. of steel per week, producing a weekly average of 250,000

gross. There are four or five manufacturers in France and Germany, and but six recognized manufaeturers in the U. S., situated in New Jersey, Pennsylvania, New York, and Connecticut, and employing about 400 people. The average weekly production is about 20,000 gross. The many names given by the venders of steel pens to the material from which they are made are but fancy names and do not indicate the quality of metal. The demand for steel pens is almost confined to Europe and Ameriea. The great Asiatie nations still write with pens made from reeds or with eamel's-hair pencils.

The first gross of pens sold in England in 1820 brought at wholesale about seven guineas or $36 in U. S. money. In 1825 they were sold at 31 cents, and in recent years pens as good as those sold in 1820 were disposed of at 10 cents per gross.

Gold Pens.—Although the U. S. has failed to eompete successfully with Great Britain in the manufacture of steel pens as to quality of metal and workmanship, the reverse may be said of gold ones. In this manufacture, requiring a higher degree of skill, the U. S. has for some years been foremost, and the product is now sold largely in Great Britain, Franee, and Germany. The first attempt at making gold pens was made in England about 1825. The metal, though alloyed, is too soft to make a durable point, therefore it beeame necessary to protect the points with diamonds or rubies; but John Isaac Hawkins, a eitizen of the U. S. residing in England, was led by aceident to use the native alloy of iridium and osmium, one of the hardest and most refractory of all metallic alloys. Hawkins's rights were purchased by a clergyman, who in 1835 indueed a watchmaker in Detroit to engage in the manufacture of gold pens. These were first made by hand, and were very poor substitutes for the quill. In 1840 he removed to New York and enlarged his business. One of the men in his employ, John Rendell, invented a number of maehines for the making and tempering of the pens, giving them the elasticity of the quill and the permaneney of the metal. About 1850 it was discovered that by bedding the iridium points in the gold instead of soldering them the eorrosive influenee of the ink on the two metals, the solder and the gold, was avoided and a firmer hold on the pen was given to the points. The elastieity was inereased and the temper regulated by a series of rolls and other processes. The cost of gold pens makes it absolutely neeessary that every one should be perfeet and durable, therefore only experts are allowed to inspeet and test them before they are offered for sale. The rejection of at least four in a dozen is a result of this severe serutiny and test. About 150 persons are employed in the manufaeture of gold pens in the U. S. by fourteen makers; the annual product has a value of about $500,000.

Fountain or Stylographic Pens.—These pens have a reservoir handle, earrying a supply of ink of sufficient quantity to last several days or, if eonstantly used, for several hours' eontinuous writing. A removable eap is usually provided to cover the point, so that the instrument may be carried about like an ordinary lead-peneil. In 1860 an attempt was made to produee fountain pens, but not until 1879 were they construeted to operate sueeessfully. The early attempts at making reservoir pens were generally confined to contrivances embraeed in the use of internal tubes, ducts, valves, or springs operated upon by the action of the nibs, which foreed the ink from a feeding-pipe upon the pen, assisted by air admitted at the top of the holder, to take the place of the exhausted ink. This mechanism was very erratic in its work, the ink flowing either too slow or too fast. The best results were obtained by providing a tubular holder tightly closed at its upper end, while at the lower end is inserted, usually, an ordinary nib pen made of gold, with an ink-feeder lying adjacent to the pen to attract the ink from the reservoir. Air is admitted at the lower end of the reservoir, whereby a constant automatic feeding is secured by capillary action between the feed-plate and the pen. As the ink is withdrawn air enters at the lower end of the eolumn and ascends in globules through the column of ink to fill the spaee made vaeant by the use of the ink. There are many patents for fountain pens, whieh were invented in the U. S., but the principle involved seems to be the retention of the ink by atmospheric pressure and the furnishing of a supply ready for use for hours of continuous writing without the necessity of dipping constantly into an ink-well.

THEODORE E. SMITH.

Penalty [from Fr. *pénalité*, punishment, from Lat *pœnalis*, pertaining to punishment, deriv. of *pœna*, punishment, loan-word from Gr. ποινή, fine, and represented by Fr. *peine*, Eng. *pain*]: the imposition of the payment of a sum of money or of some personal suffering. It may be imposed by the law, as in criminal or punitive cases, or by contract. The eighth amendment of the U. S. Constitution forbids the imposition of excessive fines or pecuniary penalties and the infliction of eruel and unusual punishments by the Federal Government. In the absenee of constitutional restraint the infliction of penalties and the disposition of the proceeds are matters of legislative discretion. A statutory penalty must be clearly imposed; it will not be implied. The legislative imposition of a penalty on a specific aet or omission is treated generally as equivalent to its prohibition. It may appear, however, from the entire statute that the legislature intended not to render the act or omission absolutely illegal, but to punish the offending party. *De Mers* vs. *Daniels*, 39 Northwestern Reporter 98; 39 Minn. 158.

A party may subject himself to a penalty by contract, as in the ease of an ordinary bond or of an agreement not to engage in a partieular business or profession. At common law the penal sum named in such a eontract was recoverable in case the contract was broken, but equity intervened early and redueed the recovery to the actual damages caused by the breach. This beneficent policy received the approval of Parliament in 1697 (8 and 9 William III., c. 11, § 8), and soon became the prevailing rule in common-law courts. In many eases, however, the parties to a contract are allowed to stipulate the amount to be paid by either upon his breaeh of its provisions as liquidated damages. If such a stipulation is made beeause of the uncertainty of the damages, it will be sustained; but if it is resorted to for the purpose of securing the performance of the contract by the threat of a punishment for its breaeh, it will be treated as a penalty, and the injured party will be allowed to reeover sueh damages only as he can prove the breach has caused him. The language of the contraet is not treated by the courts as conclusive of the intention of the parties. They may deelare the sum stipulated for to be liquidated damages, while the court, looking at all of the eontraet provisions, will declare it a penalty. On the other hand, they may refer to the sum as a penalty, while the entire transaetion discloses that they intended to agree upon and abide by it as their rating of damages instead of leaving them to be assessed or guessed at by a jury or a court.

FRANCIS M. BURDICK.

Penance [from O. Fr. *penance* < Lat. *pœniten'tia*, repentanee (whenee Eng. *penitence*), deriv. of *pœ'nitet*, makes repent]: in general, the atonement for sin. Roman Catholie theology treats penance both as a virtue and as a sacrament. The virtue of penanee includes sorrow for sin, amendment, and the performanee of expiatory works. The sacrament of penanee is that in which the forgiveness of sins eommitted after baptism is granted, by the absolution of a duly authorized priest, to those who repent, confess, and perform satisfaction. This sacrament was instituted by our Saviour in the words, "Receive ye the Holy Ghost; whose sins ye shall forgive they are forgiven them, and whose sins ye shall retain they are retained" (John xx. 22). The power thus eonferred is double; the priest, acting as God's minister, may grant absolution or withhold it. Also it is a judicial power: the priest must know what the sins are before he can remit them or retain them. Hence the necessity of confession. The mere fact, however, of declaring one's sins does not procure their pardon. The ehief condition on the part of the penitent is sincere contrition. If this be wanting, the absolution is null, and the confession, instead of removing guilt, adds to it the crime of sacrilege. Nor does the penitent's obligation, when he is properly disposed, end with the priest's absolution. For though this releases him from sin and, in case of grievous offenses, from their eternal punishment, it does not always caneel the temporal reparation required by divine justice. This satisfaction, as it is termed, the priest imposes in the form of prayer, almsdeed, fasting, or other good works to be done by the penitent. In no case does the sacrament of penance imply a "permission to commit sin."

This is the teaching not only of the Latin Church, but also of the Eastern Churches, of those even which at an early period severed their connection with Rome. The sacramental character of penance was acknowledged moreover by those sectarians who held peculiar views regarding the power of forgiving sins. Though the Novatians and Montanists excepted certain grievous sins from this power, few of them denied it absolutely. The Donatists claimed

that it could be exercised only by worthy ministers; the Waldenses, that it belonged to the laity as well as to the priesthood; Huss and Wycliffe, that its efficacy depended upon the worthiness of those who exercised it, and that perfect contrition rendered the sacrament unnecessary. The Reformers spoke, it is true, of an *absolutio*; but as they considered this a mere declaration of forgiveness, and forgiveness itself a revival of baptismal grace—*regressus ad baptismum*—they virtually rejected the sacrament of penance.

The *practice* of the Church in administering the sacrament and in dealing with penitents has varied from time to time. During the first four centuries auricular confession was often followed by a public confession when it was thought that this would be edifying. As, however, the opposite effect was sometimes produced, the public confession was abandoned toward the middle of the fifth century. Similar vicissitudes appear in the history of the *penitential discipline* or process by which the sinner after due reparation was reconciled to the Church. The offenses for which public penance was enjoined—*peccata capitalia*—were adultery, idolatry, and murder. The penalty was excommunication, and this in the latter half of the second century was perpetual. Later on it was limited to a period longer or shorter according to the nature of the offense. In the East the penitents were divided into four class. The Προσκλαίοντες, *flentes*, or weepers, remained outside the church during divine service and implored the prayers of the faithful. The Ἀκροώμενοι, *audientes*, or hearers, entered the church but remained behind the catechumens, and like them left when the more solemn part of the service began. The Ὑποπίπτοντες, *substrati*, were dismissed after the bishop's blessing, which they received kneeling or prostrate. The Συστάντες, *consistentes*, were present during the whole service, but did not communicate. This classification was not in vogue in the West, where penitents were treated in the same way as catechumens, but were obliged to wear a peculiar dress, to abstain from all luxuries, and to practice various austerities. The nature of the penance and its duration were decided by the bishop, who also presided at the public reconciliation.

In the East this discipline disappeared along with public confession at the close of the fourth century. The Western Church relaxed its discipline gradually from the seventh century until the thirteenth or fourteenth. As a substitute for public penance fasts, almsdeeds, and pilgrimages were enjoined. The crusades, especially, served to relax the penitential rigor. In the sixteenth century efforts were made to restore the ancient practice, but these had neither a widespread nor a lasting success. At the present day, though excommunication is the penalty for certain crimes, the performance of public penance is rare.

Literature.—Bingham's *Christian Antiquities*, bk. xvii. f. (Oxford, 1855); Pelliccia, *De Christianæ Ecclesiæ Politia* (Cologne, 1829); Probst, *Sakramente und Sakramentalien* (Tübingen, 1872). J. J. Keane.

Penang': an island in the Strait of Malacca, forming a part of the Straits Settlements, a crown colony of Great Britain. Area, 107 sq. miles. The ground is high and mountainous, but the soil is very fertile, and eminently well adapted to the cultivation of pepper, cloves, nutmegs, and other spices, which are largely exported. Sugar, coffee, indigo, and cotton are also raised, and tin is one of the chief exports. Province Wellesley, a narrow, very fertile coast strip on the mainland opposite the island is a part of Penang Settlement. The chief town is George Town, with a good harbor and considerable trade. Revised by C. C. Adams.

Pena'tes [= Lat.; cf. *pe'nus*, store, closet, *pe'nitus*, inwardly, prepos. *penes*, with]: in Roman mythology, the gods of the household, originally the guardians of the storeroom, i. e. those who care for the daily bread of the family. They were gods of the hearth, and were worshiped by offerings of food and drink at the daily meals in a manner similar to the worship of the Lares (*q. v.*). The designation Penates is often used in a loose way, and may include, as Servius says, all gods who are worshiped in the home. Their name was to the Roman synonymous with home; they were the gods of his fathers and of his race, and, in short, formed the point about which religious conceptions concerning the family centered. The community, as being but an extension of the family, had also its Penates, associated with the cult of Vesta, by whose priests, the Vestal virgins, they were worshiped in much the same manner as the Penates of the household. G. L. Hendrickson.

Pencil [from O. Fr. *pincel* > Fr. *pinceau*, painter's pencil, brush (with *i* on analogy of *pingere*, paint) < Lat. *penicil'lus*, collateral form of *peni'culus*, brush, painter's brush, liter., dimin. of *pe'nis*, tail]: an instrument for painting, drawing, or writing. The oldest pictures were no doubt produced simply by lumps of colored earth or chalk cut in forms convenient for holding in the hand; but in the fourth century B. C. Greek artists began to use wet colors, which were laid on with fine hair brushes. For such brushes or pencils the hairs of camels, badgers, sables, minks, kolinskis, fitches, goats, and the bristles of hogs are used. They are tied up in bundles terminating in a perfectly smooth cone, well pointed, and either drawn through goose-quills or fastened in metallic holders provided with wooden handles. The manufacture of such a pencil, especially of the finest kinds used by artists, requires great skill and care.

Ancient writers mention the use of lead for ruling on papyrus, as well as documents ruled with graphite, and probably fragments of different colored minerals were used previous to all historic mention. Even as late as the nineteenth century pencils made of soft lead hammered into convenient forms were used and known as "plummets." Now graphite, sometimes called plumbago or blacklead, mixed with a soft gritless clay, has superseded all other materials.

Graphite is one of the three principal forms of carbon, and is obtained in innumerable localities. (See Graphite.) In the sixteenth century a mine of very pure graphite was discovered in Cumberland, England, and became famous as the Borrowdale mine. The graphite was so soft and pure that it was readily sawed into thin strips which were glued into slabs of wood, properly grooved, and then sawed into pencils. After the exhaustion of the Borrowdale mine powdered graphite mixed with clay was used. This method was the invention of the Comte de Paris. The mixture of graphite and clay while in the soft state was placed in grooved wood, and, after hardening, a thin veneer of wood was glued on and the slabs sawed into pencil form.

The present practice is briefly as follows: Powdered graphite freed from all grit and impurities is mixed with clay, the quantity of clay depending upon the degree of hardness required. The harder leads can be made in smaller diameter than the soft leads. The mass, made thoroughly homogeneous, is then spun through dies by pressure, and the leads cut into lengths desired. Afterward the leads are baked to make them strong, and then placed in grooved cedar slabs. The slabs are formed by machinery into pencils and finished into various styles. Red, blue, and other colored leads are made of colored pigments and wax. They can not be subjected to the toughening process of baking on account of the nature of the materials, but in other respects the method of manufacture is the same.

Lead-pencils are manufactured in France, Bavaria, Austria, and the U. S. The wood used is obtained chiefly from the forests of Bohemia and Florida. George E. Long.

Pendentive: a piece of masonry which supports a cupola or dome, and rests in its turn on arches below. Each pendentive is somewhat triangular in shape, for it is bounded on each side by the curving extrados of an arch, and at top by the lowest ring of the cupola. Pendentives may be either parts of a larger cupola which is penetrated by the great arches, or may be composed of small arches built across from one great arch to another, or of a system of corbels. R. S.

Pendleton: city (laid out in 1869, named after George H. Pendleton); capital of Umatilla co., Ore. (for location, see map of Oregon, ref. 1–H); on the Umatilla river, and the Union Pac. and the Wash. and Col. River railways; 231 miles E. of Portland. The limits of the city were enlarged in 1884 under a special act of Congress by the addition of 640 acres of the Umatilla Indian reservation. The city is on both sides of the river, which is here spanned by three bridges and affords good power for manufacturing. A levee nearly 2 miles long has been constructed on the south bank of the river at a cost of $40,000. Pendleton has a court-house, built in 1889 at a cost of $90,000, a graded public-school building built in 1886 at a cost of $20,000, St. Joseph's Academy (Roman Catholic), Pendleton Academy, 7 churches, 2 national banks, a savings-bank, 4 hotels, electric-light plant, flour-mills, machine-shops, and other manufactories, and 2 daily and 2 weekly newspapers. Pop. (1880) 730; (1890) 2,506; (1900) 4,406. Editor of "East Oregonian."

Pendleton, Edmund: statesman; b. in Caroline co., Va., Sept. 9, 1721; became a lawyer when twenty-one years old;

was one of the leaders of the Virginia Legislature, and often its Speaker; as a conservative he was the politieal antagonist of Patrick Henry; was in the first Continental Congress 1774–75; drew up the resolutions by which Virginia instructed her delegates to propose the Declaration of Independence; though maimed for life by an accident in 1777, he continued to take an important part in public affairs, and afterward presided over the courts of chancery and of appeals, and over the convention of 1788, by which Virginia indorsed the U. S. Constitution. He was distinguished as a debater. D. at Richmond, Va., Oct. 23, 1803.

Pendleton, William Kimbrough, LL. D.: edueator; b. in Louisa co., Va., Sept. 8, 1817; educated in the University of Virginia, where he graduated from the law school and was admitted to the bar. In 1841 he married a daughter of Alexander Campbell, and, moving to Bethany, took part in the founding of Bethany College, in whieh institution he was professor until Mr. Campbell's death, when he succeeded him as president. He was a member of the West Virginia constitutional eonvention, and was four years State superintendent of public sehools. J. H. Garrison.

Pendleton, William Nelson: soldier; b. in Richmond, Va., Dec. 26, 1809; graduated at West Point in 1830; promoted brevet second lieutenant of artillery, served a year in the Augusta arsenal and as Assistant Professor of Mathematics at West Point 1831–32. Resigned Oct. 31, 1833, and became Professor of Mathematics at Bristol College, Pennsylvania, and subsequently at Delaware College, Delaware. Having been ordained a minister in the Episeopal Church in 1837, he became rector of the Episcopal dioeesan school of Virginia, in Alexandria, in 1839. At the outbreak of the war he returned to his former military occupation, and was chief of artillery in the army of Northern Virginia. He was with Gen. Lee's command when the latter surrendered in 1865. After the war he was made rector of Grace Memorial Protestant Episcopal church in Lexington, Va., where he died Jan. 17, 1883. He was author of *Science a Witness for the Bible* (London, 1860). Revised by James Mercur.

Pendulum [Mod. Lat., liter., neut. of Lat. *pen'dulus*, hanging, swinging, deriv. of *pen'dere*, hang]: a suspended body oscillating under the action of gravity. In order to investigate the laws of its motions we abstract from its material qualities, and consider a heavy point suspended by a right line without weight from a fixed point, about which it is free to move. This is ealled a *simple pendulum*; by an *oscillation* is meant its motion from one extreme of the arc to the other extreme on the opposite side of the vertieal. When the are of vibration is small, the following relation is found to obtain between the length l of the pendulum and the time t of one vibration, viz., $t^2 = \frac{\pi^2}{g} l$, g denoting the foree of gravity, or *the squares of the times are proportional to the lengths*. Henee a pendulum making one oscillation in two seconds must have four times the length of one that oscillates once in one second of time. By g is meant the veloeity aequired in one second by a heavy particle falling from rest by the aetion of the earth's gravity, the space fallen through being $= \frac{1}{2}g$. Henee we see also by putting $t = 1$ in the above equation, that $g = \pi^2 l$, or that the velocity aequired in one second is $\pi^2 \times$ the length of a simple seconds pendulum. That length having been found to be, at New York, 39·10 inches, it follows that $g = 32{\cdot}16$ feet at that place. This is the most accurate way of measuring the force of gravity at any plaee.

It thus appears that the time of vibration is independent of the length of the arc, so long as the arc is very small—an important property in the applieation of the pendulum to the regulation of time-keepers which was first made use of for that purpose by Huyghens. (See Clocks.) When a simple pendulum, being at the extremity of its arc of vibration, receives an impulse at right angles to the plane of its vibration, the heavy point will describe a curved path about the vertical, and it is then ealled a *conical pendulum*. Its path will be eireular, with a certain impulse; a greater or less impulse will cause it to deseribe elliptic arcs. This property is made use of in regulators for steam-engines and other machinery.

When instead of a simple pendulum we have a material or *compound pendulum*—consisting, for instanee, of a rod with a disk or ball attaehed to its lower extremity—the same laws ean be applied by eoneeiving the whole mass of the pendulum united in one point, called the *center of oscillation*, whose distance from the line of suspension is equal to the length of a simple pendulum vibrating in the same time as the given eompound pendulum. When the line of suspension has a considerable length, and bears a very small proportion to the suspended mass, the center of oscillation is very near the center of gravity of the latter.

When we desire to ascertain the absolute length of a seconds pendulum, it becomes necessary to measure the distance between its point of suspension and its center of oscillation. Aecurate experiments to this end were first made in 1790 at Paris by Borda, who employed a spherical platinum ball suspended by fine wire 12 feet in length, and found, after applying all due corrections, 3 feet 8·5593 lines (old French measure). The method devised by Huyghens and first employed by Kater is, however, that which affords the simplest means of ascertaining the length of an equivalent simple pendulum. It consists in using a *reversible* pendulum; that is, a rod with opposite knife-edges near either end, and so weighted with two *unequal* weights that the time of vibration is the same whiehever of the two knife-edges the pendulum is suspended from. In sueh case each knife-edge is in the center of oscillation of the other, and the time of vibration is therefore the same as that of a simple pendulum whose length is equal to the distance between the two. When the times of vibration are not exaetly, but very nearly, equal, the requisite reduction can be dedueed from the relative distances of the two knife-edges from the eenter of gravity. By having the two weights of equal size, one of them being hollow and plaeed at equal distanees from the nearest knife-edge, the resistances and other variable circumstances affect the vibrations alike in both positions of the pendulum. Such is the form of the reversible pendulum used by Plantamour in Switzerland, which has also been adopted by the European Geodesic Assoeiation. The times of oscillation are observed by means of a telescope, and are compared by the eleetrochronographic method with a standard cloek regulated by astronomieal observations. The knife-edges rest on agate planes supported by a firm frame, and about 3,000 consecutive oscillations are observed in each of the four positions in which the pendulum ean be suspended. From the combination of a great number of observations at various latitudes, Helmert found that, at a place in latitude B, the length of a seconds pendulum in meters is $0{\cdot}990918\ (1 + 0{\cdot}00531 \sin^2 B)$. Revised by S. Newcomb.

Penel'ope [in Gr. Πηνελόπη]: in the Greek legend, the daughter of Iearius, the wife of Odysseus (Ulysses), and the mother of Telemachus. When Odysseus was in Sparta as one of the suitors of Helen, he fell in love with Penelope, Helen's first cousin. In return for Odysseus's advice with regard to the suitors of Helen, Tyndareos agreed to prevail upon his brother Iearius to give Penelope in marriage to Odysseus. While Odysseus was absent at Troy Penelope was beset by numerous and eager suitors, whom she put off by declaring that she must first finish weaving the shroud of Laërtes. Aecordingly, she wove by day and unwove by night, and thus prolonged the work. Detected in her noble deceit, she was hard pressed by the villains, but was relieved by her husband's return after an absence of twenty years.

Penelop'idæ [Mod. Lat., named from *Penelope*, the typical genus, from Gr. Πηνελόπη, wife of Odysseus]: a family of gallinaceous birds (also ealled *Cracidæ*), including the eurassows and guans of South America. The bill is moderate; the wings moderate and round; tail elongated and broad; tarsi robust, with the toes three before, eonnected together by a basal web, and a long hinder one on the same plane as the front ones. The sternum has its lateral elements (*Metostea*) united by a broad margin with the central part (*Lophosteon*). The species are "strictly confined to the forests of the New World, and extend from the Rio Grande of Texas on the N. to the wooded region of Paraguay on the S. They do not oeeur in the Antilles, with the exception of Trinidad and Tobago, and on the western side of the Andes do not pass southward of the Gulf of Guayaquil." See also Curassow and Guan. Revised by F. A. Lucas.

Peneplain: See Physiography.

Penfield, Samuel Lewis: See the Appendix.

Penfield, Smith N.: See the Appendix.

Penguin [said to be a corruption of pinwing]: a name originally applied to the great auk (*Alca impennis*) from the fact that it was as flightless as if pinwinged or pinioned, i. e. had its wings locked over its baek. At an early date the name was transferred to the flightless birds of the southern seas, and is now used as a popular name for any

member of the family *Spheniscidæ*, a group of birds peculiar to the southern hemisphere, incapable of flight, and having the wings modified as swimming paddles. The body and wings are evenly covered with short, scale-like feathers, the feet are stout and but little used in swimming. These birds sit erect, resting on their tarsi, and in this attitude walk, or rather waddle, although when hurried they frequently lie flat and scramble with feet and wings. They are wonderful swimmers, and some species progress at times by a series of leaps much like those of a porpoise. There are about a dozen species, ranging in size from the great king penguin (*Aptenodytes forsteri*), which is over 3 feet in length, to the little *Eudyptila minor*, which is about half that length.

King penguin.

Penguins feed on fishes, shellfish, and small crustaceans. They dwell in communities, and the females, according to the species, lay one or two white eggs in a burrow, or in a slight depression of the ground. Most of them inhabit the colder regions of the southern hemisphere, and species have been found in the Antarctic seas as far S. as vessels have penetrated. The Falkland islands appear to be their center of distribution, half the known species occurring there.

The upper part of the plumage in nearly all species is dark bluish, or bluish gray, lower parts white. The king penguin has a band of yellow under the neck, and the members of the genus *Eudyptes* are decorated with a tuft of flowing yellow feathers on either side of the head.

F. A. Lucas.

Penikese Island: See Elizabeth Islands.

Peninsular War: See Spain (*History*), and Wellington, Arthur Wellesley, Duke of.

Penitentiaries: See Prisons.

Penn, William: founder and first legislator of the State of Pennsylvania; b. in London, Oct. 14, 1644. He was a son of Admiral Sir William Penn, and received a very careful education. He studied at Christ Church, Oxford, but having met here with Thomas Loe, he was converted to Quakerism, and shortly after expelled from the university. His father sent him on travels in Holland and France, and on his return in 1666 he was ordered to manage the estates of the family in the county of Cork, Ireland. He fulfilled this task with great success, but in Cork he met for the second time with Thomas Loe. He was imprisoned for attending a Quaker meeting, and although he was very soon liberated he had to leave Ireland. On his return to London he began to preach and work in different ways for the society to which he belonged, and after the publication of *The Sandy Foundation Shaken* (in 1668) he was thrown into the Tower. Here he wrote *No Cross, no Crown*, and *Innocency with her Open Face*, but by the interference of the Duke of York he soon obtained his freedom. The good relations between father and son were several times disturbed on account of the religious views of the latter, but after every rupture a reconciliation soon followed; and when the admiral died (in 1670) he left his estates and all his property to his son. Penn continued to preach and work for what he considered to be the highest truth, and in 1671 he was once more thrown into prison. As he would not take an oath at his trial, he was sent to Newgate for six months, and while here he wrote the celebrated defense for toleration, *The Great Cause of Liberty of Conscience*. Having been liberated, he made a tour to Holland and Germany, and on his return in 1672 he married Gulielma Maria Springett. From his father he had inherited a claim on the Government for £16,000. In settlement of this claim the Government granted him large territories in North America, the present State of Pennsylvania, with right to found a colony or society with such laws and institutions as expressed his views and principles. In 1682 he went over to America. A great number of settlers, not only Quakers, but members of all denominations, Englishmen, Swedes, and Germans, gathered together; a charter of liberties was issued, and a democratic government instituted; the city of Philadelphia was planned, and the colony soon came into a most flourishing condition. Penn returned to England toward the close of the reign of Charles II., intent on bettering the social position of the Quakers in that kingdom, in which plan he partly succeeded. During the reign of James II. his connection with the court became very intimate—so much so that he was suspected of being implicated in certain disgraceful measures of the king. After the overthrow of James he was twice accused of entertaining treasonable communications with the exiled king, and an order of council (Mar. 14, 1692) deprived him of his title to the Pennsylvania government. After a most searching trial he was fully acquitted in 1693, and another order of council restored his title to him in 1694. After the death in 1693 of his first wife, he married (in 1695) Hannah Callowhill, and went in 1699, for the second time, to Pennsylvania (Philadelphia), where he stayed till 1701. His return to England was chiefly caused by the deranged state of his affairs there. The mismanagement and villainy of his agent had brought him to the verge of bankruptcy. He was even thrown into the Fleet for some time in 1708. These vexations affected his health; in 1712 he was struck with apoplexy, and although he recovered, his mental faculties were greatly impaired after that time. D. at Ruscombe in Berkshire, July 30, 1718. His contemporaries, even such as were not his friends, testify to the correctness and justice of his character, and although he was savagely attacked by Macaulay in the *History of England*—the charges being modified, but not withdrawn in later editions—Penn's vindication at the hands of Paget (*Paradoxes and Puzzles*, Edinburgh, 1874) and W. E. Forster (*Reply to Macaulay*, reprinted in Philadelphia, 1850) has been recognized as completely successful. For Penn's own life, see biographies by S. M. Janney (Philadelphia, often reprinted) and J. Stoughton (London, 1882). A less ambitious but entertaining work is Maria Webb's *The Penns and Peningtons* (London, 1867). For Penn's part in the founding of Pennsylvania, see Winsor's *Narrative and Critical History of America*, iii., 469 ff. Penn was a voluminous writer; for a list of his works, see Joseph Smith, *Descriptive Catalogue of Friends' Books* (2 vols., London, 1867). Revised by F. B. Gummere.

Pennacook Indians: See Algonquian Indians.

Pennant: See Flag.

Pennant, Thomas, LL. D., F. R. S.: zoölogist and archæologist; b. at Downing, Flintshire, Wales, June 14, 1726; studied at Queen's and Oriel Colleges, Oxford, but did not take a degree; produced a large number of folio and quarto volumes containing his travels in various parts of the British islands, which possess few graces of style and little scientific accuracy, but have preserved from oblivion some valuable facts. D. at Downing, Dec. 16, 1798. Among the more important of his works are *British Zoölogy* (4 vols., 1765–77); *History of Quadrupeds* (2 vols., 1771); *Tours in Scotland* (3 vols., 1771–75); *Tours in Wales* (2 vols., 1778–81; new ed. 3 vols., 1883); *Arctic Zoölogy* (3 vols., 1784–87); *Antiquarian and Historical Account of London* (1790), of which many editions have been published, and his autobiography, *The Literary Life of the Late Thomas Pennant, Esq.* (1793).

Penn College: See the Appendix.

Pennsylvania: one of the U. S. of North America (North Atlantic group); the second of the original thirteen States that ratified the Federal Constitution; popularly known as the Keystone State.

Location and Area.—It lies between lat. 39° 43′ and 42° 15′ N., and lon. 74° 43′ 36″ and 80° 31′ 36″ W.; is bounded on the N. by Lake Erie and the State of New York, on the E. by Chautauqua and Delaware cos., N. Y., and the Delaware river, on the S. by Delaware, Maryland, and West Virginia, on the W. by West Virginia, Ohio, and Lake Erie; extreme length from E. to W., 302·34 miles; extreme breadth from N. to S., 175·6 miles; area, 45,215 sq. miles (28,937,600 acres), of which 230 sq. miles are water surface; capital,

Harrisburg. According to the census of 1900 the State ranked second in population. In 1890 it was first in mineral production and second in manufactures.

Physical Features.—The surface falls into three divisions—viz.: (1) The southeastern section or district extending from Delaware river to the Blue or Kittatinny Mountains; near the river a narrow plain of level land, but a few miles inland a rolling or undulating tract with gently rounded hills. This region, while containing much mineral wealth, is admirably adapted for the growth of cereals. (2) The mountain district adjoining this, which crosses the State in a belt varying in width from 75 to 160 miles, and trending from N. E. to S. W. All the mountain chains which go to make up the Appalachian system are here in their full breadth, though not attaining a great altitude. The mountains of the Appalachian system in the State, aside from their general division in two great ranges, the Blue or Kittatinny and the Alleghany range, are subdivided into a host of minor chains, intersected by numerous valleys, broad and fertile, with the precipitous east face of the Alleghany range overhanging them. (3) The western tableland, which occupies about half the area of the State, is a broad, rolling plateau, with occasional ranges of hills, but sloping N. and W. toward New York, Lake Erie, and Ohio river. It extends from the summits of the Alleghanies W. to the northwestern and western boundaries of the State. The northwestern portion has several isolated summits. It is the region of pine and hemlock lands, and furnishes vast amounts of lumber to Eastern markets.

Rivers.—There are six distinct water-basins, which, with their tributaries, drain the entire State—viz.: the Delaware and its affluents, the Susquehanna and its tributaries, the Genesee, the Potomac, Lake Erie, and the Ohio with its large and numerous affluents. The Ohio is formed by the union of two large rivers, the Alleghany and Monongahela, at Pittsburg. Both have numerous tributaries. The Monongahela receives the Youghiogheny and several smaller streams. Aside from Lake Erie there are no lakes of importance. There are several islands in the Delaware, and two or three in Lake Erie, belonging to Pennsylvania.

Obverse. Reverse.

Seal of Pennsylvania.

Soil and Productions.—The soil of the valleys and plains is generally fertile, and some of it very rich, yielding large crops for a succession of years. There is a large area in forests. The trees include several species of pine, hemlock, spruce, fir, and cedar, as well as some other coniferous trees: six or seven species of oak and four of hickory, the black walnut and butternut, three or four species of maple, the chestnut, chinquapin, beech, buckeye, linden, tulip-tree, dogwood, hornbeam, birch, ash, willow, elm, aspen, sycamore, American poplar, mulberry, persimmon, gum, sassafras, locust, wild cherry, papaw, catalpa, magnolia, crab-apple, etc. The flora is varied. The number of wild animals is quite large—bears, panthers, wildcats, lynxes, wolves, otters, the red and the gray fox, the raccoon, marten, mink, weasel, skunk, opossum, musk-rat, porcupine, woodchuck or groundhog, and occasionally the beaver; the flying, red, striped, and gray squirrel, the hare or rabbit, and among the larger game the Virginian deer, and rarely the elk. Birds are numerous—of prey, the bald and the golden eagle, the turkey-buzzard, fish and other varieties of hawk, owls, the whippoorwill, the night-hawk, the swallow, etc.; these and the reptiles are the same as those of New York and New Jersey.

The following summary from the census reports of 1880 and 1890 shows the extent of farm operations in the State:

FARMS, ETC.	1880.	1890.	Per cent.*
Total number of farms	213,542	211,557	0·9
Total acreage of farms	19,791,341	18,364,370	7·2
Total value of farms, including buildings and fences	$975,689,410	$922,240,233	5·5

* Decrease.

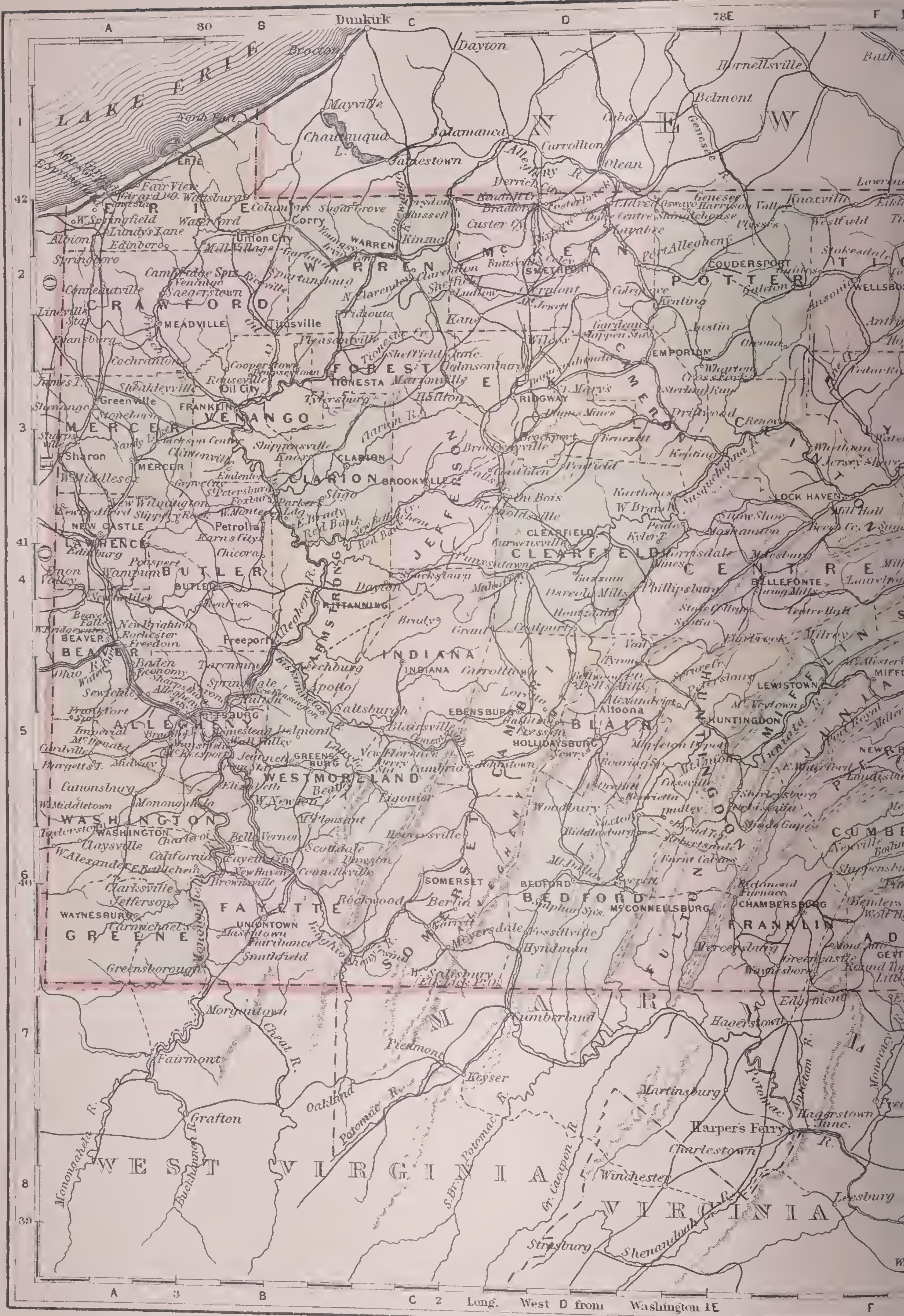
The following table shows the acreage, yield, and value of the principal crops in the calendar year 1900:

CROPS.	Acreage.	Yield.	Value.
Corn	1,308,316	32,707,900 bush.	$14,718,555
Wheat	1,502,321	20,281,334 "	14,602,560
Oats	1,221,893	38,000,872 "	11,400,262
Rye	288,647	4,416,299 "	2,340,638
Barley	7,793	148,067 "	74,034
Buckwheat	227,743	3,188,402 "	1,753,621
Tobacco (1896)	13,884	16,244,280 lb.	1,299,542
Potatoes	188,306	10,921,748 bush.	5,788,526
Hay	2,429,601	2,672,561 tons	37,148,598
Totals	7,178,504	.....	$89,126,336

On Jan. 1, 1900, the farm animals comprised 559,722 horses, value $33,243,571; 37,794 mules, value $2,878,355; 970,473 milch cows, value $32,171,180; 523,653 oxen and other cattle, value $14,314,840; 814,322 sheep, value $2,928,302; and about 1,000,000 swine, value $8,000,000—total head, 3,905,964; total value, $93,536,248.

Minerals.—Gold, silver, copper, tin, and sulphur in a native state have been discovered in Pennsylvania, but none of them in quantities to make their working profitable. Iron does not exist in a native state, but the iron ores embrace every known ore and many not found elsewhere. The most valuable mineral, economically, is coal, bituminous and anthracite. Of bituminous, the production in 1899 was 74,150,175 short tons, valued at $56,247,791. Of the total product, 53,671,963 tons were loaded at the mines for shipment, 1,525,772 tons were sold in local trade and used by employees, 972,692 tons were used at the mines for steam and heat, and 17,979,748 tons were made into coke. The production of anthracite was 53,944,647 short tons, valued at $88,142,130, of which 47,823,241 tons were loaded at the mines for shipment, 1,144,609 tons were sold in local trade and used by employees, and 4,976,797 tons were used at the mines for steam and heat. The total production of both kinds was 128,094,822 short tons, valued at $144,389,921. The State produced 14,743,214 bbls. of petroleum, valued at $13,608,002, ranking second to Ohio. In the production of iron ores the State ranked fourth in 1899 with 38,331 long tons of red hematite, 152,468 tons of brown hematite, 815,771 tons of magnetite, and 2,757 tons of carbonate—total product, 1,009,327 long tons, valued at $1,991,772. In 1883 natural gas began to be used extensively for fuel, and the value of the amount so consumed reached its highest point in 1888 ($19,282,375). The value of the consumption steadily decreased till 1896, since when it has shown a slight increase, being in 1899 $8,337,210. The consumption in Pennsylvania alone in 1888 was about equal to the entire consumption in the U. S. in 1899. The productions of the quarrying industries in 1899 were valued as follows: Granite, $385,101 ($237,780 in 1898); slate, $2,537,022 ($2,491,756 in 1898); marble, $139,506 ($39,373 in 1898); sandstone, $717,053 ($478,451 in 1898); limestone, $3,088,583 ($2,746,256 in 1898); cement, $4,546,322 ($3,392,689 in 1898); and metallic paint, 18,680 short tons, value $212,734 (16,232 tons, value $220,637 in 1898). There are numerous mineral springs, some of them of great medicinal value. The bottled product in 1899 was valued at $340,254. Of the minerals possessing only scientific value the number is very great, embracing almost every mineral of note in the largest catalogues.

Climate.—There are considerable differences in the climate of different portions of the State. The mean annual



LAKE ERIE
Dunkirk
Dayton
Brocton
Mayville
Chautauqua L.
Jamestown
Salamanca
Carrollton
Olean
Cuba
Belmont
Hornellsville
Bath
ERIE
Corry
WARREN
CRAWFORD
MEADVILLE
Titusville
FOREST
TIONESTA
Oil City
FRANKLIN
VENANGO
MERCER
Sharon
Greenville
CLARION
BROOKVILLE
NEW CASTLE
LAWRENCE
BUTLER
Petrolia
BEAVER
ALLEGHENY
WASHINGTON
WAYNESBURG
GREENE
FAYETTE
UNIONTOWN
WESTMORELAND
Ligonier
INDIANA
ARMSTRONG
KITTANNING
JEFFERSON
CLEARFIELD
ELK
RIDGWAY
McKEAN
SMETHPORT
Bradford
POTTER
COUDERSPORT
EMPORIUM
CAMERON
CENTRE
BELLEFONTE
LOCK HAVEN
WELLSBORO
MIFFLIN
LEWISTOWN
HUNTINGDON
BLAIR
Altoona
HOLLIDAYSBURG
EBENSBURG
Johnstown
SOMERSET
BEDFORD
McCONNELLSBURG
FULTON
FRANKLIN
CHAMBERSBURG
CUMBERLAND
Cumberland
Hagerstown
Morgantown
Fairmont
Grafton
Keyser
Piedmont
Oakland
Martinsburg
Harper's Ferry
Charlestown
Winchester
Leesburg
Strasburg
WEST VIRGINIA
VIRGINIA
Potomac R.
Shenandoah R.
Monongahela R.
Cheat R.
Allegheny R.
Long. West from Washington


PENNSYLVANIA
Scale of Miles
W. 77 from G Greenwich
Long. 1 East
Ithaca
Watkins
Elmira
Owego
Binghamton
Deposit
Hancock
Callicoon
Monticello
Poughkeepsie
Newburgh
HUDSON R.
SUSQUEHANNA
MONTROSE
BRADFORD
TOWANDA
SULLIVAN
LAPORTE
WYOMING
TUNKHANNOCK
LACKAWANNA
SCRANTON
HONESDALE
WAYNE
PIKE
MILFORD
Port Jervis
Goshen
WILKESBARRE
LUZERNE
WILLIAMSPORT
MONTOUR
COLUMBIA
BLOOMSBURG
DANVILLE
LEWISBURG
SUNBURY
MONROE
STROUDSBURG
CARBON
MAUCH CHUNK
Newton
Franklin
Paterson
Dover
Morristown
Hackensack
NEWARK
Orange
Elizabeth
Plainfield
Rahway
NEW YORK
BROOKLYN
SCHUYLKILL
POTTSVILLE
NORTHAMPTON
EASTON
ALLENTOWN
LEHIGH
BUCKS
DOYLESTOWN
Somerville
Flemington
New Brunswick
Princeton
TRENTON
Long Branch
Freehold
BERKS
READING
LEBANON
HARRISBURG
DAUPHIN
MONTGOMERY
NORRISTOWN
POTTSTOWN
LANCASTER
YORK
CHESTER
WESTCHESTER
MEDIA
PHILADELPHIA
Camden
Woodbury
Mt. Holly
Toms River
Wilmington
Pennsgrove
New Castle
Salem
Elkton
Delaware City
Havre de Grace
Bel Air
Westminster
Towson
BALTIMORE
Ellicott City
ANNAPOLIS
Vineland
Bridgeton
Tuckerton
Atlantic City
Ocean City
Somers Pt.
Port Norris
Sea Isle City
Cape May
DOVER
Chestertown
Centreville
Queenstown
Denton
Clayton
DELAWARE
ATLANTIC OCEAN

temperature, which is 52° in the southeastern counties, decreases to 48° in the central counties and 44° in the north and northwest. The amount of rainfall is usually greatest in the southeast and decreases north and west.

Divisions.—For administrative purposes Pennsylvania is divided into sixty-seven counties, as follows:

COUNTIES AND COUNTY TOWNS, WITH POPULATION.

COUNTIES.	* Ref.	Pop. 1890.	Pop. 1900.	COUNTY-TOWNS.	Pop. 1900.
Adams	6-F	33,486	34,496	Gettysburg	3,495
Allegheny	5-B	551,959	775,058	Pittsburg	321,616
Armstrong	4-B	46,747	52,551	Kittanning	3,902
Beaver	4-A	50,077	56,432	Beaver	2,348
Bedford	6-D	38,644	39,468	Bedford	2,167
Berks	5-I	137,327	159,615	Reading	78,961
Blair	5-D	70,866	85,099	Hollidaysburg	2,998
Bradford	2-G	59,233	59,403	Towanda	4,663
Bucks	5-J	70,615	71,190	Doylestown	3,034
Butler	4-D	55,338	56,962	Butler	10,853
Cambria	5-D	66,375	104,837	Ebensburg	1,574
Cameron	3-D	7,238	7,048	Emporium	2,463
Carbon	4-I	38,624	44,510	Mauch Chunk	4,029
Centre	4-E	43,269	42,894	Bellefonte	4,216
Chester	6-I	89,377	95,095	Westchester	9,524
Clarion	3-C	36,802	34,283	Clarion	2,004
Clearfield	4-D	69,565	80,614	Clearfield	5,081
Clinton	3-E	28,685	29,197	Lock Haven	7,210
Columbia	4-H	36,832	39,896	Bloomsburg	6,170
Crawford	2-A	65,324	63,643	Meadville	10,291
Cumberland	6-F	47,271	50,344	Carlisle	9,626
Dauphin	5-G	96,977	114,443	Harrisburg	50,167
Delaware	6-J	74,683	94,762	Media	3,075
Elk	3-D	22,239	32,903	Ridgway	3,515
Erie	1-A	86,074	98,473	Erie	52,733
Fayette	6-B	80,006	110,412	Uniontown	7,344
Forest	3-C	8,482	11,039	Tionesta	815
Franklin	6-E	51,433	54,902	Chambersburg	8,864
Fulton	6-E	10,137	9,924	McConnellsburg	576
Greene	6-A	28,935	28,281	Waynesburg	2,544
Huntingdon	5-E	35,751	34,650	Huntingdon	6,053
Indiana	5-C	42,175	42,556	Indiana	4,142
Jefferson	3-C	44,005	59,113	Brookville	2,472
Juniata	5-F	16,655	16,054	Mifflintown	953
Lackawanna	3-I	142,088	193,831	Scranton	102,026
Lancaster	6-H	149,095	159,241	Lancaster	41,459
Lawrence	4-A	37,517	57,042	New Castle	28,339
Lebanon	5-H	48,131	53,827	Lebanon	17,628
Lehigh	5-I	76,631	93,893	Allentown	35,416
Luzerne	3-H	201,203	257,121	Wilkesbarre	51,721
Lycoming	3-F	70,579	75,663	Williamsport	28,757
McKean	2-D	46,863	51,343	Smethport	1,704
Mercer	3-A	55,744	57,387	Mercer	1,804
Mifflin	5-E	19,996	23,160	Lewistown	4,451
Monroe	4-I	20,111	21,161	Stroudsburg	3,450
Montgomery	6-I	123,290	138,995	Norristown	22,265
Montour	4-G	15,645	15,526	Danville	8,042
Northampton	4-J	84,220	99,687	Easton	25,238
Northumberland	4-G	74,698	90,911	Sunbury	9,810
Perry	5-F	26,276	26,263	New Bloomfield	772
Philadelphia	6-J	1,046,964	1,293,697	Philadelphia	1,293,697
Pike	3-J	9,412	8,766	Milford	884
Potter	2-E	22,778	30,621	Coudersport	3,217
Schuylkill	5-H	154,163	172,927	Pottsville	15,710
Snyder	4-F	17,651	17,304	Middleburg	513
Somerset	6-C	37,317	49,461	Somerset	1,834
Sullivan	3-G	11,620	12,134	Laporte	442
Susquehanna	2-H	40,093	40,043	Montrose	1,827
Tioga	2-F	52,313	49,086	Wellsboro	2,954
Union	4-F	17,820	17,592	Lewisburg	3,457
Venango	3-B	46,640	49,648	Franklin	7,317
Warren	2-C	37,585	38,946	Warren	8,043
Washington	5-A	71,155	92,181	Washington	7,670
Wayne	2-J	31,010	30,171	Honesdale	2,864
Westmoreland	5-B	112,819	160,175	Greensburg	6,508
Wyoming	2-H	15,891	17,152	Tunkhannock	1,305
York	6-G	99,489	116,413	York	33,708
Totals		5,258,014	6,302,115		

* Reference for location of counties, see map of Pennsylvania.

Principal Cities and Towns.—Philadelphia, 1,293,697; Pittsburg, 321,616; Alleghany, 129,896; Scranton, 102,026; Reading, 78,961; Erie, 52,733; Wilkesbarre, 51,721; Harrisburg, 50,167; Lancaster, 41,459; Altoona, 38,973; Johnstown, 35,936; Allentown, 35,416; McKeesport, 34,227; Chester, 33,988; York, 33,708; Williamsport, 28,757; Newcastle, 28,339; Easton, 25,238; Morristown, 22,265; Shenandoah, 20,321; Shamokin, 18,202; Lebanon, 17,628; Pottsville, 15,710; Braddock, 15,654; Bradford, 15,029.

Population and Races.—1860, 2,906,215; 1870, 3,521,951; 1880, 4,282,891; 1890, 5,258,014 (native, 4,412,294; foreign, 845,720; males, 2,666,331; females, 2,591,683; white, 5,148,257; colored, 109,757, of whom 107,596 were Negroes, 1,146 Chinese, 32 Japanese, and 983 civilized Indians).

Industries and Business Interests.—In 1890 the census returns showed that 39,336 manufacturing establishments reported. These had a combined capital of $990,999,375; investment in plants, $505,400,180, including value of machinery, tools, and implements, $258,427,613; persons employed, 620,484; paid for wages $40,788,793, for materials used $773,530,105, for miscellaneous expenses $74,833,862; and had products valued at $1,331,523,101. The principal industry reported was the manufacture of iron and steel, which had 417 establishments, employed 103,976 persons, paid $57,435,000 for wages and $180,803,312 for materials, and had products valued at $295,358,622. Other leading industries, with the value of their products, were: Machinery, $67,587,025; sugar and molasses, $46,599,754; lumber and its products, $46,171,522; clothing, $42,552,794; flour and grist mill products, $39,478,076; leather, $39,011,518; carpets, $22,886,416; and cotton goods, $18,431,773. No census report was issued on the ship-building industry. In 1893 the iron and steel industry had 199 furnaces, of which 109 were anthracite, 76 bituminous, and 14 charcoal; 221 rolling-mills; 90 steel-works, of which 20 were Bessemer, 2 Clapp-Griffiths, 1 Robert-Bessemer, 42 open-hearth, and 25 crucible; 25 tin-plate works; 10 forges and bloomeries; 1,392 cut-nail machines; and 9 wire-nail works. The production of pig-iron in 1899 aggregated 6,558,878 long tons; Bessemer-steel ingots, 3,968,779 tons; Bessemer-steel rails, 1,227,258 tons; open-hearth and other steel about 2,500,000 tons. There were 150 coking establishments, which had 27,591 ovens, burned 19,930,419 short tons of coal, and produced 13,577,870 short tons of coke, valued at $22,881,910.

Finance.—The revenue of the State is mostly derived from special taxes on corporations, including bank stock, foreign insurance companies, corporation stock, gross receipts, incomes, commutation of tonnage, licenses, etc., and in 1900 aggregated $17,494,211.78. The total public debt Dec. 1, 1900, was $6,815,299.02; sinking funds, $6,021,402.12—net debt, $783,896.90. The assessed valuation of real estate was $3,027,649,299; of this $299,485,963 is exempt. The total amount of taxes collected was $55,808,585.32.

Banking.—On Sept. 5, 1900, there were 469 national banks with capital of $76,206,321.41, surplus and profits of $66,534,160.85, and deposits of $380,756,230.37. On May 17 of the same year 95 State banks, capital $8,422,014, surplus and profits $8,390,120, and deposits $73,345,813; and 14 mutual savings-banks, surplus and profits $9,717,364, and $105,416,854 in savings deposits from 361,220 depositors. On June 30 the private banks numbered 28, capital $965,005, surplus and profits $304,301, and deposits $7,406,101; and there were 97 loan and trust companies, capital $39,809,778, surplus and profits $31,160,623, and deposits $160,259,761.

Building and Loan Associations.—The numerous building and loan associations have been an agency of immense value in enabling the people to provide themselves with homes. In June, 1894, the State bureau of statistics presented the following estimates for 1,239 such associations: Assets, $103,943,364; cash income, one year, $44,432,686.57; matured shares and withdrawals, one year, $12,933,970.56; average assets per association, $83,892.14; total expenses, one year, $381,636.78; salaries, one year, $328,636.78; total membership, 272,580; total borrowers, 81,658; and total shares, 1,651,814.

Post-offices and Periodicals.—On Jan. 1, 1901, there were 5,216 post-offices in the State, of which 322 were presidential (15 first-class, 88 second-class, 219 third-class) and 4,894 fourth-class, with 2,311 money-order offices, and 219 money-order stations. There were 1,393 newspapers and periodicals, of which 197 were daily, 6 tri-weekly, 35 semi-weekly, 908 weekly, 3 bi-weekly, 9 semi-monthly, 219 monthly, 8 bi-monthly, and 13 quarterly publications.

Means of Communication.—On June 30, 1892, there were in operation 9,022·87 miles of direct railway, with a total of 16,177·31 miles of track. The five companies (operating wholly or partly within the State) that showed the greatest earnings from freight traffic were the Pennsylvania, $47,619,280.40; Philadelphia and Reading, $26,792,121.20; New York, Lake Erie and Western, $24,895,983.96; Lake Shore and Michigan Southern, $14,884,871.53; and the Pittsburg, Cincinnati, Chicago and St. Louis, $10,950,876.38—making a total of $125,143,133.47. The five companies showing the greatest passenger earnings were the Pennsylvania, $19,636,075.77; Lake Shore and Michigan Southern, $7,421,844.48; Philadelphia and Reading, $5,866,711.24; New York, Lake Erie and Western, $6,530,134.27; and Philadelphia, Wilmington and Baltimore, $4,591,661.68. There are in the State 9 canal and navigation companies, with a capital of $58,114,258, and a funded and floating debt of $39,851,005.56. The cost of canals and fixtures was $30,125,578.21; gross receipts of the year, $2,803,953.82; expenses, $607,416. In

1899 there were 10,181·43 miles of railway, and the total earnings were $498,012,493; operating expenses, $428,837,899; and dividends, $37,823,306.

The number of street-railway companies reporting in 1892 was 221, with a capital of $45,462,262, and a funded and floating debt of $22,091,385. The cost of roads and equipment was $41,636,011; mileage of road, 819,015; cars in use, 3,050, horses and mules, 10,878; cars propelled by electricity, 660, by cable, 324: passengers carried, 260,655,224; total receipts, $14,629,704; expenses, $8,188,745; and value of real estate, $2,849,578. The number of telegraph and telephone companies was 23, with a capital of $99,578,652, and a funded and floating debt of $19,327,469. The cost of lines and equipments was $4,920,327; length of lines in Pennsylvania, 13,538·87 miles; receipts in Pennsylvania, $1,355,914; expenses in Pennsylvania, $424,143.

Churches.—The census of 1890 gave the following statistics of the religious bodies having a membership of 5,000 and upward in the State:

DENOMINATIONS.	Organizations.	Churches and halls.	Members.	Value of church property.
Roman Catholic	654	660	551,577	$10,068,770
Methodist Episcopal	2,042	2,041	222,886	12,642,104
Presb. in the U. S. of America	939	1,101	161,386	15,491,680
Lutheran, General Council	616	515	124,163	4,993,355
Reformed in the U. S.	754	624	122,944	5,121,328
Baptists, Regular	634	690	83,122	5,984,322
Lutheran, General Synod	596	562	78,938	3,672,650
Protestant Episcopal	369	446	54,720	10,854,131
Evangelical Association	662	660	42,379	1,590,605
United Presb. of N. A.	281	290	39,204	2,552,450
United Brethren in Christ	526	520	33,951	1,086,135
Dunkard, Conservative	101	251	14,194	354,008
Disciples of Christ	125	116	12,007	533,147
African Methodist Episcopal	87	117	11,613	605,000
Methodist Protestant	172	169	10,081	641,575
Mennonite	114	113	10,077	221,100
Friends, Hicksite	65	74	10,001	546,700
Congregational	108	108	9,818	672,588
Church of God	162	156	9,344	375,185
African Meth. Epis., Zion	62	62	8,689	256,150
Lutheran Synod. Conference	26	26	6,559	284,915
Cumberland Presb.	52	50	6,210	257,500
Jews, Reformed	18	18	5,582	552,500
Lutheran, Joint Syn. of Ohio, etc.	32	32	5,552	206,100
German Evan. Synod of N. A.	12	12	5,293	132,150

Schools.—In the year ending the first Monday of June, 1900, the whole number of teachers was 29,390—men, 9,394, women, 19,996; the total enrollment was 1,151,880, the total receipts for schools and buildings were $24,916,668.69, and the total expenditures were $21,476,994.90. The number of school districts in the State is 2,510; number of schools, 28,330; number of graded schools, 15,720; number of superintendents, 140; average salaries of male teachers per month, $44.25; of female, $37.74; average length of school term in months, 8·33; average number of pupils in daily attendance, 854,640; teachers' wages, $11,205,482.61; cost of school text-books, $806,148.30; cost of school supplies other than text-books, $422,696.87; fuel, contingencies, fees of collectors, and other expenses, $4,978,540.36. The State appropriation for the school year ending June 5, 1899, was $5,500,000, and the estimated value of school property was $54,797,506.32. There were 14 normal schools, maintained partly by the State and partly by fees. Text-books in all public schools are free. There are 34 colleges and universities, including 6 business colleges and 40 to 50 seminaries, academies, institutes, and other secondary schools. The State was a pioneer in providing soldiers' orphans' schools, and three such schools are still maintained.

Libraries.—According to a U. S. Government report in 1891 on public libraries of 1,000 volumes and upward each Pennsylvania had 351 libraries, which contained 2,318,456 bound volumes and 387,511 pamphlets.

Charitable, Reformatory, and Penal Institutions.—The State supports a great number of charitable institutions, including five hospitals for the insane, a newly erected special hospital for the chronic insane, and institutions for the blind, for the deaf and dumb, and for the feeble-minded. There are two penitentiaries, the Eastern and the Western, two reform schools for wayward youth, and an industrial reformatory for persons convicted of first offenses. An effort is made in all the penal and reformatory institutions to provide educational and industrial training.

Political Organization.—The Legislature is called a General Assembly, and consists of a Senate of 50 members, chosen for four years (one-half every two years), and a House of Representatives of about 200 members (in 1895, 204), chosen for two years. The membership of both is based on population, and the State is divided into districts after each U. S. census. Senators must be twenty-four years of age and representatives twenty-one years; both must have been citizens of the State four years and of their districts one year next before election, and must reside in their districts during term of service. All laws must be passed by bill, and no bill save the appropriation bill can contain more than one subject, which must be clearly expressed in its title. The purpose of a bill can not be changed during its passage. Each bill must be referred to a committee, be reported therefrom, and printed for the use of the members before it can be considered. It must be read at length on three different days in each house, and on its final passage must receive the affirmative votes of a majority of all the members elected to each house. Amendments made by either house must be concurred in by a majority of all the members of the other, and reports of conference committees must be adopted by a majority of the members of each house. All bills for raising revenue must originate in the House of Representatives, but the Senate may amend such bills. All bills and resolutions passed must be signed by the presiding officer of each house, in its presence, after the titles have been publicly read, and the fact of signing must be publicly entered on the journals. The chief executive is the Governor, elected for four years; salary, $10,000 per annum. Besides exercising the usual administrative powers he may veto any bill (or, in an appropriation bill, any separate item), which to become operative must be re-enacted by a vote of two-thirds of the members of each house. He appoints (with the advice and consent of the Senate) a secretary of the commonwealth, attorney-general, and adjutant-general, to serve at his pleasure; a superintendent of public instruction for four years, a commissioner of insurance for three years, a superintendent of public printing for four years, and a State librarian for three years. Other administrative officers are elected—viz.: a State treasurer for two years, auditor-general for three years, and secretary of internal affairs for three years. The treasurer and auditor-general can not serve two successive terms. A Lieutenant-Governor is elected at the same time and for the same term as the Governor. He presides over the Senate, has a vote only in case of a tie, and succeeds to a vacancy in the office of Governor, in which event the president *pro tem.* of the Senate becomes Lieutenant-Governor. The judicial power is vested in a Supreme Court, courts of common pleas, oyer and terminer, general jail delivery, quarter sessions of the peace, orphans' courts, magistrates' courts, and such others as the Legislature may establish, and in aldermen and justices of the peace. The Supreme Court is the highest court of both original and appellate jurisdiction. It consists of seven judges, elected for twenty-one years, and ineligible to reelection, the oldest in commission sitting as chief justice; salary, $8,000 per annum. The State is divided into judicial districts, varying in number according to population, for the courts of common pleas. Each county containing 40,000 or more inhabitants forms a separate district; those containing less are combined. Districts are fixed by the Legislature within limits prescribed by the constitution. The judges are elected for a term of ten years. Special provisions exist for the two most populous counties, Allegheny and Philadelphia.

The right to vote at all elections is possessed by every male citizen, twenty-one years of age, who has been a citizen of the U. S. at least one month, has resided in the State one year (six months if, having previously been a qualified elector, or native-born citizen of the State, he shall have removed therefrom and returned), immediately preceding the election; has resided in the election district where he shall offer to vote at least two months immediately preceding the election; and, if twenty-two years of age or upward, has paid within two years a State or county tax, which shall have been assessed at least two months and paid at least one month before the election. Women twenty-one years of age and over are eligible to every office of control or management under the school laws of the State. General elections are held on the Tuesday next following the first Monday in November. All regular municipal elections (for city, ward, borough, and township officers) are held annually on the third Tuesday in February.

History.—The first settlement within the bounds of Pennsylvania was at Tinicum island by Swedish colonists, under

John Printz's administration. In 1655 the Dutch from New Amsterdam marched upon these Swedish settlements and took formal possession of the country. In 1660 a Dutch settlement was planted at the Minisinks, the settlers being colonists from New Amsterdam. When the English captured New Amsterdam, in 1664, the colony on the Delaware followed its fortunes, and remained under the government of New York (except for a part of 1673–74, when the Dutch recaptured it) until Mar. 4, 1681, when Charles II. granted to William Penn the "tract of land in America lying N. of Maryland, on the E. bounded with Delaware river, on the W. limited as Maryland, and northward to extend as far as plantable." Penn landed at New Castle (now in Delaware) Oct. 27 (o. s.), 1682. During 1683 he organized his new government and provided places for the many immigrants (mostly Friends) who began to flock thither. He returned to England in 1684 for the settlement of the boundary between Pennsylvania and Maryland. In 1699 he again visited his province, remaining till 1701, and gave the colonists a new constitution and Philadelphia a charter. From this time to 1720 emigration to Pennsylvania constantly increased. Penn died in 1718, and his heirs succeeded him as proprietaries. The war between France and Great Britain in 1744 led to apprehensions of trouble with the Indians, whom the French were stimulating to hostility against the English colonists. Great efforts were made to retain the friendship of the Indians, but all in vain. The Shawanese were the first to break faith with the colonists. The French, having secured them as allies, constantly increased their aggressions. The boundary between Pennsylvania and Maryland was run in 1766–67 by Charles Mason and Jeremiah Dixon. In 1768, by a treaty with the Six Nations, a large tract of land, called the New Purchase, embracing most of the counties of Northern and Northwestern Pennsylvania, was conveyed to the proprietaries, and at once induced an enlarged immigration. Pennsylvania took an active part in the movement for independence. (See PHILADELPHIA.) The massacre of the Wyoming settlers by British soldiers, Tories, and Indians occurred in July, 1778, and was summarily avenged by the McIntosh and the Sullivan expeditions. In 1778 the royal charter was annulled, and the Penns were allowed £130,000 for their unsettled lands in the State. Pennsylvania furnished more than her full quota of troops for the Revolutionary war. Slavery was abolished in 1780. The "Whisky Insurrection" in the western counties occurred in 1794; it occasioned great excitement, but was put down without bloodshed. A less considerable insurrection was attempted four years later, but was promptly suppressed. In 1799 the State capital was removed to Lancaster, and in 1812 to Harrisburg. After the war of 1812 the State was largely engaged in colossal enterprises of internal improvement—canals and railways—which for some years embarrassed her finances. In 1859 the petroleum discoveries were made. The State was three times invaded by the Confederates—first on Oct. 10, 1862, when Chambersburg was captured and military stores burned; second, by Gen. Lee, when the battle of Gettysburg was fought on her territory; third, in July, 1864, when Chambersburg was burned. The State furnished nearly 400,000 soldiers for the civil war (1861–65).

The constitution of 1776 was framed on the advice of the Continental Congress. A convention, called on the recommendation of a conference of county committees (ignoring the Assembly of the province then in session), drew up a constitution and provided for setting it in operation. It was not submitted to vote of the people. It provided for a single legislative assembly and a plural executive (president and council). It also provided for a council of censors, two from each county, to meet every seven years, with authority to investigate breaches of the constitution and recommend changes in it; and it contained the germ of the modern *referendum* by requiring all public bills to be printed for the consideration of the people before their final passage, which, except on occasions of public emergency, was to be deferred till a succeeding session. On Sept. 15, 1789, the Assembly provided for a convention to amend the constitution. The convention met Nov. 24, completed its work Feb. 20, 1790, voted that the new constitution be published, adjourned till Aug. 9, and on Sept. 2 adopted it with some modifications. It was not submitted to the popular vote. By this constitution the number of representatives was to be not less than 60 nor more than 100, distributed among the counties in proportion to taxable inhabitants. A senate was created to consist of not more than one-third nor less than one-fourth the number of the lower house. The executive power was vested in a Governor, to be elected for a term of three years. Judges were to be appointed to serve during good behavior (seven years having been the previous term), and to receive a fixed compensation. This constitution introduced a highly important change of the old English law of libel, by providing that "in prosecutions for the publication of papers investigating the official conduct of officers or men in a public capacity, or where the matter published is proper for public information, the truth thereof may [might] be given in evidence." In 1837 and 1838 another convention was held which reduced the patronage of the Governor, gave the election of all county officers to the people, and limited the term of judges to fifteen, ten, and five years. Amendments to this constitution were proposed by the Legislature and adopted by the people—one in 1850, four in 1857, three in 1864, and one in 1872. In 1872 and 1873 another convention framed the present constitution, which introduced many important changes, and was ratified Dec. 16, 1873. Under this constitution a Governor can not be elected his own successor.

GOVERNORS OF PENNSYLVANIA.

COLONIAL.

Under the Swedes.

Peter Minuit	1638
Peter Hollandaer	1641
John Printz	1643
John Pappegoya	1653
Johan C. Rysingh	1654

Under the Dutch.

John Paul Jacquet	1655
Colony divided into city and company	1657–62
Jacob Alricks (city)	1657
Alex. d'Hinoyossa (city)	1659
Goeran Van Dyke (company)	1657
Wm. Beekman (company)	1658
Colony united	1662
Wm. Beekman	1662
Alexander d'Hinoyossa	1663
Captured by the English	1664

Under the English.

Col. Richard Nicolls (gov.)	1664
Robert Carr (deputy gov.)	1664
Col. Francis Lovelace	1667

Under the Dutch.

Anthony Colve (gov.)	1673
Peter Alricks (deputy gov.)	1673

Under the English.

Sir Edmund Andros	1674

The Proprietary Government.

Wm. Markham (dep. gov.)	1681
Wm. Penn (proprietary)	1682
The Council (Thos. Lloyd, president)	1684
Commissioners appointed by Penn	1688
John Blackwell (dep. gov.)	1688
The Council (Thos. Lloyd, president)	1690
Thos. Lloyd (d. g. of prov.)	1691
Wm. Markham (deputy governor lower counties)	1691

Under the Crown.

Benj. Fletcher, Goveruor of New York (governor)	1693
Wm. Markham (lieut.-gov.)	1693

Proprietary Government.

Wm. Markham (gov.)	1695
Wm. Penn (proprietary)	1699
Andrew Hamilton (gov.)	1701
Council (E. Shippen, pres.)	1703
John Evans (gov.)	1704
Charles Gookin (lieut.-gov.)	1709
Sir Wm. Keith (lieut.-gov.)	1717
Patrick Gordon (lieut.-gov.)	1726
Council (J. Logan, pres.)	1736
Geo. Thomas (lieut.-gov.)	1738
Council (A. Palmer, pres.)	1747
Jas. Hamilton (lieut.-gov.)	1748
Robt. Hunter Morris (lt.-gov.)	1754
William Denny (lieut.-gov.)	1756
Jas. Hamilton (lieut.-gov.)	1759
John Penn (gov.)	1763
Council (J. Hamilton, pres.)	1771
Richard Penn (gov.)	1771
John Penn (lieut.-gov.)	1776

In the Revolution.

Com. of Safety (B. Franklin, chairman)	Sept., 1776–Mar., 1777

Pres. of Supreme Ex. Council.

Thos. Wharton, Jr.	Mar. 5, 1777
George Bryan (v.-p.), acting	May 23, 1778
Joseph Reed	Dec. 22, 1778
William Moore	Nov. 15, 1781
John Dickinson	Nov. 7, 1782
Benj. Franklin	Oct. 18, 1785
Thomas Mifflin	Nov. 5, 1788

STATE.

Thomas Mifflin	1790
Thomas McKean	1799
Simon Snyder	1808
William Findlay	1817
Joseph Heister	1820
John Andrew Shulze	1823
George Wolf	1829
Joseph Ritner	1835
David R. Porter	1839
Francis R. Shunk	1845
Wm. F. Johnston	1848
William Bigler	1852
James Pollock	1855
William F. Packer	1858
Andrew G. Curtin	1861
John W. Geary	1867
John F. Hartranft	1873
John F. Hartranft	1876
Henry M. Hoyt	1879
Robert E. Pattison	1883–87
James A. Beaver	1887–91
Robert E. Pattison	1891–95
Daniel H. Hastings	1895–99
William A. Stone	1899–

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torical Society, 1888); *The Pennsylvania Magazine of History and Biography*, 18 vols.; and numerous county and local histories. GEORGE W. ATHERTON.

Pennsylvania College: an institution at Gettysburg, Pa.; founded in 1832, under the auspices of the Lutheran Church. In 1834 the State of Pennsylvania appropriated $18,000 to the institution, and, for a number of years, annually $1,000. By an act of the Legislature in 1850 one-third of the value of the funds of Franklin College of Lancaster, Pa., was transferred to Pennsylvania College, to establish in it a professorship known as the "Franklin professorship." A preparatory department has been from the first connected with the institution. The control is in the hands of a board of thirty-six trustees, six of whom are nominated by the alumni association, but all of whom are elected by the board itself as vacancies occur. The president (1901) is Rev. Harvey W. McKnight, elected in 1884. There are professorships of the German language and literature, of the English language and literature, of the natural sciences, of hygiene and physical culture, and of the English Bible. The institution possesses chemical and philosophical apparatus, a laboratory for practical chemistry, a cabinet of mineralogy, and an astronomical observatory. Its libraries and those of its literary societies contain over 24,000 volumes. Since 1888 a large recitation and library hall has been erected at a cost of $91,000, also Bena Chapel, and Pennsylvania and Linnæan halls and the chemical laboratory have been remodeled and improved at a cost of about $40,000. The number of students was 249 in 1899–1900. H. W. MCKNIGHT.

Pennsylvania Dutch (more correctly *Pennsylvania German*): a South-German dialect, due to the fusion of forms existing on the upper Rhine in Rhenish Bavaria, Baden, Darmstadt, Würtemberg, German Switzerland, and Alsace, and taking up in the U. S. (chiefly in Pennsylvania) an English element, as English itself took up native words like *hickory*, or French forms like *prairie*, *bayou*, and *ville*. The characteristics of the dialect may be learned from the excellent poems in it by the late H. Harbaugh, D. D. (1870), and in Haldeman's *Pennsylvania Dutch* (1872). It is a mistake to suppose that it is a corrupt dialect of German, or in any way akin to such broken English as Leland in his *Hans Breitmann's Ballads* attributes to European German. Careless speakers of English unconsciously corrupt their language with Germanic idioms, as in the use of "dumb" for *dull* or *stupid*, and "red beet" for *beet*, translating *die rothe Rübe*, because in German a "white" beet (*weisse Rübe*) is a turnip.

Pennsylvania, University of: an institution which originated as a charity school in 1740; was founded as an academy in 1749; incorporated as a college in 1755; erected into a university, the first in the U. S., in 1779. The medical department, the oldest in America, was founded in 1765, and the law department in 1789. In 1872 the institution was removed to its present site in West Philadelphia, Pa., where it has above 52 acres. The twelve departments of the university occupy twenty-three buildings. The college embraces the courses in arts and science; the Towne Scientific School, including the courses in civil, mechanical, and electrical engineering, chemistry, etc.; the School of Architecture; the School of Biology; the School of American History; and the Wharton School of Finance and Economy. These are all four-year courses, with the exception of the two-year courses in history. In the science courses the degree of B. S. is given after four years, and the technical degree after prescribed post-graduate work. The college offers altogether 450 courses. The department of medicine had a three years' course up to the fall of 1893, when it was made four years. Closely connected with it are the University Hospital, with accommodations for over 200 patients; the auxiliary department of medicine, which makes provision for advanced study in medical science; and the recently endowed Wistar Institute of Anatomy and Biology. The Dental School has a three years' course, and is thoroughly equipped, the students using, with the medical students, the largest chemical instruction laboratory building in the world. The veterinary department occupies four buildings erected for its use, two of these being devoted to the Veterinary Hospital. The course of instruction lasts three years. The department of law has a course of three years, with additional post-graduate instruction where desired. The method of instruction is partly by lectures and partly by moot-courts. The department of hygiene, opened in 1892, is situated in a large building, with ample facilities for the study of hygiene and bacteriology, and for special research. The university's courses leading to the post-graduate degrees of M. A., M. S., and Ph. D. are under the supervision of the department of philosophy. Allied with this is the graduate department for women, which makes free provision for a certain number of students. The university museums are very large, and the libraries contain more than 140,000 bound volumes and a larger number of unbound volumes and pamphlets. In 1900 there were 258 professors and other teachers, and 2,790 students.

Pennsylvania, Western University of: See Appendix.

Penny [M. Eng. *peni* < O. Eng. *penig*, *pening*, *pending*. For ending, cf. *shilling* and *farthing*. Etymology obscure]: an English coin, first mentioned in the laws of Ina, King of Wessex, about 695 A. D. It was at first of silver, and at one time weighed 22½ grains troy, but its value and weight slowly declined. The first copper pence were introduced in 1797. At present the British penny is of bronze. It is the twelfth part of a shilling, and is designated by the letter *d*, the initial of the Lat. *denarius*. The name is sometimes also applied to the U. S. cent.

Penn Yan: village; capital of Yates co., N. Y. (for location, see map of New York, ref. 5–E); at the foot of Keuka Lake; on the Fall Brook and the North. Cent. railways; 43 miles N. by W. of Elmira, 53 miles S. E. of Rochester. It is the distributing center of the largest grape-growing region E. of California, being surrounded by 16,000 acres of vineyard. It has daily steamboat connection with Hammondsport, at the head of the lake, and derives good power for manufacturing from the lake. There are 2 national banks with combined capital of $100,000, a State bank with capital of $50,000, an academy, and a monthly and 3 weekly newspapers. Pop. (1880) 3,475; (1890) 4,254; (1900) 4,650. EDITOR OF "CHRONICLE."

Pennyroyal [(by attraction to *penny*) < O. Eng. *puliall royal*, transl. of Lat. *pulegium regium*; *pule'gium*, fleabane, pennyroyal (deriv. of *pulex*, flea), whence Eng. *puliall* + *regium*, royal]: a fragrant labiate herb of the Old World (*Mentha pulegium*) growing wild or cultivated in gardens, and used in Europe in domestic medicine as a stimulant and carminative. It is a perennial herb, very common in Southern Europe, and still hardy in the northern part of Germany. Its odor is quite distinct from that of other mints, having in its sweetness something sour which at first is found very refreshing, but soon becomes nauseous. In the U. S. the name is given to *Hedeoma pulegioides* (low pennyroyal) and *Mentha canadensis* (high pennyroyal), both having very nearly the odor of the English pennyroyal. They are found all over the U. S., from Mexico to Canada, mostly in barren and arid places. They are valuable as deobstruents, carminatives, and diaphoretics.

Pennyweight: See WEIGHTS AND MEASURES.

Penobscot Bay: an inlet of the Atlantic Ocean penetrating the coast of Maine for 30 miles, having Waldo and Knox Counties on the W. and Hancock County on the E. Its deep waters abound in islands and good harbors; principal tributary, Penobscot river.

Penobscot Indians: See ALGONQUIAN INDIANS.

Penobscot River: the longest and largest river of Maine, and the most important navigable stream in the New England States. It rises in Somerset County, near the Canada line, flows E. into Chesuncook Lake, thence S. E. to its union with the Mattawamkeag, having 12 miles above united in the town of Medway with the Seboois or east branch of the Penobscot. Afterward its course is S. by W. to Penobscot Bay; its total length is 300 miles. It is navigable for large ships to Bangor, 60 miles, where the tide rises 17 feet. Above this point small steamers run for many miles. Its upper waters afford valuable motive power, and great numbers of logs are floated from the forests of Northern Maine to Bangor, and then sawed for lumber. The valley of the Penobscot has an area of 8,200 sq. miles. The mean outflow of water is given as 146,250 cubic feet per minute, but this enormous motive power is only in small part utilized.

Penology: See PRISON DISCIPLINE.

Penrith: town; in the county of Cumberland, England; 18 miles S. S. E. of Carlisle (see map of England, ref. 4–F). It is well built, and has a ruined castle in which Richard III. is said to have lived before he came to the throne. There are tanneries, breweries, and sawmills. Pop. (1891) 8,981.

Pensacola: city, port of entry, and capital of Escambia co., Fla. (for location, see map of Florida, ref. 2–B); on Pensacola Bay, and the Louisv. and Nashv. and the Pensacola and Perdido railways; 6 miles N. of the Gulf of Mexico, 48 miles E. of Mobile. It has an excellent landlocked harbor with from 31 to 33 feet of water on the bar; was a place of much importance during the Spanish and English government of Florida; and is the site of a U. S. navy-yard, of Forts Pensacola, McRee, Barrancas, and Pickens, and of the ruins of the old Spanish fortresses of San Miguel and San Bernardo. The city has gas, electric-light, water, and street-railway plants, and contains 11 public-school buildings, public-school property valued at over $65,000, U. S. Government building (cost $250,000), opera-house (cost $75,000), court-house (cost $45,000), State armory, several public parks, 3 national banks with combined capital of $400,000, and 2 daily and 5 weekly newspapers. It has a large foreign and domestic trade in lumber, timber, shingles, phosphate, cotton, fresh fish, and coal. The climate is generally healthful, the sanitary and quarantine regulations of the port being of a character to preclude the possibility of further introductions of yellow fever. In 1899 the city had an assessed valuation of $3,159,096, and a net debt of $279,754. Pop. (1890) 11,750; (1900) 17,750.

EDITOR OF "NEWS."

Pensacola Bay: an inlet of the Gulf of Mexico: at the western extremity of Florida, extending inland N. E. about 35 miles, affording a deep, capacious, and commodious harbor. It is divided into Escambia Bay on the W. and the Bay of Santa Maria de Galvez on the E., and receives Escambia, Black Water, and Yellow Water rivers. The entrance is a mile wide between Santa Rosa island, on the E. defended by Fort Pickens, and the entrance point of the mainland on the W., on which stands Fort McRae. Less than 2 miles N. of the latter stands the old Spanish fort of San Carlos de Barrancas, and in its immediate vicinity a naval hospital, extensive barracks, and a lighthouse, while a short distance N. E. is the navy-yard, which was surrendered to the Florida militia Jan. 12, 1861, not long before the outbreak of the civil war, but recovered by the Federal forces, after sharp engagements, early in 1862.

Pensions [from Lat. *pen'sio*, payment, deriv. of *pen'dere*, *pen'sum*, weigh, weigh out, pay]: allowances of money, generally in fixed amounts and annual payments, made by the government to certain individuals or to their families and representatives, in consideration of some public services performed or supposed to have been performed by them. In Great Britain, besides large sums devoted to pensioning army and navy men, pensions are conferred upon the judges of the higher courts and upon many other civil officers who have performed their duties for a specified number of years and then resigned their active functions. They are also frequently granted to distinguished and meritorious authors, artists, scientific men, inventors, and the like, or to their widows or families, for the purpose of rewarding personal merit and of encouraging literature, art, and science. The policy of the U. S. Government has confined the bestowment of pensions to the officers and privates who have served in the army or navy during the wars in which the republic has been engaged, or who have been wounded or otherwise disabled while in active service, and to their widows, children, and other dependent relatives. The provisions of the existing laws relating to pensions in the U. S. are contained in the Revised Statutes of the U. S. (§§ 4692–4791, and later).

Pentacrinus [Mod. Lat., from Gr. πέντε, five + κρίνον, lily]: a genus of Crinoids (see CRINOIDEA) containing nine living and many fossil species, most abundant in the Jurassic. The living species are inhabitants of the deeper portions of the Atlantic and Pacific Oceans.

Pentam'eter [from Gr. πενταμετρος, of five measures; πέντε, five + μέτρον, measure]: properly, a verse of five feet, but the name is usually given to the syncopated dactylic hexameter of Greek and Latin elegiac poetry. (See ELEGIAC DISTICH.) It consists of two cola (like the masculine first colon of a hexameter) with invariable cæsura between, the entire feet of the second colon always being pure dactyls:

– ⏑ ⏑ | – ⏑ ⏑ | – ‖ – ⏑ ⏑ | – ⏑ ⏑ | – ×

αὐτὰς ἀναιδείη γαῖαν ἐπιστρέφεται.

Panditur ad nullas ianua nigra preces.

Never is death's dark door opened at human appeal.

The third foot is often to be read with a pause instead of prolongation of the syllable.

The name originated from the absurd assumption that the verse was – ⏑ ⏑ | – ⏑ ⏑ | – – | ⏑ ⏑ – | ⏑ ⏑ –, though the correct reading is explicitly taught by ancient authors.

MILTON W. HUMPHREYS.

Pentateuch [from Lat. *pentateu'chus* = Gr. πενταteυχος; πέντε, five + τεῦχος, implement, book, deriv. of τεύχειν, prepare]: the collective name of the first five books of the Old Testament—Genesis, Exodus, Leviticus, Numbers, and Deuteronomy. It originated from the Greek translators and Fathers; the Jews themselves called this division of their sacred book *Torah*, the Law. These and the book of Joshua form the HEXATEUCH (*q. v.* for authenticity, etc.). See also the article BIBLE.

Pentathion'ic Acid: an acid of the composition $H_2S_5O_6$, prepared by the action of hydrogen sulphide, H_2S, on a solution of sulphur dioxide, SO_2, in water. It is unstable, and very little is known about it.

Pentecost [from Lat. *pentecos'te* = Gr. πεντηκοστή, the fiftieth (sc. ἡμέρα, day), deriv. of πεντήκοντα, fifty]: one of the three principal festivals of the Jews, celebrated on the fiftieth day after the 16th Nisan, the second day of the Passover (Lev. xxiii. 15, 16), whence the name. It was originally called the "Feast of Weeks" (took place at the beginning of harvest-time, hence also its other name, "Feast of Harvest"), was characterized by the offering, as "first fruits," of two loaves of leavened bread made from new grain, and was a period of liberality to the poor. In modern times the Jewish festival of the Pentecost lasts two days, and the anniversary of the giving of the Law on Sinai has been combined with the earlier festival. In the Christian churches the word Pentecost has a different meaning, derived from the occurrences related in Acts ii.—viz., the descent of the Holy Spirit upon the infant Church ten days after the Ascension, the gift of tongues, and the conversion of 3,000 persons. In the English Church, Penteeost is known as Whitsunday or Whitsuntide, from the white garments formerly worn by candidates for baptism.

Revised by S. M. JACKSON.

Pentecost, GEORGE FREDERICK, D. D.: clergyman and author; b. at Albion, Ill., Sept. 23, 1842; learned the trade of a printer, then studied law. He became a member of Georgetown College, Kentueky, whieh he left in 1862 to serve in the Union army. He was the pastor sueeessively of five Baptist churches, but from 1881 to 1890 he was pastor of a Congregational ehurch in Brooklyn, N. Y. For many years he has been engaged in evangelistic work in the U. S., in India, and in Great Britain. He has written *Bible Studies for 1889* (1888); *The Gospel of Luke* (1889); and several religious books, besides traets. In 1885 he became the editor of *Words and Weapons for Christian Workers*.

G. P. FISHER.

Pentland Firth: a channel connecting the Atlantic with the German Ocean, and separating the Orkney islands from Scotland; is 17 miles long, from 6 to 8 miles broad, and annually passed through by about 4,000 vessels, though it is very difficult to navigate.

Penum'bra: See ECLIPSE.

Pen'za: government of European Russia; lying around the rivers Moksha and Soora (see map of Russia, ref. 8–F). Area, 14,997 sq. miles. The ground is mostly level and somewhat elevated, and the soil fertile. Wheat, flax, hemp, tobacco, hops, and beetroots are raised; forests of oak-trees cover nearly one-third of the country. Besides agriculture, the prineipal branch of industry, manufactures of linen stuffs, spirits, glass, and beetroot-sugar are carried on. Pop. (1897) 1,483,948. The capital, Penza, on the Soora, has a cathedral, a large park, and manufactures of paper, soap, spirits, beetroot-sugar, etc. Pop. (1897) 55,680.

Penzance': town; in the county of Cornwall, England; at the head of Mount's Bay; 80 miles S. by W. of Plymouth and the terminus of the Great Western Railway (see map of England, ref. 15–B). It has an esplanade commanding picturesque land and sea views, a harbor, forming a tidal basin of 21 acres, with doeks and two piers. The chief buildings, principally constructed of granite, include the public rooms in the Italian Renaissance style and the market-house in the Grecian style. The churches of St. Mary and St. Paul are built of cut granite in the Perpendieular and thirteenth century styles, respectively. The most important industries are the mackerel and pilchard fisheries and market gardening. The mild climate and the beauty of the surroundings attract a great number of visitors. Pop. (1891) 12,448.

Pe'ony [from O. Fr. *pione* > Fr. *pivoine* < Lat. *pæo'nia* = Gr. *παιωνία*, deriv. of *Παίων*, *Παιάν*, the god of healing. See PÆAN]: any herb or shrub of the genus *Pæonia*, family *Ranunculaceæ*. The U. S. has but one native species, *P. brownii*, of the Pacific States and British America. It has small purple flowers. The various Old World species are cultivated as ornamental plants. The flowers are generally showy. Of the many artificial varieties some are fragrant. All have a poisonous principle, and some species were once employed in medicine, but none are much used at present. The seeds and roots of some species are used as food by wild tribes in Asia and America. The finest varieties in garden-culture belong to *P. officinalis*, *albifolia*, *tenuiflora*, *paradoxa*, etc. The tree-peony of Japan (*P. moutan*) affords some very fine varieties. Revised by L. H. BAILEY.

People's Party: a political party in the U. S. whose leading principle is opposition to the control exerted by wealth. The idea prevails, especially in the West and South, that the laws are largely framed and executed in a manner to give undue advantage to those who are unscrupulous in the use of money, and that this is the prime reason for the great inequality in the distribution of property. According to the estimate of special census agent G. K. Holmes, 9 per cent. of the people own 71 per cent. of the national wealth, while Thomas G. Shearman estimated that less than 50,000 people own half.

Principles and Arguments.—The great increase in the proportion of business done by corporations, with the resulting concentration of capital into the hands of a few managers and the temptation to use it to protect or procure valuable franchises or trade advantages, together with the preservation of monopolies and the expense of securing elections (which appears to be from $7,000 to $13,000 for a Congressman, the salary of whose term is only $10,000), have introduced an era of official venality unparalleled since the days of Walpole. To such an extent do rich men find their way into the Senate that the average income of a Senator is estimated to be above that of a British peer, stated by London *Truth* at $135,000 per annum. This condition excites attention in Europe and leads to comments like that of Leroy Beaulieu, that money seems to be the legitimate sovereign of democracies.

Of the laws and lack of laws through which the rich are aggrandized, the chief attention of the Populists has been given to those creating or permitting (1) unequal taxation; (2) trusts and monopolies; (3) the single gold standard, excluding silver.

The burden of local taxation caused by the escape or unjust exemption of notes, stocks, and bonds—the peculiar property of the wealthy—is rapidly increasing. Though personal property increases much faster than real, its assessment relatively declines. This is roughly seen in the census data, which show an increase from 1870 to 1890 in the real estate taxed from 9,914 millions of dollars to 18,933, while the increase for the same time in personalty was from 4,264 millions to 5,718. The comptroller of the State of New York, in his report for 1890, gave his official opinion that in that State more than 2,500 millions of personal property unjustly escaped taxation. In Massachusetts it is the opinion of men versed in the subject that the people are defrauded of more than $15,000,000 a year in taxes, a sum which at legal interest compounded for a generation would equal the whole valuation by the assessors. The taxes shirked by the wealthy fall over largely on the farmers, whose property is visible and can not escape, and, through rents, on to the working classes. The Populist calls for equal taxation of property, sometimes for doomage laws, and always for an income-tax.

As to monopolies, the substance of the Populist doctrine is that as the Government recognizes its duty to protect the citizen against the man who by superior physical strength wrongfully seizes his pocketbook, it is equally bound to protect him against the man who by superior financial strength or special privilege does the same. Therefore it calls for adequate control of such, and, where necessary for this purpose, for Government ownership and operation of monopolistic properties. As this is the first step in the plan of Edward Bellamy, the Nationalists are generally Populists.

The leading question, however, has been that of honest money, whose proper function is to buy always the same average amount of commodities. When A buys of B 1,000 bush. of wheat for $1,000, payable in five years with interest, the money should give B, when the debt is paid, not the same amount of wheat, for that may have fallen or risen, but the same average amount of all exchangeable commodities which it would buy when the debt was made. It need not give the same amount of labor, for that may have risen or fallen, and B has no more right to claim that than he has to claim the same wheat, though given by him in time of plenty and paid in time of famine. Neither can he justly claim more commodities if improved modes of production may have cheapened them. He gave to A a certain amount of commodities or capital for a rent called interest, and he has no better claim to be made whole for such a depreciation than he would have had he rented a house, to be made whole for a reduction in its value caused by the introduction during the tenancy of some improved mode of building. He would have suffered that loss had he kept his house or capital himself. All economists agree that there has been since 1873 a great increase in the purchasing power of gold. If the foregoing reasoning is correct, debtors have thereby been defrauded. Most economists agree that this is due to the demonetization of silver in 1873, and the smallness of the annual increment of gold since going into the money volume compared with the increase of demand; but the cause is immaterial. The extent of this appreciation of gold since 1873 is shown by various price-tables which substantially agree. Those of Augustus Sauerbeck show a decline in prices of 38·3 per cent. up to Nov. 1, 1892, and the financial depression of 1893 probably increased this to 44 or 45, which represents an increase in the purchasing power of money of about 80 per cent.

A conception of the hardship to debtors may be had by a rough estimate. The debts of the world are supposed to reach 150 billions of dollars. Suppose the volume since 1873 to have been 100 billions, and the average increase in the purchasing power of money has been 30 per cent., the unjust exaction from debtors will reach 30 billions in commodities, while the whole assessed value of the property, real and personal, of the U. S. in 1890 was only 24 billions. Declining prices also involve business stagnation. The Populists generally, restless at the great increase in the burden of their debts, propose fresh issues of paper and the free coinage of silver. Those in Massachusetts have proposed multiple standard money, involving the demonetization of gold and silver, and the substitution of a volume of irredeemable legal-tender treasury notes, issued only by the Government, and receivable for all its dues, the volume to be expanded or contracted according as it shall be found that the dollar will buy more or less in a given market than a predetermined average amount of a large number of commodities (say 100) selected as best representing all commodities. The purchasing power of the dollar would thus always be kept uniform.

The Farmers' Alliance.—The farmers, pinched by such conditions as rendered it very hard to pay their debts, bled by railroads and middlemen who sold them goods and made advances on their crops, began to organize societies for mutual advantage, education, and defense. The chief of these has been the Farmers' Alliance. Its effective beginning was in a small body organized at Poolville, Tex., July 28, 1879. The order, having extended into a few counties, formed, and obtained a charter for, a State alliance in Texas, Oct. 6, 1880. By 1882 120 sub-alliances had been organized. This order was consolidated with another of like purpose, the Farmers' Union of Louisiana. A national organization, the National Farmers' Alliance and Co-operative Union of America, was established at Waco, Tex., in Jan., 1887. The Agricultural Wheel, another like order, was also joined, subject to ratification of the subordinate bodies, and a constitution was adopted at a meeting of both orders at Meridian, Miss., Dec. 5, 1888. The Agricultural Wheel originated Feb. 15, 1882, at a meeting held in a log cabin near Des Arc, Ark. It was chartered in Aug., 1882, organized a State Wheel Apr. 7, 1883, and a National Wheel in 1886. In 1888 it reached 1,947 subordinate bodies, and had 75,000 members in Arkansas alone. The name given the consolidated order at Meridian was The Farmers' and Laborers' Union of America. The union was after ratification proclaimed as of Oct. 1, 1889. The order contained fully 1,000,000 members, and extended into eighteen States and Territories. The next national meeting was held at St. Louis, Dec. 3, 1889. The constitution was amended, and the name National Farmers' Alliance and Industrial Union adopted. These orders had been largely educational and social, and did not admit colored persons. They had established co-operative stores and united in various ways to promote agricultural interests. They were strictly non-partisan,

but were free to formulate political demands, and active within the old party organizations. Great interest had begun to be felt in all the kindred organizations representing the industrial masses to agree upon common political principles and unite to secure just legislation. Accordingly, the National Farmers' Alliance of the Northwest and the National Colored Farmers' Alliance met also at St. Louis at the same time. The Knights of Labor sent also their president, with other officers. Demands were formulated with the express concurrence of the latter, which were adopted, with those of later conventions, with some modifications by the People's Party in their national convention at Omaha in 1892. The next annual meeting of the National Farmers' Alliance and Industrial Union was held at Ocala, Fla., Dec. 2, 1890. Additional demands were made, and it was voted "that a free ballot and a fair count will be insisted upon and had for colored and white alike by every true Alliance man in America."

The Formation of the People's Party.—By this time, failure to secure favorable results through the old parties being apparent, a strong pressure existed for separate political action. The Alliance and its sympathizers had made in 1890 energetic contests in many sections in the South, mainly through the primaries, but in the Northwest at the polls. The results were greatest in Georgia and Kansas. In the latter State a Republican plurality of 80,000 was cut down to 8,000, the Legislature was carried (securing a U. S. Senator), and five Congressmen out of seven elected. The chairman of the executive committee at Ocala, stating that a third party was opposed in the South but favored in the West and Northwest, suggested a meeting of "delegates from all the organizations of producers" to decide the question. A committee was chosen to carry this into effect, and the St. Louis conference of Feb. 22, 1892, was the result. Another conference, to provide for a national ticket in 1892, if the St. Louis conference should fail to do so, was arranged for by individual delegates at Ocala, and held at Cincinnati on May 19, 1891. At St. Louis the third-party men gained control. The opponents were mainly from the South, and some of the leaders bolted afterward. A vote was passed requesting Alliance Congressmen to stay out of old-party caucuses. An address was adopted denouncing the old parties and declaring that a party representing the principles then agreed was necessary. Action which might be held to contravene the organic law of the order was taken by the delegates as individuals remaining in their seats after adjournment.

The national convention of the People's Party provided for by these conferences was held at Omaha, July 4, 1892, with 1,347 regularly elected delegates. A platform was adopted, of which the demands may be thus epitomized:

A national legal-tender currency, safe, sound, and flexible, issued by the Government only without the use of banks, direct distribution to the people at a tax not to exceed 2 per cent. per annum, to be provided as set forth in the Alliance sub-treasury plan or a better system, and by payments in discharge of obligations for public improvements. Free coinage of silver and gold at the ratio of 16 to 1. Increase of the circulating medium to $50 per capita. A graduated income-tax. Limitation of State and national revenues to the necessary expenses of government economically and honestly administered. Government ownership and operation of railroads, telegraphs, and telephones. That land and natural sources of wealth should not be monopolized for speculation, and alien ownership of land should be prohibited. That land owned by railroads and corporations in excess of needs and land of aliens should be reclaimed by the Government and held for settlers.

Resolutions were adopted for a free ballot and a fair count, to be secured by the unperverted Australian secret-ballot system. For the application of the revenue of the graduated income tax to relieve the taxes on domestic industries; for fair and liberal pensions; for further restriction of undesirable immigration; for enforcement of the eight-hour law on Government work, with penalties; against the Pinkertons; for the initiative and referendum; for limiting the offices of President and Vice-President to one term; and against subsidies and private corporations.

On this platform James B. Weaver, of Iowa, was nominated for President, and James G. Field, of Virginia, for Vice-President. The vote for Weaver reached 1,041,028. He carried the States of Colorado, Idaho, Kansas, Nevada, and North Dakota, receiving twenty-two electoral votes. Five U. S. Senators and eleven Representatives were elected.

At the meeting at Memphis, Nov. 9, 1892, a new subordinate organization was formed in aid of the People's Party. It was called the Industrial Legion and was indorsed by the national executive committee. In 1894 1,000 subordinate legions were in existence. HENRY WINN.

Peoria: city (settled in 1779); capital of Peoria co., Ill. (for location, see map of Illinois, ref. 4–D); on the Illinois river, and eleven main lines of railway; 45 miles W. N. W. of Bloomington, 160 miles S. W. of Chicago. It is at the foot of an expansion of the river known as Peoria Lake, has a water frontage of about 4 miles, and covers an elevated plateau extending back three-quarters of a mile to a bluff rising 120 feet above tide-water. On the bluff are many fine residences, and from it may be had many attractive views of the river valley and the adjacent country. An elaborate system of parks and driveways has been established. There are 35 miles of paved streets. The city is in a corn and coal region, is noted for its manufactures of spirits, and is the eighth grain-market in the U. S. It has an extensive commerce by rail and water with Chicago, St. Louis, and other large centers. There are 16 public-school buildings, public-school property valued at over $500,000, court-house (cost $300,000), U. S. Government building (cost $250,000), cathedral (cost $225,000), high-school building (cost $75,000), new system of water-works, 3 libraries (High School, Law, and Public) containing over 55,000 volumes, 7 national banks with combined capital of $1,400,000, 4 State banks with capital of $700,000, 5 savings-banks, 2 private banks, 6 electric street-railways, gas and electric light plants, and a monthly, 6 daily, and 11 weekly periodicals. The census returns of 1890 showed that 554 manufacturing establishments (representing 90 industries) reported. These combined had a capital of $15,072,567, employed 7,696 persons, paid $4,327,637 for wages and $9,979,907 for materials, and had products valued at $55,504,523. The principal industries reported were, in the order of capital investment, the manufacture of agricultural implements, 7 establishments and $967,366 capital; malt liquors, 4 establishments and $874,496 capital; cooperage, 8 establishments and $388,200 capital; foundry and machine-shop products, 14 establishments and $372,072 capital; printing and publishing, 19 establishments and $359,520 capital; planing-mill products, 5 establishments and $343,132 capital; and flour and grist mill products, 8 establishments and $280,100 capital. There are 14 distilleries, 5 grain elevators with a total capacity of 2,400,000 bush., 2 large glucose-factories, using 30,000 bush. of corn per day, an extensive chemical laboratory, flour-mills, straw-board mill, rolling mill, white lead works, stock-yards, and several meat-packing houses. The city expenditures during 1893 were $338,785; bank clearings, $82,836,982; grain receipts, 33,670,870 bush.; and internal revenue collection, $13,389,736. In 1894 the city had an assessed valuation of $8,869,644, and a net debt of $614,500. Pop. (1880) 29,259; (1890) 41,024; (1900) 56,100.

Peoria Indians: See ALGONQUIAN INDIANS.

Pepe, GUGLIELMO: revolutionist; b. at Squillace, Italy, in 1783; served in the army of the Parthenopean republic, fought on the side of the French in Spain, and afterward under Murat. By the year 1815 he had risen to the rank of lieutenant-general. Sympathizing with the aspirations of the liberal party in Naples he joined the Carbonari, and in 1820 placed himself at the head of a military revolt. This was at first successful; Pepe entered Naples in triumph, and the king was forced to accept the constitution, but Austrian intervention, under the sanction of the Holy Alliance, soon restored the Bourbon tyranny. Pepe was defeated at Rieti Mar. 7, 1821, and fled to London, later to Paris. Having returned in 1848, he commanded the Neapolitan contingent against the Austrians, and distinguished himself by his brilliant defense of Venice. He afterward lived in Turin, where he died Aug. 9, 1855. His principal works are *Relation des Évènements Politiques et Militaires qui ont eu lieu à Naples en 1820 et 1821* (Paris, 1822; Italian and French); *Histoire des Révolutions et Guerres d'Italie en 1847–49* (Paris, 1850).

Pepin, Lake: an expansion of the Mississippi river; 27 miles long and from 2 to 3 miles wide, having Pierce and Pepin cos., Wis., on the N. E., and Goodhue and Wabashaw cos., Minn., on the S. W. It is surrounded by rocky ramparts of picturesque and inspiring appearance. The lake is not very deep.

Pepin (or **Pippin**) **le Bref** [Fr., Pepin the Short]: the first Carlovingian king of the Franks; b. in 714; son of

Charles Martel and father of Charlemagne; became in 741 major-domus of Neustria and Burgundy under Childeric III., one of the *rois fainéants*, and in 747 succeeded his brother Carloman as major-domus of Austrasia and the Rhine country, including Thuringia and Suabia. In 749 he defeated the Bavarians, and in 752 was crowned King of the Franks by St. Boniface by authority of Pope Zachary; conquered Septimania from the Saracens 752–760; was again crowned by Pope Stephen III. 754; broke the power of the Lombards in Italy 754–756, and gave the exarchate of Ravenna and the Pentapolis to the holy see, the origin of the temporal power of the popes; overcame the Saxons 757; took Narbonne from the Saracens 759; waged a stubborn war with Guaifar, Duke of Aquitania, 760–768, and in the latter year procured the assassination of his valorous enemy. D. Sept. 18 or 24, 768. See FRANKS, THE.

Pepin of Héristal: founder of the Carlovingian line of Frankish kings; a grandson of Pepin von Landen, mayor of the palace in Austrasia; became Duke of the Austrasian Franks 680, and in 687, by the battle of Testry, conquered Burgundy and Neustria, and afterward subdued the Frisians and ravaged Suabia. D. Dec. 16, 714 A. D. He never assumed the royal title, but exercised sovereign power in the name of four successive Merovingian *fainéant* kings. Charles Martel was his natural son.

Pepper [M. Eng. *peper* < O. Eng. *pipor*, from Lat. *piper* from Gr. *πίπερι*, *πέπερι*; cf. Sanskr. *pippala*, a kind of pepper, Pers. *pulpul*, pepper]: a name applied to the pungent fruits of certain plants and to the condiment prepared therefrom. Black pepper is the product of a climbing shrub belonging to the family PIPERACEÆ (*q. v.*), with a smooth, woody stem from 12 to 20 feet long, with leathery, ovate, cordate leaves, and, opposite to each leaf, a solitary spike with hermaphrodite flowers, and fruits of the size of a pea and bright red when ripe. The plant is a native of the East Indies, but now extensively cultivated in most tropical countries. It was known to the Romans, and highly appreciated during the Middle Ages, when a pound of pepper was considered a royal present. It is now one of the most common spices. The white pepper of commerce is the same product with the outer covering removed. Red pepper is the product of a species of *Capsicum*, a genus of the Nightshade family especially *C. annuum* and *C. frutescens*, natives of South America, but now widely dispersed in warm countries. From these the Chili and Cayenne peppers are made. The commercial product is prepared by grinding the dried ripe fruits, adding flour to the powder, and baking the whole into cakes. These cakes are then ground into commercial pepper. In temperate climates many varieties of red peppers are grown for home use and as an ingredient of mixed pickles. These kitchen-garden peppers, while immensely variable, are no doubt all offspring of *Capsicum annuum*. Over thirty varieties are now in cultivation in the U. S. The most pungent of these are the so-called Cayenne and Chili varieties, which bear very long and slender finger-like fruits. The mild varieties, or so-called "sweet peppers," are fruits of great size and are somewhat hollow and furrowed. The Bull Nose, Sweet Mountain, and Grossum are common sorts of this type. Red peppers need a warm, quick soil and a forward exposure. As they continue to bear until cut off by frost, the largest product is obtained when the plants are started under glass. Jamaica pepper is the product of a species of *Eugenia* of the family *Myrtaceæ*, and various other species of *Piper*, as *P. longum*, *P. officinarum*, *P. methysticum*, *and P. betle*, yield pepper or pepper-like products. Both pepper and capsicum are useful gastric stimulants and carminatives. Cubebs, used in medicine, are the product of *P. cubeba* (*Cubeba officinalis*). L. H. BAILEY.

Pepper, WILLIAM, M. D., LL. D.: eleventh provost of the University of Pennsylvania; specialist in medicine; b. in Philadelphia, Aug. 21, 1843; son of Dr. William Pepper (Professor of Theory and Practice of Medicine, University of Pennsylvania, 1860–64); graduated at the University of Pennsylvania 1862; from the medical department 1864; lecturer on morbid anatomy 1868–70, on clinical medicine 1870–76; Professor of Clinical Medicine 1876–87; Professor of Theory and Practice of Medicine, succeeding Dr. Stillé, 1887; unanimously elected provost of the university 1881; resigned in 1894. During his administration the material equipment of the institution increased in value not less than $2,500,000, and the Wharton School of Finance and Economy, the department of veterinary medicine, the School of Philosophy, the School of Biology, the School of American History, the department of archæology and palæontology, and the department of hygiene were added. He attended to his professional practice while organizing and moulding the university. He was medical director of the Centennial Exposition 1876, and for his services received from the King of Sweden the decoration of Knight Commander of the Order of St. Olaf. He was elected president of the Association of American Physicians 1891, and of the first Pan-American Medical Congress in Washington (1893). He founded *The Medical Times*, and was its editor 1870–71. His principal literary work was the editing of the *System of Medicine*, by American authors (1885–86). Among his contributions to journals or the transactions of societies are *Trephining in Cerebral Disease* (1871); *Local Treatment of Pulmonary Cavities* (1874); *Catarrhal Irritation* (1881); *Report on the Mineral Springs of America* (1881); *Epilepsy* (1883); *Phthisis in Pennsylvania* (1886). Other publications of less technical character are *Sanitary Relations of Hospitals* (1875); *Higher Medical Education: the True Interest of the Public and the Profession* (1877); *Report* of the Medical Department of the Centennial Exposition (1877). He was associate editor in charge of the department of medicine, surgery, and collateral sciences, *Johnson's Universal Cyclopædia*. D. in Pleasanton, Cal., July 28, 1898. C. H. THURBER.

Pepperell, Sir WILLIAM: b. at Kittery Point, Me., June 27, 1696, of Welsh descent; the son of a fisherman; became a merchant and a distinguished Indian fighter; was a member of the Massachusetts council 1727–59; became chief justice of the common pleas court 1730; captured Louisburg 1745; was made a baronet 1746; a colonel of the British army 1749; major-general 1755; lieutenant-general 1759; was acting Governor of Massachusetts 1756–58. D. at Kittery, Me., July 6, 1759.—WILLIAM PEPPERELL SPARHAWK, his grandson, took his name, title, and his great estates in 1774, but lost everything in consequence of his Tory principles in 1778. D. in London, Dec. 17, 1816.

Pepper Family: the PIPERACEÆ (*q. v.*).

Pepperidge: See BLACK-GUM.

Peppermint: a well-known labiate herb, the *Mentha piperita*, a native of the Old World, but completely naturalized in the New. This plant and its essential oil are extensively used in confectionery, and in medicine as a carminative and to conceal the flavor of nauseous drugs. Peppermint is extensively cultivated in Kalamazoo, St. Joseph, and Wayne cos., Mich., and in Wayne co., N. Y.

Pepsin [from Gr. *πέψις*, cooking, digesting, deriv. of *πέσσειν*, cook]: an active ferment of the gastric juice, secreted by the cells lining the "peptic" glands, and may be precipitated by alcohol or lead acetate. It has never yet been perfectly isolated, but is known to be one of the albuminoids or nitrogenous organic substances. Pepsin possesses the power of converting proteids into peptones in the presence of an acid and heat. It does not digest starches. Substances called pepsin, usually containing some of the active principle, are often prescribed in dyspepsia for the relief of the irritated stomach. Recently so pure a pepsin has been isolated that it will digest 25,000 times its own weight of albumen. Pepsin is usually derived from the stomach of the pig. Revised by H. A. HARE.

Peptonized Food: food prepared, through the action of pancreatin upon proteid substances, for the purpose of supplanting natural digestion in persons whose digestive apparatus is too feeble to carry out its function properly. This process of peptonization (see FERMENTATION) has become an exceedingly important one in dietetics, and is constantly resorted to. The method of peptonizing milk is as follows: From 5 to 20 grains of pancreatin and 5 grains of bicarbonate of sodium are added to a pint of milk at a temperature of 100°, and the process of peptonization is permitted to go on for varying lengths of time, according to the degree of digestion which is desired; 5, 10, or 20 minutes is the period generally allowed. After this time, if the digestive process is not stopped, the formation of a large amount of peptone gives such a bitter taste to the milk that most patients refuse to take it. Most of the pancreatin used for peptonizing foods is put up by manufacturing chemists in small glass tubes containing the proper quantities and ingredients for one process, or in compressed tablets containing the same quantity.

Peptonized beef is made in the same way by taking a quarter of a pound of finely minced lean beef, adding to it a pint of warm water, mixing it in a saucepan, and then

keeping the mixture at the temperature of the body, or a little above, for a few minutes. In the case of both the milk and the beef the process of peptonizing may be stopped in one or two ways, either by bringing the liquid to the boiling-point, which destroys the ferment, or by placing it upon ice, where it will rapidly cool. If it is desirable to stop the process absolutely, it is safer to bring the liquid to the boiling-point than to cool it. H. A. Hare.

Pepys, pep'is, or peps, Samuel: diarist; b. Feb. 23, 1633; the son of a London tailor; was educated at Huntingdon, and at Magdalene College, Cambridge; became a Roundhead, but turned Royalist under Monk; held various positions in the navy and was secretary to the admiralty under James II. He was imprisoned 1679–80 for alleged complicity in the popish plot; president of the Royal Society 1684–86, and was in 1690 imprisoned for a time as a Jacobite. D. in London, May 26, 1703. Pepys's *Diary*, kept in shorthand (1660–69), has been often imperfectly reprinted since 1825, when Lord Braybrooke's incomplete edition appeared. Bohn's edition, by H. B. Wheatley (8 vols.), gives the complete annotated text as rendered from the MS. by Rev. Mynors Bright, with the exception of some details of his and wife's ailments, and some coarse expressions and stories, all such omissions being indicated by dots. This work is instructive and entertaining, giving us a valuable insight into the everyday life of the times of the later Stuarts. His *Memoirs of the Royal Navy* (1690), *Portugal History* (1677), and other writings, are of some value. He was an industrious collector of ballads, prints, maps, and music, a dabbler in the various sciences and the fine arts, and founder of the Pepysian Library at Magdalene College, Cambridge. See H. B. Wheatley, *Samuel Pepys and the World he lived in* (London, 1880). Revised by H. A. Beers.

Pequod or Pequot Indians: See Algonquian Indians.

Pe'ra [from Gr. *πέραν*, beyond]: a suburb of Constantinople. The term has been applied since the sixth century to the formerly waste plateau N. of the Golden Horn and beyond Galata. This region began to be inhabited after the Ottoman Conquest (1453), and has become the diplomatic quarter of the metropolis and the chief residence of the foreign Christians. In the great fire of 1870 more than 1,000 persons lost their lives, and over 6,000 houses were consumed, but the suburb has been entirely rebuilt. E. A. G.

Peræ'a [= Lat. = Gr. *περαία* (sc. *γῆ*, land, or *χώρα*, region), liter., the farther country, the country beyond, fem. of *περαῖος*, lying farther, beyond, deriv. of *πέραν*, beyond]: any one of several districts lying beyond a river, strait, or sea, but used especially of that part of Trans-Jordanic Palestine which extended from Pella on the N. to Machærus on the S., and from Philadelphia on the E. to the Jordan on the W. These were its boundaries as given by Josephus in his *De Bello Judaico*, iii., 3, 3. It is there described as generally wild and rugged, though well watered by streams and fountains, and in some parts of it very fertile. The name has also been applied to the whole of Palestine beyond the Jordan. Peræa constituted one of the four provinces into which Herod, and later the Romans, divided Palestine.

Per Capita: See Descent.

Perception [from Lat. *percep'tio*, deriv. of *perci'pere*, *percep'tum*, seize, perceive, liter., take or get completely; *per-*, through, thoroughly + *ca'pere*, take]: the act of obtaining knowledge of external objects through or by means of the organs of sense, or of internal states and conditions by means of consciousness or intuition. It also signifies the result of such act. Application has been made of this term to signify cognition or thinking in general, including all the theoretical powers—sensation, representation, inference, and intuition. In this sense perception and volition would include all the powers of the mind. It is limited by many writers to external perception by means of the senses, and the higher activities of reason and reflection are regarded as modified sensation. The presence of inference or judgment in each act of sense-perception has been pointed out by Reid, Kant, Fichte, Hegel, Plato, and others. Erasmus Darwin made volition an essential element of higher perception—the association of ideas. In so far as attention underlies perception, the modifying influence of the will is obvious.

Historical.—The doctrine of the intervention of images arising from effluxes from sense-objects has played a great *rôle* in the history of philosophy. Empedocles (500 B. C.) first advanced this theory, explaining sense-perception through effluxes and pores, interpenetration and mixture of elements arising through the same; effluxes of fire and water to and from the eyes constituting sight; of air into the ears, producing sound; smell and taste being similarly caused. Cognition of the elements of things was held to be by means of corresponding elements in ourselves. Anaxagoras (500 B. C.) noted the principle of contrast in perception, and held that like is not known by like, but by unlike, thus repudiating the principle of identity as set up by Empedocles, and explaining perception through difference. The atomists Leucippus and Democritus (460 B. C.) taught the doctrine of effluxes modified to suit their doctrine of atoms. Atoms impinge on our senses and produce images. These thinkers also distinguished between obscure perception (*σκοτία*)—i. e. through the organs of sense—and clear perception (*γνησία*), through investigation. The doctrine of effluxes appears again with Epicurus (341–270 B. C.); sense-perceptions are mental images coming from the surfaces of things by efflux. Plato (427–347) pointed out the existence of inference in all sense-perception, and showed it to be necessary to reconcile the contradictory predicates which inhere in sense-objects by reason of their relativity. He found a higher form of perception in the cognition of ideas, which constitute the true in and for itself; sense-perception deals with the changing and variable. Aristotle (384–322 B. C.) held that sense-perception (*αἴσθησις*) is the result of qualities which exist potentially in the objects perceived, and actually in the perceiving subject. The seeing of colors, for example, depends on the activity of the medium of vision (air or water). In the active reason (*νοῦς ποιητικός*), which is the highest phase of the soul, will and perception are one; it is creative and cognitive in one. The Peripatetic Strato (288 B. C.) made this higher perception to be only a modification of the lower, and in this direction the Stoics tended, their prevalent doctrine being that sense-perception is the origin and criterion of all perception. St. Augustine, Thomas Aquinas, and Meister Eckhart held the doctrine of effluxes and images which were taken up into the soul through the senses; but with Aristotle, they distinguished from this the higher perception through the active reason, which gives us knowledge of divine truth. Descartes (1596–1650) laid great stress on the distinction between clear and obscure perceptions, making the former cognizant of eternal truths existing only in the mind, and the latter cognizant of external things and their affections. He separated soul from body so sharply that he was forced to explain their connection (in volition and sense-perception) by divine interference. Geulincx tried to explain the same by the doctrine of occasionalism, holding that through God's power our psychical activity is transmuted into corporeal, and the latter into the former. Malebranche unfolded this into the mystical doctrine that we perceive all things by participation in God's perception. Spinoza, however, abandoned the Cartesian dualism altogether for the doctrine of the unity of substance, which makes perception explicable. Leibnitz denied the theory of effluxes as a mere mechanical explanation, and set forth the more spiritual one of monads as perceiving-substances which reflect or represent within themselves, each, the entire universe. Obscure or insensible perceptions are those which are unaccompanied with consciousness or memory. The myriad of perceptions to which we do not direct our attention are of this order. The whole universe is latent, as it were, in each monad, existing in this form of insensible perception, which needs only to be aroused to consciousness to become actual knowledge. Thus even the lowest state of the monad—that simply of heavy matter—contains in its weight an obscure representation of the universe of matter, for the weight of each body depends upon the mass of all other bodies in space. Thus the entire history of each being and of all beings is contained in a dormant state in each being; and it is the activity of the soul which brings them to consciousness in the various grades of perception. The aggregate of these obscure or insensible perceptions makes up the instinct of animals, and the disposition, impulses, and emotions of man. Herbart (1776–1841) and Beneke (1798–1854) have pursued this thought of Leibnitz, and have made many valuable discoveries in psychology. The mutual arrest of opposing ideas in consciousness, and the power which one idea has of intensifying or obscuring and rendering latent another, as well as of combining, when latent, with other latent ideas and reappearing in consciousness in a new guise—the investigation of these phases of perception forms one of the most interesting chapters in modern psychology. Kant (1732–

1804) made time and space the *a priori* forms of sense-perception, and denied the objective validity of higher perception, limiting it to subjective forms. Reid (1710–96) taught that mind is active in sense-perception, every act being an act of judgment or inference. Common sense or higher perception cognizes necessary truths of inherence, causation, and design—truths which Kant had pronounced merely subjective. Sir William Hamilton agrees on the one hand with Reid in repudiating the intervention of images and material effluxes, but holds with Kant that we do not cognize things in themselves, thus rejecting Reid's common-sense theory. WILLIAM T. HARRIS.

Current Theories of Perception.—Leaving the general problems of the theory of knowledge to metaphysics, current psychological theories have to do only with the process of perception, considered as an operation of mind in attaining knowledge of the external world. That is, we have to answer the simple question, "How do we arrive at the knowledge of individual objects localized in space and time?" In view of the terms of this question and of the analysis which follows, we may define perception in a general way as *the process of the construction of our representation of the external world.*

A little reflection leads to the conclusion that our perception of the external world is a matter of mental construction. All advance into the region of mind must be through mental states. The characteristic of mind is consciousness, and nothing can enter the domain of mind except through the mediation of consciousness. This is seen in the fact that our images play in consciousness in such a way as sometimes to deceive us in regard to the external world. (See ILLUSION.) Many pathological facts show this. When the eye is deranged the mind is deceived in regard to colors and distances. When we have a cold our taste is impaired. When the hand is amputated, irritation of the nerve ends is still localized in the hand. This amounts to saying that the mental picture, which in every case is necessary to the perception of the object, is impaired or dissipated. The nervous system also intervenes between the mind and the world, and the proper activity of mind in representation depends upon the normal functioning of this system. This fact, that the mind deals with its images primarily and with external realities only through these images, is best seen when we consider that all mental states are modifications of consciousness itself, and that the perception of the external world, however real that world be, with its conditions of space and time, is possible only by some process of mind whereby these conditions can be mentally reconstructed and the data of experience cast in the forms of this reconstruction.

The construction of the representation of the external world is generally analyzed into three stages, which we may call *Discrimination*, *Localization*, and *Sense-intuition.*

Discrimination.—The beginning of all life experience is probably a state of general undifferentiated feeling. There are, at this beginning of sensation, no distinct forms for the different senses, no notion of externality, no perception either of one's own body or of things. It is easy to imagine one's self in that condition. All physical feeling is then vague, like the internal sensations which we can not localize or trace to their causes. It is probable that the muscular sense, with touch, constitutes almost the whole of this experience. The earliest transition from this state of general sensation is also probably due to touch and the muscular sense, through differences of intensity in feelings of resistance, and through the sense of locality in the body. The special organs of the other senses are more complex and must be adapted to their function of reporting impressions from without. Yet no step toward a real differentiation of sensations can take place till a reaction of consciousness is possible in the shape of *attention.* Definite sensations as such are not distinguished without attention. At first this attention is called "primary" or reflex; but by it the unordered and chaotic mass of sensation, which is thrown upon the helpless individual, is divided and distinguished. As this differentiation proceeds, each sense becomes a distinct source of experience, somewhat in the following order of development: muscular sense, touch, temperature, light, sound, taste, smell, color. The mere fact of differentiation, however, can give us no sense of difference between our own body and a foreign body. This distinction can arise only after we begin to localize our states; and even then all these states are located first in the bodily organs.

Localization.—By this is meant the mental reference of sensations to a locality in space. "Things," as we perceive them, are always in space. Whence does the perception of space arise, and to what factor in the perceiving process is it due? This is the question of the origin of the idea of space, one of the problems most discussed in general philosophy, and one to which contemporary psychology is fully alive.

In the perception of space relations by the muscular sense, touch, and sight, the senses through which it is accomplished, two classes of data seem to be involved. These data are of a physical kind, and serve as basis for a mental reaction. They are *muscular movements* and *local signs.*

Muscular Movement.—In the discussions of muscular sense, sensations of "effort" are usually distinguished from sensations of "resistance." Both of these seem necessary to the finished feeling of movement, though feelings of resistance play a predominating *rôle.* We learn from pathological cases that if the feeling of resistance be destroyed, a limb may be moved voluntarily, but there may be no knowledge of the actual movement, and, consequently, no indication of space position; but, on the other hand, the movement of a limb mechanically is felt as movement when there is no voluntary motor discharge. Hence, whether we hold that space is a succession of resistances, or that space is an original element in the muscular experience, we still find the element of muscular resistance in our first sensations of locality. The same influence of movement is found in the appreciation of space relations by the eye.

The muscular movements of the eye are of extreme delicacy and variety. There is for every point of the retina a fixed amount and direction of movement necessary to bring the center of clearest vision to that point; and when such a point, right, left, above, below, is excited there is at once a tendency to revolve the ball of the eye in such a way as to bring the line of vision through this point. This represents a given degree of central nervous discharge to bring about the muscular strain. Since movement of the eyes precedes vision, there are no means whereby such movement can be ruled out; and further, the influence it exerts in localization is seen in the fact that if one of the muscles of the eye be destroyed, so that no movement follows its stimulation, objects are localized as if this movement had taken place.

Local Signs.—The second kind of data required by modern theories is the local sign, by which is meant some character in each position on the skin and retina by which its peculiar location is reported. The doctrine was first propounded by Lotze.

Perception of Foreign Body.—The distinction between our own and a foreign body arises very early in child life, and is not subsequent to the completed idea of our own body. As we have seen, the perception of our own body as extended involves both distance or movement, and resistance. In the primary feeling of resistance we have the beginning of the perception of foreign body. The amount of movement or distance, measured in muscular sensation, indicates roughly, at first, but with great precision later, the localities of objects around us in reference to our own body. This is greatly aided by active touch and by sight. We feel round a body and give it the third dimension, which we have already found to be an attribute of our own body. The distinction between our own members and other objects is further assisted by the phenomenon of double touch; that is, the two sensations of touching and being touched, when we come in contact with our own skin. In paralysis our own limbs are to us as foreign bodies, inasmuch as the sensation of active touch is present alone. Another important series of double sensations arises when the child sees and also feels his own movements.

Sense-intuition.—The final factor in perception is the gathering up of all the data of sense, time, and place in the finished objects of the external world. This is sense-intuition. It is largely due to association, as is shown again by pathological cases. Injuries to the brain, either accidental (in man) or intended (in animals), may leave the creature with all his senses intact, but with no power to distinguish things, their uses, their nature, their relationships. This faculty probably demands the association in the brain of many centers bound together by the so-called "association fibers." On the side of consciousness it demands healthy and concentrated attention. See ASSOCIATION OF IDEAS, SUGGESTION, SENSATION, PSYCHOLOGY, ILLUSION, and INSANITY.

LITERATURE.—See the *Psychologies* of James, Höffding, Sully, Ladd, Baldwin; Hume, *Treatise on Human Nature*; Berkeley, *Principles of Knowledge*; Mill, *Examination of Hamilton*; Pikler, *Belief in Objective Existence*; articles

by Stout, Robertson, Baldwin, on *External Reality* in *Mind* (1890–91); Royce, *The External World and the Social Consciousness* (*Philos. Review*, Sept., 1894). J. M. Baldwin.

Per'ceval, Spencer: statesman; b. in London, England, Nov. 1, 1762; was the second son of John, Earl of Egmont; educated at Harrow and Cambridge; studied law at Lincoln's Inn; was called to the bar 1786; entered Parliament for Northampton 1796; became intimate with Pitt, through whose influence he was made solicitor-general in the Addington ministry 1801; was promoted to attorney-general 1802; conducted the prosecution in the celebrated Peltier case; was an active partisan of war with France and an opponent of Catholic emancipation; resigned office on the death of Pitt; became chancellor of the exchequer in the Portland cabinet Apr., 1807: succeeded the Duke of Portland as premier Oct., 1809; and was assassinated by John Bellingham in the lobby of the House of Commons May 11, 1812.

Perch [viâ O. Fr. from Lat. *per'ca* = Gr. *πέρκη*, perch; cf. *περκνός*, dark-colored: Sanskr. *pṛ̂çni*, spotted. The Teutonic cognate appears in Germ. *forelle*]: a name originally applied to the species of *Perca* or yellow perches (*Perca fluviatilis* of Europe (see Fishes for illustration), and the related American *Perca flavescens*). In the U. S., especially southward and westward, where the yellow perch is not found, the name is applied loosely to various spiny-rayed fishes. See Percidæ. Revised by D. S. Jordan.

Perchlo'rates: See Perchloric Acid.

Perchlo'ric Acid: a compound of chlorine, hydrogen, and oxygen. When potassium chlorate is heated for the purpose of making oxygen it first undergoes a change represented in the following equation, the products being oxygen, potassium chloride, and potassium perchlorate:

$$2\ KClO_3 = KCl + KClO_4 + O_2.$$

By treating potassium chlorate with sulphuric acid and heating, perchloric acid distills over in solution in water. When pure it is a colorless, fuming liquid of the composition $HClO_4$. It acts very energetically upon combustible substances, causing explosions in consequence of the ease with which it gives up its oxygen. *Perchlorates* are salts formed by the action of perchloric acid on bases. The potassium perchlorate formed when potassium chlorate is heated, as stated above, is a good example. Ira Remsen.

Per'cidæ [Mod. Lat., named from *per'ca*, the typical genus, from Lat. *per'ca*. See Perch]: a family of fishes typified by the common yellow perches of Europe and the U. S. The body is elongated; covered with ctenoid scales, and the head conic and more or less compressed; the mouth variable in size; teeth villiform, on the jaws as well as palate; branchial apertures ample; branchiostegal rays seven; dorsals two, the anterior with many spinous rays, the posterior with soft ones; anal small, far behind; ventrals thoracic, each with one spine and five rays. The skeleton has numerous vertebræ (in the perch 21 + 20 — 21); the stomach is cæcal, and pyloric cæca are developed. The family, as now limited, embraces only fresh-water fishes distinguished by the increased number of vertebræ and other associated characters. To it are to be referred, besides the large and familiar species of the group, numerous small fishes distributed among the fresh waters of the U. S., commonly known as Darters, and composing the genus *Etheostoma*. These small fishes, some seventy species in all, are confined to the eastern waters of the U. S., and are remarkable for their brilliancy of coloration, some of them surpassing in this respect all other fresh-water fishes whatsoever. These are concentrated perches fitted to a life on the rocky bottoms of swift streams. All the *Percidæ* are confined to the north temperate zone. The best-known genera are *Perca*, including the common yellow perches; *Lucioperca*, including the pike-perches; *Accrina*, represented by the ruffles of Europe; *Aspro*, confined to the Old World; *Etheostoma*, confined to the New World. Revised by D. S. Jordan.

Percop'sidæ [Mod. Lat., named from *Percop'sis*, the typical genus; *Perca*, perch + Gr. *ὄψις*, appearance]: a family of fishes represented by two genera, *Percopsis* and *Columbia*, confined to North America. The form is perch-like, with the mouth and the rough scales of the perch associated with the fins of a trout. The body is covered by moderate scales with comb-like margins; lateral line well defined and nearly straight, but somewhat concurrent with the back; head conical, compressed; opercular apparatus with all the bones present and unarmed; mouth small, but with a lateral cleft; upper jaw with its margin formed by the intermaxillary bones alone; teeth villiform on the jaws, but none on the palate; branchial apertures ample; branchiostegal rays six; one true dorsal fin, with mostly branched rays; an adipose fin also developed as in the Salmonids; the anal small; ventrals thoracic. The family was considered by Prof. Agassiz, who first described its type, as one of the most remarkable of living fishes, and was referred by him either to the vicinity of the *Percidæ*, or considered as perhaps the type of a peculiar order; it is now, however, generally admitted to be most closely related to certain South American forms (*Haplochitonidæ*, etc.), and more distantly to the *Salmonidæ*. Two species are known, the sand-roller (*Percopsis guttatus*), from the Great Lakes and the Western rivers, and *Columbia transmontana*, from the Columbia river.

Revised by D. S. Jordan.

Percussion [from Lat. *percus'sio*, deriv. of *percu'tere*, strike through or thoroughly; *per*, through, thoroughly + *qua'tere*, shake, strike]: in medicine, a peculiar branch of auscultation, by which the presence or absence of air and fluid in certain internal organs is ascertained by the aid of artificial sounds. These sounds are produced either directly by tapping with the fingers or a small hammer tipped with India-rubber on the surface of the body just above the place to be investigated, or mediately by the aid of a plexímeter, and struck either with the fingers or with a hammer. See Auscultation.

Percussion-caps: See Fulminates.

Percy: a noted family of England, descended from William de Percy, who was a companion of William the Conqueror, and derived his name from the village of Percy in Normandy. The barony of Alnwick was acquired by Henry de Percy in the reign of Edward I. His grandson having married into the royal Lancastrian family, Henry Percy, father of the celebrated Hotspur, was created Earl of Northumberland in 1377 by Richard II. The first four earls of this family took prominent parts in the wars of the Roses, and all perished in battle or by assassination. The title became extinct in 1537, but was revived in 1557 in favor of Thomas Percy, who was beheaded at York 1572 for conspiring against Elizabeth. His brother Henry, eighth earl, was charged with conspiring in favor of Mary, Queen of Scots, and was murdered in the Tower of London June 21, 1585; Henry, the ninth earl, was imprisoned many years in the Tower for alleged participation in the Gunpowder Plot of 1605. The title having again become extinct in 1670, it was revived in 1749 in favor of Seymour, Duke of Somerset, a grandson of the last earl. His son-in-law, Sir Hugh Smithson, took the name of Percy, succeeded by permission of Parliament to the earldom in 1750, and was made first Duke of Northumberland 1766. His son, Hugh (known as Earl Percy), was engaged in the battle of Lexington, suceeeded to the dukedom June 6, 1786, and died July 10, 1817. The career of his son, Algernon Percy, fourth duke, has been given under the title Northumberland, Duke of.—The present representative of the family is Algernon George Percy, LL. D., sixth duke, b. May 2, 1810, who succeeded to the title Aug. 22, 1867, and became Lord of the Admiralty 1858. Northumberland House, Charing Cross, the London residence of the Percies for many generations, was sold to the board of public works in 1873 for £500,000, to be pulled down for the opening of a new street, and the duke employed a considerable part of that sum in the improvement of Trafalgar Square.

Percy, Henry (surnamed Hotspur): son of the first Earl of Northumberland; b. in England May 20, 1364; became famous in the wars of France and of the Scottish border; defeated and killed Douglas at Otterburn (Chevy Chase) 1388; joined Henry of Lancaster 1399, aiding him to obtain the English throne; was rewarded with the wardenship of the East Marches and the gift of the Isle of Man; was distinguished at the battle of Homildon Hill 1402; took up arms with his father to place Mortimer, Earl of March, on the throne, and was killed at the battle of Shrewsbury, July 21, 1403. He is immortalized in Shakspeare's *Henry IV.*

Percy, Thomas: clergyman and author; b. at Bridgenorth, Shropshire, England, Apr. 13, 1728; was educated at Christ Church, Oxford, where he took his master's degree 1753; became vicar of Easton Maudit and rector of Wilby 1756; and Bishop of Dromore, Ireland, 1782. D. at Dromore, Sept. 30, 1811. His best-known work, *The Reliques of Ancient English Poetry* (1765), had a wide influence in develop-

ing a taste for ballad literature and antiquities. It has been repeatedly published, e. g. edited by H. B. Wheatley (3 vols., London, 1891); by R. A. Willmott (1893): and the folio MS. reprinted by J. W. Hales and F. J. Furnivall (3 vols., 1868), with *Life* by J. Pickford. He translated Mallet's *Northern Antiquities* (1770, now in Bohn's Library), and collected a mass of ancient tales and poetry which were not printed until 1868. Among his other works is a *Key to the New Testament.* Revised by H. A. Beers.

Perdic'cas (in Gr. Περδίκκας): the name of several kings of Macedonia—(1) the founder of the dynasty, an Argive, who became king about 700 B. C.; (2) Perdiccas II. reigned from 454–413 B. C.; (3) Perdiccas III. reigned from 365–360 B. C.: (4) a prince of the royal blood and general of Alexander the Great. When on his death-bed Alexander gave him his ring, the symbol of the royal power; he held the empire together for a short time by his superior energy and talents, but when it became evident that he himself aspired to the crown, a coalition was formed against him by Antipater, Craterus, and Ptolemy, and on his expedition against Ptolemy he was assassinated in 321 B. C., near Memphis, by his own soldiers. Revised by J. R. S. Sterrett.

Pereda, pā-rā'dăa, José María, de: novelist; b. at Santander, Spain, in 1833. His first repute as a writer came from his remarkable knowledge of all the peculiarities of the life of his native region—*La Montaña*, as it is commonly called in Spain. With almost photographic accuracy, but with great literary skill, he reproduced this life in the sketches which about 1859 began to appear in the journal called *La Abeja Montañesa*, of Santander. In 1864 he collected these sketches in his first book, entitled *Escenas montañesas.* For some years he continued to produce only such brief pictures of the land and people he was familiar with—*Tipos y paisajes* (1871); *Bocetos al temple* (1876); *Tipos trashumantes* (1877). In 1877 began a new period in his literary career, with the story *El Buey Suelto*, of ampler dimensions, though still a picture of manners rather than a novel. In 1878 came the study of political intrigue, *Don Gonzalo González de la Gonzalera*, though this also had had a predecessor in the story *Los hombres de pró*, written in 1872, but published in the volume *Bocetos al temple.* In 1879 appeared *De tal palo, tal astilla*, in which at last there is something of both the amplitude and the repose of a complete work of art. This was followed in 1881 by another volume of sketches, *Esbozos y rasguños*, and by the novel *El sabor de la tierruca.* Since these Pereda has published the stories *Pedro Sánchez* (1883); *Sotileza* (a study of Galician fisher-life, 1884); *La Montálvez* (1887); *La Puchera* (1888); *Nubes de estío* (1891); and *Al primer vuelo: Idilio vulgar* (1891). Pereda is one of the greatest masters in Spain of the novel of description or manners. Not a "naturalist," or realist, by theory, he yet is primarily an observer of fact, not an imaginative creator. So rich and powerful is his style, however, that his work rises into the domain of art. The *Obras completas de D. José M. de Pereda* began to appear in Madrid in 1889, and up to 1891 fifteen volumes had been issued. A. R. Marsh.

Per'egrine Falcon [*peregrine* is from Lat. *peregri'nus* (whence Eng. *pilgrim*), migratory, coming from foreign parts, deriv. of *peregre*, "in the country"; *per* + *ager*, field]: a hawk formerly much used in falconry; the *Falco peregrinus* of ornithologists. It is bold, graceful, swift, docile, strong, and destructive, and was the favorite among the noble falcons, though less powerful than the lanner and the jerfalcon. The female peregrine is the bird which is, *par excellence*, called falcon; the male is the tercel, and is smaller than his mate. See also Falcon.

Perei'ra, Jonathan, M. D., F. R. S.: pharmacologist and therapeutist; b. in Shoreditch, London, May 22, 1804; studied at Finsbury for four years; received a medical education; was licensed by the apothecaries 1823; became fellow of the Royal College of Surgeons 1825; apothecary and chemical lecturer to the Aldersgate Street Dispensary 1823: Professor of Materia Medica in the same school 1832; in 1833 Professor of Chemistry in London Hospital; took the doctor's degree at Erlangen 1840; became a fellow of the Royal College of Physicians 1845; physician to the London Hospital 1851: was one of the examiners of London University. D. in London, Jan. 20, 1853. His great work was the *Elements of Materia Medica and Therapeutics* (1839–40), still a standard authority; also published a *Treatise on Diet* (1843), *Lectures on Polarized Light* (1843), and other works.
Revised by S. T. Armstrong.

Perei'ra da Sil'va, João Manoel: historian; b. at Rio de Janeiro, Brazil, Aug. 30, 1817. He graduated in law at Paris, and settled at Rio de Janeiro where, after 1844, he was somewhat prominent in politics. His works are voluminous, and deal mainly with modern Brazilian history and biography. They include: *Plutarco Brasileiro* (1847), enlarged and republished as *Varões illustres do Brasil* (1858); *Historia da fundação do Imperio Brasileiro* (7 vols., 1864–68); *Segundo periodo do reinado de D. Pedro I.* (1871); and *Historia do Brasil de 1831 á 1840* (1878). H. H. S.

Perekop: town in the government of Taurida, European Russia; on the isthmus of the same name, which connects the Crimea with the mainland (see map of Russia, ref. 10–D). The town, which was formerly strongly fortified, is still of great strategical and commercial importance, as it is situated at a point where all the roads leading from Southern Russia into the Crimea connect. The preliminary works for a ship-canal through the isthmus were completed in 1889. Pop. about 5,000.

Pe'rez (Sp. pron. pā'reth), Antonio: b. at Monreal de Ariza, Aragon, Spain, in 1541; natural son of Gonzalo Perez, who was long a secretary of Charles V. and Philip II.; educated at the University of Louvain, studying also at Venice and at Madrid; became Secretary of State to Philip II. on the death of his father in 1567; was the chief agent of that treacherous monarch in many of his secret crimes, especially in the assassination of Juan de Escovedo 1578; was tried for that crime, imprisoned, and exiled from the court; was again arrested for the same crime in 1590, when, being put to the torture, he confessed the act, but accused the king of complicity; escaped to Aragon in April, where he placed himself under the protection of the *fueros* or privileges of that kingdom; was twice seized by royal command and handed over to the Inquisition, but on both occasions released by the people, thus giving rise to a rebellion which ended in the suppression of the *fueros* of Aragon. Perez escaped to France Nov., 1591; resided in England as secret agent of Henry IV. 1593–95; published in London his *Relaciones*, giving his own account of his romantic adventures (1594), and was the author of *Cartas Familiares* and several other works, elegantly written. D. in Paris, Nov. 3, 1611. See Mignet's *Antoine Perez et Philippe II.* (1845).

Pérez de Hita, Ginés: Spanish romancer and historian, the dates of whose birth and death are alike unknown. The one assured fact of his biography is that he took part as a soldier in the cruel campaign against the revolted Spanish Moors (1568–71). He was probably a citizen of Murcia, though there are reasons for thinking that his birthplace was the town of Mula, some 20 miles W. of Murcia. The fame of Pérez de Hita comes from the work, in two parts, commonly known as the *Guerras civiles de Granada.* The first of these, purporting to be a history, was published in Saragossa in 1595. (An edition of Alcalá (1588) is mentioned in some bibliographies, but seems uncertain.) The work is not a history, but an historical romance based upon popular tradition, and as a work of fiction is very notable. The second part, published in Barcelona in 1619 (written, however, and perhaps published, in 1604), deals with events seventy years later than those of the first part—in fact, the events of that very campaign against the Moors in which Pérez de Hita had himself taken part. Here there is much of historical fact, but here also the author has added romantic embellishments. Numerous editions of the work as a whole have appeared even down to the present day. Calderón took the story of Tuzani (*Guerras de Granada*, 2a parte, cap. xxii., xxiii., xxiv.) for the theme of one of the finest of his plays, *Amor después de la Muerte.* In France Mme. de Scudéry founded upon the work of Pérez de Hita her romance, *L'Almahide*, which in its turn gave rise to a long series of romances and plays. Later we have also in France the *Gonsalve de Cordoue* of Florian, and *L'Abencerrage* of Chateaubriand, both based on the same material. Finally, we have in the U. S. the famous *Conquest of Granada* of Washington Irving, which reproduces both in its affectation of historical accuracy and its romantic coloring its original. The best edition of the *Guerras de Granada* is in volume iii. of Rivadeneyra's *Biblioteca de Autores Españoles* (Madrid, 1876). A. R. Marsh.

Pérez de Montalván, Juan: See Montalván, Juan Pérez, de.

Pérez Galdós, Benito: Spanish novelist: b. at Las Palmas, Canary islands, May 10, 1845. In 1863 he went to

Madrid to study law, but with little affection for the profession. He already inclined toward letters, and soon tried his hand at writing pieces for the stage, none of which had sufficient merit to be actually produced. In 1867 he had the happy inspiration to write a novel, *La Fontana de Oro*, on which he worked for several years, finally publishing it in 1871. The success of this encouraged him to write a second story, *El Audaz*, published in 1872. Both these tales were essentially historical romances, dealing with events in Spanish history of the years 1820–23 and 1804 respectively. Through them Pérez Galdós entered upon his two long series of historical novels, called by him *Episodios Nacionales*, dealing either with the period of struggle against Napoleon, or with the agitation of the contest of Spanish liberalism against the tyranny of Ferdinand VII. The first of these works was *Trafalgar*, written in 1873, and it has been succeeded by the following volumes of the first series: *La Corte de Carlos IV.*; *El 19 de Marzo y el 2 de Mayo*; *Bailén*; *Napoleón en Chamartín*; *Zaragoza*; *Gerona*; *Cádiz*; *Juan Martín el Empecinado*; *La batalla de los Arapiles.* To the second series belong *El Equipaje del Rey José*; *Memorias de un Cortesano de 1815*; *La segunda casaca*; *El Grande Oriente*; *7 de Julio*; *Los cien mil hijos de San Luis*; *El Terror de 1824*; *Un voluntario realista*; *Los Apostólicos*; *Un faccioso más y algunos frailes menos.* In these works Pérez Galdós shows clearly the influences of Erckmann-Chatrian, but at the same time he tells his story always with a force and purity of style peculiar to himself, and notable enough to give him a foremost place among living novelists. More original in matter and more interesting to others than Spaniards are the novels called by their author *Novelas españolas contemporáneas.* Among these are *Doña Perfecta*; *Gloria*; *Marianela*; *La familia de León Roch*; *La Desheredada*; *El Amigo Manso*; *El Doctor Centeno*; *Tormento*; *La de Bringas*; *Lo Prohibido*; *Fortunata y Jacinta*; *Miau*; *La Incógnita.* In all these works are to be found both truth to social fact and imaginative rendering of that fact in a very unusual degree. This results perhaps from the circumstance that while Pérez Galdós has felt deeply the so-called realistic tendencies of recent literature, he has not blindly accepted the theories of the French school of realists. His chief admiration is the English, not the French, novel; and certainly both his style and his matter show a happy combination of manliness and uprightness of feeling with desire to state the truth as it is. Of late years Pérez Galdós has lived chiefly in Madrid, varying his literary labors with those of a deputy, representing Puerto Rico. He has also been long the editor of the best Spanish periodical, the *Revista de España.* In politics he is an ardent upholder of the liberal-monarchical—i. e. constitutional—party. There are numerous editions of all Pérez Galdós's novels. See Leopoldo Alas (Clarín), *Benito Pérez Galdós, estudio crítico-biográfico* (Madrid, 1889).

A. R. Marsh.

Perfectionism: the doctrine held by many, both Roman Catholics and Protestants, that it is possible to lead a sinless life. The former maintain that the law of God may be and frequently is perfectly obeyed, yet that no man is entirely free from venial sins—i. e. those which do not send the soul to perdition. They claim that as a matter of fact many do lead perfect lives, and even accumulate a fund of supererogatory merit. The commonest teaching on the subject among Protestants proceeds from the Methodists, who assert that it is possible to live in complete conformity to God's law; yet not so that one is entirely free from errors and infirmities. There is, however, no inward disposition to sin, and no outward commission of it, so there is what is called "Christian perfection." President Asa Mahan, of Oberlin University, Ohio, and Prof. Charles G. Finney, both Congregationalists, taught that one could attain that state of devotedness to God which is required by the moral law. So among the Society of Friends it has been held that the justified may be free from actual sin; but the Lutheran and Reformed creeds agree in maintaining that "sanctification is never perfected in this life; that sin is not in any case entirely subdued; so that the most advanced believer has need so long as he continues in the flesh daily to pray for the forgiveness of sins" (C. Hodge). Those who accept these creeds agree also that perfection with those who claim it is a relative term; that it is based upon a comparatively shallow conception of the holiness of God and the deceitfulness of sin. They assert that the godly who lay no claim to perfection do live as holily as those who do, but both are faulty, and that the claim to be perfect is one which no one can make without great risk of spiritual pride.

Samuel Macauley Jackson.

Perfumery: See the Appendix.

Pergamus, or **Pergamum**: an ancient city of Mysia, Asia Minor; founded by Greek colonists on the northern bank of the river Caïcus, 120 stadia (less than 15 miles) from the sea. In the confusion which reigned after the death of Alexander the Great, the city became important as the stronghold of Lysimachus. His governor, Philetærus, made himself independent, and Attalus I. (241–197 B. C.) succeeded in establishing a kingdom, of which Pergamus became the capital. The Romans favored this new state as a useful ally against Macedonia and Syria, and at different times Phrygia, Lydia, Pisidia, Lycaonia, and Pamphylia were added to it. Meanwhile the capital became one of the greatest and most magnificent cities of Asia Minor, celebrated for its architectural monuments, its splendid library, its grammar school, its invention of parchment, etc. King Attalus III. (133 B. C.) bequeathed his possessions to the Romans, and they made Pergamus the focus of all the great military and commercial routes of Asia Minor. Under the Byzantine rule it rapidly declined, but extensive ruins around the modern Bergama (*q. v.*) testify to its former importance.

Periander: See Corinth.

Perianth: See Flower.

Pericarditis: See Heart Disease.

Pericar'dium [Mod. Lat., from Gr. *περικάρδιον*; *περί*, around + *καρδία*, heart]: the fibro-serous sac which surrounds the heart. Its outer fibrous part is very dense and strong; its inner or serous lining membrane is continuous with that which covers the heart. It secretes a thin lubricating serous fluid which facilitates the motions of the heart. See Heart.

Per'icles [= Lat. = Gr. *Περικλῆς*, *Περικλέης*, liter., far-famed: *περί*, around + *κλέος*, fame]: statesman; b. at Athens about 495 B. C., descended on the father's side from the Pisistratidæ, on the mother's from the Alcmæonidæ; received the instruction of Zeno and Anaxagoras; served with distinction in the army, and entered, about 469 B. C., on his political career as a member of the democratic party. He proposed laws according to which the funds of the public treasury were employed for the benefit of the poorer classes. It became the law that citizens should be paid when serving in the army, on a jury, or when performing any other public duty, even when attending the religious festivals; and thereby it became possible for the poorer classes to take part more actively in public life. By these laws Pericles gained the attention and favor of his party, and soon he attained the absolute leadership of it by his eminent talents, his irresistible eloquence, his adroitness in party manœuvring, and his wise plans. A great victory was achieved over the aristocratic party in 461 B. C.; its position was undermined and its leader was crushed. The Areopagus, which was the principal political organ of the Athenian oligarchy, lost almost entirely its influence as a party organ by the introduction of a new jury system; and after his unsuccessful campaign against Mt. Ithome, Cimon was impeached, and shortly after banished by ostracism. Pericles was now in reality the ruler of the state. Cimon was recalled in 454 B. C., but on the proposition of Pericles, and it was said that there existed an agreement between them, according to which Cimon should command the army on its foreign expeditions and Pericles govern at home. After the death of Cimon, in 449 B. C., the aristocratic party was reorganized by one Thucydides, and once more arrayed against Pericles. In 444 B. C. Pericles was accused of squandering the public money or employing it for inappropriate purposes, but the attempt to overthrow him failed. Thucydides was banished by ostracism, and henceforth there existed in Athens no really effective opposition to Pericles. He was arraigned once more for embezzling some of the gold destined for the statue of Athene in the Parthenon; his friends were repeatedly attacked; Phidias died in prison, Anaxagoras was banished, and Aspasia was saved only by great exertions; but these and other similar events were nothing more than the outbursts of a desperate envy and maliciousness. There is no instance in which any important measure of Pericles was frustrated by an internal opposition. It was the great aim of his policy to make Athens the brilliant and magnificent political center of a united Greece. He opposed his countrymen's extravagant plans of conquest in Egypt, Car-

thage, or Sicily, and concentrated his whole energy on the affairs of Greece herself. Athens stood at the head of a confederacy of several Greek states for defense against a possible Persian invasion. This confederacy held its meetings and kept its treasury at Delos. By Pericles's dexterous negotiations both the meetings and the treasury were transferred to Athens; furthermore, the contributions of the allies were commuted from actual service to a sum of money, for which Athens alone undertook to furnish the whole military armament. Thus the supremacy of Athens was established, and it was further developed by the successful settlement of new colonies, by supporting the democratic parties in the Greek states, etc. Of great influence too in this respect were the magnificence of the city and the splendor of the life led in it. It was the time of Phidias, Socrates, Sophocles. The Parthenon, the first Odeon, and the Propylæa were built. Commerce flourished, and many branches of industry were carried to perfection; but Athens had an unrelenting rival in the Spartan aristocracy. The Peloponnesian war drew nearer and nearer, and, although Pericles warded it off for several years by bribery, at last it became inevitable. In the same year that it broke out the city was fearfully devastated by the plague. Next year Pericles died (429 B. C.), and with his death began the decline of Athens.

Revised by J. R. S. Sterrett.

Pericles, Age of: See Architecture.

Peridot: See Chrysolite.

Peridotite [from *peridot*, French name for chrysolite or olivine]: an important group of very basic, ferro-magnesian, igneous rocks, free from feldspar, and having as their essential constituent the mineral olivine. Peridotites are subdivided according to the minerals which they contain beside olivine as follows: *picrite* (+ augite), *harzburgite* (+ enstatite), *buchnerite* (+ augite + enstatite), *wehrlite* (+ diallage), *lherzolite* (+ diallage + enstatite), *cortlandtite* (+ enstatite + hornblende), *scyelite* (+ biotite), *dunite* (+ chromite).

The peridotites are holocrystalline rocks usually with an evenly granular structure. They are generally considered to be of igneous origin, and have been definitely proved to be so in some cases. Their component minerals so readily change to serpentine that rocks of this class may be regarded as having given rise to many of the masses of serpentine so common in the older geological formations of the globe. Some of the types of peridotite find their equivalents among the meteoric stones.

Another group of ferro-magnesian rocks closely allied to the peridotites is called by the collective name *pyroxenite*. These rocks contain too little alumina to allow of the formation of feldspar, and also too much silica to permit the crystallization of olivine. They are composed essentially of pyroxene in different varieties, and may be subdivided, like the peridotites, into bronzitite, diallagite, websterite (bronzite + diallage), etc.

G. H. Williams.

Perier, pe-ri-ā′, Casimir: politician; b. at Grenoble, department of Isère, France, Oct. 21, 1777; was educated at Lyons; served for a short time in the army; engaged then in the large and prosperous banking business established at Paris by his father and elder brother; was elected a member of the Chamber of Deputies in 1817, and became one of the leaders of the opposition under Charles X. After the Revolution of July, 1830, he was prime minister to Louis Philippe, from Mar. 13, 1831, to his death, May 16, 1832, and as such he occupied a distinctly defined standpoint, the so-called *juste-milieu*, which he vindicated with great vigor, and also with partial success. Attempts at insurrection were speedily put down, and his resistance to the differently colored tendencies of anarchy, ultramontane and radical, which showed themselves in France after 1830, was very effective. Guizot, who in several respects was his political disciple and heir, has given a very vivid and impressive picture of him in his *Mémoires*. His speeches, etc., were published, with a biographical notice by Charles de Rémusat, as *Opinions et discours* (4 vols., Paris, 1834).

Revised by A. G. Canfield.

Periers, pe-ri-ā′, Jean Bonaventure, des: author: b. in Burgundy, France, at the end of the fifteenth century; though poor, had a liberal education, and found a protector in Marguerite of Navarre. From 1531 to 1537 he was engaged upon the translation of the *Lysis* of Plato, in aiding Étienne Dolet on his *Commentarii linguæ latinæ*, and other scholarly labors. In 1537 he published the *Cymbalum mundi*, a veiled attack on religion, which was burned by the *parlement*, lost him the patronage of Marguerite, and drew to him such universal suspicion that he committed suicide about 1544. His best-known work is his *Nouvelles récréations et joyeux devis*, a collection of short stories reviving somewhat the matter and the spirit of the old *fableaux*. His works have been edited by Lacour (2 vols., Paris, 1866); the *Cymbalum mundi*, with a valuable commentary, by F. Frank (Paris, 1874).

A. G. Canfield.

Per'igee [Gr. περί, around, near + γῆ, earth]: in astronomy, that point of the moon's orbit which is nearest to the earth. Anciently, when the sun and planets were supposed to circulate around the earth, the term was also applied to them.

Périgueux, pā′rĕĕ′gö′ (anc. *Vesunna*): town; in the department of Dordogne, France; on the right bank of the Isle, a tributary of the Dordogne, 95 miles by rail N. E. of Bordeaux (see map of France, ref. 7–D). The old part of the city, containing the magnificent cathedral and many interesting Roman remains, consists of narrow and gloomy streets, but it is encircled by new and elegant boulevards occupying the site of the old walls and ramparts. A large trade in liqueurs, truffles, partridges, and wine, and some manufactures of paper and woolens are carried on. Pop. (1896) 31,313.

Perihe'lion [Gr. περί, around, near + ἥλιος, sun]: in astronomy, that point in the orbit of a planet or comet which is nearest to the sun. Its position or longitude is one of the elements by which the orbit is determined.

Perim, pā-reem′: a small island belonging to Great Britain, in the Strait of Bab-el-Mandeb, at the entrance of the Red Sea, 19 miles from the African coast and 1½ mile from the Arabian. Area, 7 sq. miles. It rises about 230 feet from the sea, is rocky, nearly destitute of vegetation, and without water, but it has a good harbor on its southern coast, and its fortifications command the strait on both sides. Perim was first occupied by the British in 1799, while Napoleon was in Egypt. It was given up in 1801, but again occupied and fortified in 1857, on account of the cutting of the Suez Canal. In 1883 it was made a coaling station. The island is under the jurisdiction of the governor of Bombay Presidency. Pop. about 400.

Perimeter: See Recording Apparatus, Psychological, in the Appendix.

Periodical: any publication appearing at stated intervals. In current usage the word is applied only to publications composed of miscellaneous articles, appearing less often than once a week and more frequently than once a year, thus excluding the daily and weekly newspapers on the one hand, and annual publications, such as almanacs, directories, etc., on the other. Using the word in this restricted sense, periodicals may be roughly divided into three main groups: (1) Magazines and reviews devoted to general literature and science; (2) what may be termed class periodicals, devoted to particular branches of science, art, or industry; (3) publications of academies and societies, though in this group it is often difficult to determine what is and what is not entitled to be called a periodical. As regards form, by far the greater number of periodicals in the English language are monthly publications, and the same may be said of continental European periodicals as a whole, though in France and Italy the fortnightly is a favorite form, and in Germany a large and constantly increasing number of periodicals are issued at irregular intervals.

The earliest representative of the modern periodical is generally considered to be the still flourishing *Journal des Savants*, which began its career in Jan., 1665, as a weekly review of literary events, but, after the thirteenth number, was issued at irregular intervals down to 1723, when it suspended publication, to reappear as a monthly in 1724; after several subsequent interruptions it was finally re-established in 1816 as the organ of the French Academy, and is now edited by a committee of scholars under the auspices of the Minister of Public Instruction. Though the origin of the modern periodical may thus be traced back to the seventeenth century, its development was slow, and the periodicals of the seventeenth and eighteenth centuries were neither numerous nor of great importance. Thus we find that of the 5,100 scientific and technical periodicals recorded in Bolton's catalogue as published during the period from 1665 to 1882, apparently not more than eighty were in existence before 1800, and of the 232 literary periodicals important

enough to be included in Poole's *Index to English Literature*, only three date back to 1800. The foundation of *The Edinburgh Review* in 1802 may be taken as the starting-point of this remarkable development of English periodical literature, and in tracing its course we find that the decade from 1840 to 1850 was notably prolific in new periodicals, as was also the decade from 1860 to 1870, which was marked by the rise of the shilling magazines. In the U. S. the periodicals of the eighteenth century were few, and, as a rule, had but a brief existence. It was not till about the middle of the nineteenth century that what we now regard as the distinctively American type of monthly magazine began to appear. The illustrations which form one of the characteristic features of this type, at first crude and coarse in execution, have now been brought to a high degree of perfection.

It is almost impossible to obtain accurate statistics of the number of periodicals now appearing throughout the world, but taking the best available statistics for the U. S. alone we find that in 1892 the total number of all kinds of periodicals published in the U. S., excluding newspapers and annuals, was 3,309. Of these, 307 appeared fortnightly, 2,754 monthly, 56 bi-monthly, and 192 quarterly. These figures may give some idea of the enormous number of periodicals now published. In every country of the civilized world each science, art, and industry has its own special journals.

The few really valuable and important papers which see the light in periodicals would soon lie buried in the mass of forgotten or neglected journals were it not for the existence of indexes and special bibliographies which furnish a clew to this labyrinth of literature. Among the more important of these indexes are the following: Poole and Fletcher's *Index to Periodical Literature* (from 1800 to 1882), with its two supplements (1883–87 and 1887–92); it includes only periodicals in the English language, and purely professional and scientific journals are generally omitted. A continuation of this is *The Annual Literary Index* (1892–93). An annual *Index to Periodical Literature* is also published by *The Review of Reviews*. The *Catalogue of Scientific Papers* (1800–63), compiled and published by the Royal Society of London, with its two supplements (1863–73 and 1873–83), is an alphabetical index, by authors, of scientific papers contained in the transactions of societies, journals, and other periodical works which have been published throughout the world since the beginning of the nineteenth century, excluding such papers as are purely literary, technical, or professional. For technical literature an admirable guide is provided by the *Repertorium der technischen Journal-Litteratur*, now published annually in Berlin under the auspices of the German Patent Office. This index, begun by Schubarth, with an index covering the period from 1823 to 1853, and continued by Kerl and Rieth, gives under subject-headings the contents of all the important technical periodicals of the world. The *Index Medicus*, edited by Billings and Fletcher and published monthly, supplies a classified subject-index of the current medical literature of the world. A very full list of special bibliographies and of indexes to periodicals is given in the *Handbook for Readers*, issued by the Boston Public Library.

Of periodicals themselves there exists no universal catalogue. Probably the volumes of the British Museum *Catalogue* devoted to *Academies* and *Periodicals* give the largest and fullest general list of periodicals to be found anywhere. For scientific periodicals we have Bolton's *Catalogue of Scientific and Technical Periodicals, 1665–1882*, published by the Smithsonian Institution; this was intended to contain the principal independent periodicals of any branch of pure and applied science published in all countries down to 1882, but medical periodicals and serials published by scientific societies are not included. This is supplemented by Scudder's *Catalogue of Scientific Serials of all Countries, including the Transactions of Learned Societies in the Natural, Physical, and Mathematical Sciences, 1633–1876*, published by Harvard University.

For the current periodicals of different countries, reference must be made to such annual publications as the *American Newspaper Directory* for the U. S., May's *British and Irish Press Guide* for Great Britain, *Annuaire de la Presse française* for France, *Deutscher Journal-Katalog* for Germany, etc. The growth of the periodical press in the U. S. is well described in North's *History and Present Condition of the Newspaper and Periodical Press of the United States, with a Catalogue of the Publications of the Census Year*, in vol. viii. of the tenth census of the U. S.

G. W. Harris.

Periodic Law: See Chemistry.

Periœ'ci [= Lat. = Gr. *περίοικοι*, plur. of *περίοικος*, dwelling around; *περί*, around + *οἶκος*, house, dwelling]: in Laconia and other ancient Dorian lands, the descendants of the more ancient inhabitants of the country. The Periœci were freemen, and not strictly vassals, much less serfs like the Helots, but they were inferior in social rank and political rights to the Spartiatæ. They occupied the inferior kind of lands, were artisans, merchants, and sailors, and had at times a share in the government. They might, at least at some periods, intermarry with the Dorians, and they served in war even as hoplites, though not in the same corps with Dorians. They were in many cases people of wealth and refinement.

Revised by J. R. S. Sterrett.

Perios'teum [Mod. Lat., from Gr. *περιόστεος*, surrounding bones; *περί*, around + *ὀστέον*, bone]: the strong fibrous membrane which surrounds the bones, excepting only the parts covered with cartilage. It is found also around the roots of the teeth, and lines the sockets in which the teeth are fixed. That which covers the outside of the skull is the *pericranium*, and that within the skull is the *dura mater*; but the *dura mater* of the spinal cord is distinct from the periosteum. The periosteal membrane is called *endosteum* when it lines the medullary cavity of a bone. The periosteum is continuous with the tendons and ligaments. It is very vascular, and plays an important part in the growth and nutrition of bone. Thus, in operations for the removal of diseased bone the periosteum should be carefully peeled off and left *in situ*, and in many cases new and healthy bone will be developed from it, especially if the patient be young. See Histology (*Bone*). Revised by W. Pepper.

Periosti'tis [Mod. Lat.; *perios'teum* (which see) + suffix *-itis*, denoting a disease of]: the inflammation of the periosteum; sometimes caused by a syphilitic, scrofulous, or perhaps rheumatic dyscrasia, or by injury; it is also very commonly induced in boys and young men by a sudden exposure to severe cold, as by bathing in very cold water after violent exercise, by standing long in cold water, and the like. It is a very painful disease, and is best treated by local poultices, by opiates, and by free incisions. Cases due to any specific cause will require special constitutional treatment.

Revised by W. Pepper.

Peripatetic Philosophy: See Aristotle.

Peripatus: See Onychophora.

Perissodac'tyla [Mod. Lat.; Gr. *περισσός*, odd, liter., extra, over, superfluous (deriv. of *περί*, around, over, beyond) + *δάκτυλος*, finger, toe]: a sub-order—or, according to some authors, an order—of the hoofed animals (Ungulata), so named because the digits are unpaired or unequal. These are unpaired or uneven, the third being the largest and most exserted, the fourth nearly coequal in size and position with the second, and the fifth on the hind foot at least atrophied; the astragalus has the anterior or inferior articulate surface divided into two very unequal facets; the femur is provided with a third trochanter; the dorso-lumbar vertebræ are in increased number—i. e. not less than twenty-two (d. 18 — 19 + 1, 1·3 — 6). The skull has the intermaxillary bones tectiform or shelving in a roof-like manner above, and united at the symphyses, and the incisors, when present, are implanted nearly vertically, and are parallel to their roots; the stomach is cæcal; the cæcum very much enlarged and sacculated. The sub-order thus distinguished includes three families represented by living forms: the tapirs (*Tapiridæ*), rhinoceroses (*Rhinocerotidæ*), and horses (*Equidæ*). In previous geological ages numerous others, more or less related to them, flourished. The affinities of these forms were, to some extent, recognized by Cuvier, and still more by de Blainville, but the sub-order was first distinctly introduced with formal characters by Prof. Owen.

Peristaltic Motions [*peristaltic* is from Gr. *περισταλτικός*, clasping and compressing, deriv. of *περιστέλλειν*, wrap up, wrap around; *περί*, around + *στέλλειν*, send]: certain movements which take place in the alimentary canal, the term being generally restricted to the worm-like action by means of which the food is carried to and fro over the mucous membrane of stomach and intestines. The walls of both stomach and intestines are made up of two layers of involuntary muscular tissue, which are arranged as an external longitudinal and an internal circular; the outermost layer of the intestine is serous, and is simply a reflexion of the peritoneum. The internal coat consists of a mucous tissue, varying in structure in different parts. From the anatomy of the parts it is

easy to perceive how, by the simple action of its muscular walls, the food after its entrance into the stomach is first moved about in this organ, and then, having passed into the small intestine, is carried onward by the gradual contraction and relaxation, which, starting from above, is continued downward. During the processes of digestion this movement is readily observed by opening the abdomen of a living animal, and it will be seen that the movement continues for a short time, then ceases, to be renewed. Not only does the muscular wall carry the food toward the outlet of the canal, but often after the mass has been pushed, or rather squeezed, for a certain distance downward, it is carried back again in the opposite direction (antiperistaltic movement). There is probably little if any peristaltic action while the intestine is empty, it being the stimulus of food which causes it. The alimentary mass, coming in contact with the periphery of the nerves situated in the mucous membrane, imparts a certain amount of irritation, which is followed by muscular movement—i. e. contraction and relaxation—probably through the agency of the *ganglionic plexus*, situated in the walls of the intestine; and this slow, gradual passage of the food backward and forward is required for the processes of digestion. Various other theories are entertained in regard to the causation of peristalsis. The bile does probably aid by stimulating activity, but the direct irritation by food and effete products is the important agency. Revised by WILLIAM PEPPER.

Peristerop'odes [from Gr. περιστερά, pigeon + πούς, ποδός, foot]: a division, or sub-order, of the *Gallinæ*, including the curassows and mound-builders, distinguished by having the hind toe long and on a level with the others as in pigeons; contrasted with *Alectoropodes*, or true fowls, which have the hind toe short and elevated. F. A. L.

Perithecia: See FUNGI.

Peritoneum: See PERITONITIS.

Peritoni'tis [Mod. Lat., deriv. of *peritone'um* (cf. PERIOSTITIS), = Gr. περιτόναιον, liter., neut. of περιτόναιος, stretched or stretching over or all around, peritoneum; περί, around + τείνειν, stretch]: inflammation of the peritoneum, a serous membrane investing the viscera of the abdomen; popularly designated "inflammation of the bowels." The peritoneum has two layers, and constitutes a closed sac; the external layer lines the abdominal walls; the internal is reflected over the stomach and intestines, liver, spleen, ovaries, uterus, and bladder. These opposed surfaces are smooth and lubricated by secreted serum, permitting the free movements of the viscera, their ascent and descent in respiration, and the peristaltic movements of the bowels.

Peritonitis, or inflammation of the peritoneum, may be due to traumatism, to cold, to extension of inflammation from other organs, to general disorder of the blood, or infection. Traumatic peritonitis is the result of bruises, wounds, and surgical operations. Idiopathic peritonitis is a primary inflammation resulting from perverted conditions of the blood, or from exposure to cold. Local peritonitis from extension of inflammation is a frequent occurrence, the inflammatory process being limited to the peritoneal investment of a single organ, as the liver, uterus, or ovary. A very important source of localized peritonitis is the diseased vermiform appendix. Very many cases of so-called idiopathic peritonitis really begin as appendicitis. Puerperal peritonitis is inflammation of the uterus and peritoneum following confinement. (See PUERPERAL FEVER.) Tubercular peritonitis is an infective form due to the action of the same bacillus as that of pulmonary tuberculosis, which gains access to the peritoneum through the food, or through the blood from a primary tuberculosis of the lungs, intestines, etc. It is usually chronic, and consists in the deposition of inflammatory lymph and miliary tubercles, with interspersed masses of caseous matter, or yellow tubercle; tubercle usually coexists in the lungs and other organs. Acute peritonitis, as a rule, is of sudden onset. Abdominal pain is its prominent symptom, at first localized, but quickly diffused over the entire abdomen. The pain is increased by pressure, by the movements of respiration, and by tension of the abdominal muscles. The breathing is therefore chiefly thoracic, the diaphragm fixed to prevent abdominal movement, and the respiration is correspondingly shallow, restrained, and rapid. The limbs are retracted upon the body to relax tension of the abdominal surface. There is temporary paralysis of the muscular coat of the bowel; constipation results, also extreme flatulent distension of the intestines, and general tumefaction of the abdomen. The inflamed surface is so extensive, invests so many important organs, producing extensive peripheral nerve-irritation as well as impressions on the plexuses of the sympathetic nerve, that the constitutional depression is very marked. The face is pale, haggard, and anxious, wearing an expression of great suffering. The teeth are set, the lips tightly drawn, the eye set and sunken, the cheeks collapsed—in extreme cases constituting the *Hippocratic facies*, or *facies griffé* of the French. Peritonitis is always a dangerous disease, but its termination depends upon early diagnosis and a correct treatment, conducted with vigor and persistence. When incipient, it may be aborted or limited by local use of ice or cold water, local dry cupping, cardiac sedatives, as veratrum, and a single prompt saline purge. If fully developed, opium is the supreme remedy to allay pain and secure absolute rest of the intestines from their physiological peristaltic action. In peritonitis the tolerance of opium is very great. In some forms of peritonitis, particularly in the puerperal, small doses of saline purges, given at short intervals to produce gentle looseness of the bowels, act with better success than opium. The cold water or ice pack, if judiciously used, will be of value during the acute period of the disease, but later warm and anodyne applications are preferable. Curiously enough, chronic tuberculous peritonitis is sometimes curable by simple opening of the abdomen (cœliotomy or laparotomy) and flushing out the cavity with an antiseptic solution. Revised by WILLIAM PEPPER.

Periwinkle: any one of various half-shrubby and herbaceous erect or trailing plants of the genus *Vinca* and family *Apocynaceæ*. The *V. major*, *V. minor*, and *V. herbacea* of the gardens are hardy European plants. *V. rosea*, a fine greenhouse evergreen shrub, grows wild in most tropical regions, and also in Florida.

Periwinkle: the popular name for several small gasteropodous molluses of the genus *Littorina* and allied genera, and particularly *Littorina littorea*, a species much used for food in Europe, several hundred tons being eaten yearly. The species has become quite abundant on the eastern coast of the U. S. The name is also applied in the U. S. to several large molluses, *Busycon carica*, *Sycotypus canaliculatus*, and species of *Purpura* which do great damage to the oyster beds of the eastern coast. F. A. L.

Perizo'nius, JACOB (*Voorbroek*): historian and philologian; b. at Dam, in Holland, in 1651; studied under Græ vius at Leyden; Professor of Ancient History at Franeker in 1681, at Leyden in 1693; d. Apr. 6, 1715. His principal works are editions of *Ælian*, *Dictys Cretensis et Dares Phrygius*, *Q. Curtius*, *Animadversiones historicæ* (1685; 2d ed. by Harles, with biography, 1771); *Origines Babylon. et Ægypt.* (2 vols., 1711; 2d ed. 1736); *Adnotationes in Suetonium*, *Observationes in Valerium Maximum*. See W. Kramer, *Elogium Perizonii* (1822); Hofman-Peerlkamp in *Bibl. critica nova* (v., pp. 545–552), and *Ersch und Gruber* (iii., pt. 17, pp. 108–113). ALFRED GUDEMAN.

Perjury [viâ O. Fr. from Lat. *perju'rium*, a forswearing, a false oath, deriv. of *perjura're*, swear falsely, perjure; *per*, through + *jura're*, swear]: at common law, the crime of willfully giving false material testimony under a lawful oath in any judicial proceeding. Modern statutes have extended its scope. For example, § 5392 of the U. S. Revised Statutes provides that "every person who, having taken an oath before a competent tribunal, officer, or person, in any case in which a law of the U. S. authorizes an oath to be administered, that he will testify, declare, depose, or certify truly, or that any written testimony, declaration, deposition, or certificate by him subscribed is true, willfully and contrary to such oath states or subscribes any material matter which he does not believe to be true, is guilty of perjury, and shall be punished by fine of not more than $2,000, and by imprisonment at hard labor not more than five years." See OATH.

Whether the false testimony was material is a question for the court. If it was material, it does not matter that the witness was incompetent, or that his testimony was erroneously admitted, or that it was not believed. The essence of the crime is not the harm actually inflicted upon a particular litigant, but the false swearing with the intention to pervert justice. Hence one commits perjury who swears to something of which he is conscious he has no knowledge, although it turns out to be true. If the opinion of a witness is material, he commits perjury by a willfully false expression of it.

As perjury in a judicial proceeding is peculiarly an of-

fense against the system of laws under which the court is organized, it has been held in the U. S. that perjury committed in a Federal court is not punishable in a State court. In some cases, however, a State officer is authorized by Federal law to administer an oath in matters of Federal jurisdiction, and perjury before such an officer is a crime against the U. S.

The punishment for perjury has always been severe. Anciently it was death; then banishment or the cutting out of the tongue; later, the forfeiture of goods, while at present it is generally a fine or imprisonment and incapacity to be a witness. Formerly the evidence of two witnesses was necessary to convict one of perjury, on the theory that the oath of the witness for the prosecution was no weightier than that of the prisoner. The present rule is that the evidence of the prosecution must be sufficient to counterbalance the prisoner's oath, and the presumption of his innocence. See *U. S.* vs. *Wood*, 14 Peters 430.

FRANCIS M. BURDICK.

Perkins, ELISHA: physician; b. in Norwich, Conn., Jan. 16, 1741; established an academy in Plainfield, where he practiced medicine. In 1796 he announced the invention of metallic tractors for the cure of rheumatism, gout, and the like. His son went to Europe with the tractors, where, as well as in the U. S., the new cure, called Perkinism, was favorably received even by physicians. Lord Rivers presided over a Perkinian institution in which many marvelous cures were wrought solely by the power of imagination, for the tractors were simply pins of iron and brass which were drawn over the affected part. In Copenhagen the medical faculty published a voluminous report in favor of Perkinism; and when in 1803 the British physicians had begun to see through the imposture, Thomas G. Fessenden produced his *Terrible Tractoration* as a defense of Perkins and a satire on the doctors. Perkins afterward invented a remedy of great alleged value in the cure of fevers, and during a yellow-fever season in New York went there to test its value, but fell a victim to the disease, Sept. 6, 1799.

Perkins, FREDERIC BEECHER: See the Appendix.

Perkins, GEORGE HENRY: See the Appendix.

Perkins, JACOB: inventor; b. at Newburyport, Mass., July 9, 1766; was in childhood apprenticed to a goldsmith; invented a new method of plating shoe-buckles; was employed in 1797 to make dies for the State coinage; invented soon afterward a machine for cutting and heading nails at a single operation, and was the originator of the use of steel instead of copper plates for engraving bank-notes. After residing some years in Boston and New York he engaged in business in Philadelphia in 1814 as a bank-note engraver; went to England in 1818; obtained a contract for supplying plates to the Bank of Ireland; was the inventor of the steam-gun, of the bathometer for measuring the depth of water, of the pleometer for registering the speed of vessels, and largely aided in perfecting the manufacture of the steam-engine. D. in London, July 30, 1849.

Perlidæ: See ENTOMOLOGY.

Perm: the easternmost government of European Russia. Area, 128,211 sq. miles (see map of Russia, ref. 6–H). The larger, central part of the country is covered by the Ural Mountains, which attain a height of 5,360 feet. The chief branch of industry is mining. Gold, silver, platinum, iron, salt, coal, alabaster, marble, and diamonds are found, and some of the mines are very rich. The platinum mines (see PLATINUM) are the richest in the world. The western part of the government, situated on the European side of the mountains, has some good agricultural land where rye, oats, barley, and potatoes are grown; on the Siberian side the country is fit only for pastures. Pop. (1897) 3,002,655. The capital, Perm, on the Kama, carries on an extensive transit trade between European and Asiatic Russia, and has a cathedral, distilleries, flour-mills, and a cannon-foundry. Pop. (1897) 45,403.

Permanent Way: in railway engineering, the road-bed, track, bridges, and buildings of a line of railway, as distinguished from the rolling-stock, which consists of the locomotives and cars.

Permanganates: See MANGANESE.

Permangan'ic Acid: See MANGANESE.

Permeability and **Permeance**: See MAGNETISM OF IRON.

Permian Series: in geology, a group of rocks occurring in the province of Perm, Russia. Formations of various other countries have been recognized as their equivalents, and by some taxonomists the corresponding portion of geologic time is styled the Permian period, and made co-ordinate with the Carboniferous and other great divisions of the Palæozoic era. A more prevalent usage recognizes the Permian epoch as the closing part of the Carboniferous period. In the U. S. approximate equivalents of the Russian beds have been noted in West Virginia, Kansas, and Utah. See CARBONIFEROUS PERIOD, and consult Bulletin No. 80, U. S. Geological Survey.

G. K. G.

Permutations [from Lat. *permuta'tio*, deriv. of *permuta're*, change throughout, interchange; *per*, through, thoroughly + *muta're*, change]: the results obtained by writing a certain number of letters or factors in every possible order, so that all the letters shall enter each result, and each letter but once. Thus the letters *a*, *b*, and *c* may be written *abc*, *acb*, *bac*, *bca*, *cab*, and *cba*. Here there are three letters and $1 \times 2 \times 3$, or 6, permutations. To determine the number of permutations of n letters, n being any whole number, let us denote the number of permutations of $n - 1$ letters by Q; if we now introduce a new letter, it is obvious that it may have n places in each of the Q permutations of $n - 1$ letters; that is, it may be written before the first letter of each, between each two letters, and after the last letter of each; hence the whole number of permutations of n letters is $Q \times n$. Now, the number of permutations of 3 letters is $1 \times 2 \times 3$; hence the number of permutations of 4 letters is $1 \times 2 \times 3 \times 4$. Proceeding from this conclusion, we infer that the number of permutations of 5 letters is $1 \times 2 \times 3 \times 4 \times 5$, and so on indefinitely. Hence the number of permutations of n letters is the continued product of the natural numbers from 1 to n, inclusive, n being any whole number. If the actual product indicated by each permutation is found, it will be equal to a fixed quantity in each case. The theory of permutations finds an important application in the deduction of formulas for combinations and arrangements, and these in turn are used in developing the theory of probabilities. See Newcomb's *College Algebra*, or Oliver Wait and Jones's *Algebra*.

Revised by S. NEWCOMB.

Pernambu'co: a state in the eastern part of Brazil; bounded N. by Ceará and Parahyba, E. by the Atlantic, S. by Alagoas and Bahia, and W. by Piauhy. Area, 49,560 sq. miles. A sandstone reef follows nearly the whole coast, and the only harbors are formed by openings through it, as at the city of Pernambuco. A strip extending from the coast about 40 miles inland is low and partly flat land, originally covered with forest, well watered, and very fertile; this is known as the *Matta*. Beyond it the surface rises abruptly or gradually to the *Sertão*, or "desert"; this is properly a part of the Brazilian plateau, but much varied with hills and valleys and with a general southwest slope to the river São Francisco. Most of the *Sertão* is open land, resembling the neighboring parts of Ceará in its parched dry season (September to February) and its occasional destructive droughts. Most of the population is gathered in the *Matta* belt, where the prominent industry is sugar-planting; cotton is raised farther inland, and the *Sertão* supports large herds of cattle in favored places. There are considerable manufactures, and the state is one of the richest and most progressive in Brazil. Estimated pop. (1894) 1,254,159. The most important exports are sugar, rum, and cotton. The coast region was occupied by the Dutch 1630 to 1654.

HERBERT H. SMITH.

Pernambuco (officially *Recife*): capital and chief city and port of the state of the same name; on the coast at the mouths of the little rivers Caparibe and Beberibe (see map of South America, ref. 4–H). It consists of three parts—Recife proper and Santo Antonio, on narrow islands, one behind the other, and Boa Vista, on the neighboring mainland. These are all on flat ground, and are connected by bridges. Recife, nearest the sea, is the oldest, and its narrow streets and ancient houses, some of the Dutch period, are very interesting; it contains the principal wholesale commercial houses. The other divisions have wide streets, with many handsome buildings, and the beautiful suburbs are ornamented with stately old trees and extensive gardens. The harbor proper is formed by a sandstone reef, which has been artificially extended; it will not admit vessels of more than 17 feet draught, and large ships must anchor in the open roadstead, whence landing is often difficult. Pernambuco is nearer Europe than any other important Brazilian port, and it is almost the only commercial outlet of the state; several railways run to the interior. In population and com-

merce it is the third city in Brazil; sugar, rum, cotton, hides, tobacco, cigars, coffee, etc., are exported. The climate is generally salubrious; the heat is modified by regular trade-winds, and epidemics are infrequent. Under the Dutch (1630–54) Recife was a mere village; in the eighteenth century it supplanted the original capital and port, Olinda (*q. v.*). Pop. (1894) about 150,000. Herbert H. Smith.

Peronospora'ceæ [Mod. Lat.; Gr. περόνη, brooch, pin + σπόρος, seed]: a family of fungi, including the Downy Mildews and White Rusts. See Mildews and Rusts.

Perosi, Lorenzo: See the Appendix.

Perowne, John J. S.: See the Appendix.

Peroxide of Hydrogen: See Hydrogen Peroxide.

Perpetual Apparition, Circle of: See Circle of Perpetual Apparition.

Perpetual Motion: a term applied to a mechanism which is assumed to put itself in motion and to possess sufficient inherent power not only to continue such motion indefinitely (or until the mechanism is worn out), but to have a surplus which can be used in doing useful work. The absurdity of such an idea is evident to most well-informed minds the moment it is clearly stated, but since the first recorded scheme for a mechanical perpetual motion (by Willars de Honecort, an architect of the thirteenth century) numbers of persons have pursued this *ignis fatuus* of mechanics. In the nineteenth century there have been upward of 180 patents (the large majority of them English) granted for machines intended to move perpetually, and during that and the preceding century there have been printed descriptions of nearly 300 other schemes for perpetual motion that were not patented. The searchers for perpetual motion have employed every force in nature, but the majority employ the force of gravity in some way, a favorite contrivance being a wheel provided with movable weights intended to descend on one side at a distance from the center of rotation, and to be raised on the other side through a path much nearer that center.

The planets are examples of perpetual motion on a grand scale in that they revolve unceasingly, but even they do not fulfill the requirements of the problem of perpetual motion, inasmuch as their movements involve a perfect equilibrium of forces, and there is no surplus power for work outside of that required for their own rotations and stability in their orbits. See Force. W. F. Durfee.

Perpetuity: a future contingent interest in property, real or personal, which is not to become a vested interest until a period so remote as to be obnoxious to law. The term is also, though improperly, employed to describe any future estate, whether vested or contingent, in which the absolute power of alienation is suspended for an improper length of time. It is in the latter sense that the term is used in New York and some other States. In the former sense, the Rule against Perpetuities is a rule against remoteness; in the latter, it is a rule against restraining alienation.

The prohibition of perpetuities was only one of a number of devices adopted at various times by the courts of common law, to restrain within reasonable limits the control of the living by the dead; to limit the power of the present owner to control the enjoyment and disposition of his property by those who should come after him. The English doctrine of tenures and estates in land, whereby a man might create any number of future interests to be enjoyed in succession, apparently opened the way for an indefinite control of property by the present owner; and the feudal notion of family permanence, fostered under the influence of Primogeniture (*q. v.*), was a powerful incentive to the great landowners, to avail themselves of this opportunity. The history of our law of property is in large measure a record of a long warfare between the landlords, assisted by Parliament, on the one side, attempting to make good this posthumous control of their property, and the lawyers, backed up by the courts, on the other side, forever attempting to set the present owner free from such posthumous control. In this contest the courts were finally successful, and the Rule against Perpetuities is one of the monuments of their success.

When this rule was devised, the efforts of the landowners to "tie up" their estates for their remote posterity had already been checked in other directions. Estates tail had been rendered alienable, and the creation of contingent remainders had been restrained by the artificial rule which forbade the limitation of "a possibility upon a possibility"—as, for example, a gift to the offspring of an unborn person. There remained only those future estates known as executory uses and devises, and it was to meet the abuse of these limitations that the Rule against Perpetuities was adopted. It provided that all limitations of estates by way of springing or shifting use or executory devise must take effect within the period of a life or lives in being at the time of creating the limitations and twenty-one years afterward. Thus A may, by his will, give his property to his son, B, for his life, and then to his grandson, C, for *his* life, and then (if C has been born when the will takes effect, at the death of A) to the eldest son of C, when such eldest son shall attain the age of twenty-one years. Here the estate must finally vest within twenty-one years after the extinction of the two lives, B and C, both of which are in being at the time when the will takes effect. It is therefore within the rule. On the other hand, if an estate be given to A, a bachelor, for life, and after his death to his eldest son, when the latter shall marry, the latter limitation is void under the rule. A's son may not marry until more than twenty-one years after the death of A; and the circumstance that he does in fact marry within that period will not alter the case, as the validity of the gift is not determined by the actual event but by the possibilities of the situation at the time of the original limitation. If there is a possibility that the future estate may not vest within the period prescribed by the rule the limitation of that estate is void from the beginning.

In this form the rule is in force to-day in England, and generally wherever the common-law system of England prevails. In only a few of the U. S. has it been modified in any important respects. In New York and three or four other States, however, the common-law rule has been completely changed by statute, and converted into a rule forbidding the suspension of the absolute power of alienation for a longer period than two (or more) lives in being at the time of the limitation. In most of those States (though not in New York) the further period of twenty-one years allowed by the English rule may also be added.

For a fuller treatment of the subject, see Prof. Gray's *Rule against Perpetuities.* George W. Kirchwey.

Perpignan, pār'pēēn'yaăn': capital of the department of Pyrénées-Orientales, France; on the Tet, 7 miles from the Mediterranean (see map of France, ref. 9–F). It is a fortress of first rank, and commands the passage between France and Spain. It has a cathedral and a Moorish-Gothic bourse dating from the fourteenth century, a college, a palace of justice, distilleries, bell-foundries, and manufactures of leather, cork, and woolen fabrics, and an active trade in oil, wine, grain, silk, and fruits. Perpignan belonged to Aragon from 1172 to 1475, when it was taken by France. It was given to Spain in 1493, but retaken by France in 1642. Pop. (1896) 35,088.

Perrault, pā'rō', Charles: author; b. in Paris, France, Jan. 12, 1628; studied at the Collège de Beauvais, but left it in a moment of irritation and with a comrade finished his studies without instructors. He prepared for the bar by a rapid reading of the *Institutes* of Justinian, but did not practice long; became next clerk for his brother and cultivated letters. His verse won him some reputation and an election to the Academy (1671), and he found a protector in Colbert, whom he aided in the foundation of the Academy of Arts and who advanced him to the head of the bureau of royal buildings. In 1687 he read before the Academy a poem entitled *Le Siècle de Louis le Grand*, praising modern writers at the expense of the ancients, and this offended the admirers of antiquity and precipitated the quarrel of the "ancients and moderns." To this quarrel he owed his chief notoriety, being severely attacked by Boileau. His position was more fully stated in the *Parallèle des anciens et des modernes* (1688–96), a series of dialogues comparing Homer and Vergil with the French poets. Of more permanent value are the notices of men of letters composing the series *Les Hommes illustres qui ont paru en France pendant ce siècle* (1696–1701), and especially the volume of fairy stories, *Contes de ma mère l'Oye* (1697), containing *Cinderella*, *Blue Beard*, and others, by which alone he still remains popular. D. May 16, 1703. He left *Mémoires*, which were published in 1749, and two comedies. His *Œuvres Choisies* were published by Collin de Plancy (Paris, 1826); the *Contes* by Lefèvre (Paris, 1875). A. G. Canfield.

Perron, Anquetil, du: See Anquetil du Perron.

Perrone, per-rō'nā, Giovanni, D. D.: theologian; b. at Chieri, Piedmont, 1794; studied at Turin; entered the Society of Jesus at an early age; taught at Orvieto; spent

most of his life at Rome as professor of theology; taught at the Roman college till 1853; visited England during the Roman revolution of 1848–49; d. at Rome, Aug. 29, 1876. He exercised considerable influence on Catholic theology in the first half of the nineteenth century, and his lectures at Rome were followed by numerous students from both sides of the ocean. He had a large share in the preparation of the papal bull that defined the Immaculate Conception, and in the preliminary labors for the Vatican Council. He was also a consultor of several Roman congregations, theologian to a number of cardinals, etc. His best-known work is the *Prælectiones Theologicæ* (9 vols., 1835 ff.), which contains the summary of his professorial teaching. It had reached its fortieth edition at his death, and the *Compendium* of the same work, equally successful, is yet much used. His other writings are chiefly polemical. The best of them is his *Protestantism and the Rule of Faith* (3 vols.). As a theologian he represents the positive doctrinal and the polemical element, as distinguished from the historical and the metaphysical school. JOHN J. KEANE.

Perrot, pā′rō′, GEORGES: archæologist; b. at Villeneuve-Saint-Georges, department of Seine-et-Oise, France, Nov. 12, 1832; studied from 1855 to 1858 at the French school in Athens; made in 1861 a journey of exploration in Asia Minor; dwelt for some time at Ancyra investigating the famous inscription on the temple which the Galatians built there in honor of Augustus; became Professor of Rhetoric in the Lyceum Louis le Grand, Paris, in 1863; Professor of Greek Language and Literature in the higher normal school in 1872; Professor of Archæology in the Faculty of Letters in 1877; appointed director of the higher normal school in 1883; wrote *Exploration archéologique de la Galatie et de la Bithynie* (Paris, 1863–72); *Souvenirs d'un voyage en Asie Mineure* (1864); *Essai sur le droit public et privé de la république athénienne* (1867); and other works, and with C. Chipiez, *Histoire de l'art dans l'antiquité* (5 vols., 1881–89).

Perry: city; Dallas co., Ia. (for location, see map of Iowa, ref. 5–F); near the Raccoon river; on the Chi., Mil. and St. P. and the Chi., Rock Is. and Pac. railways; 34 miles N. W. of Des Moines. It is in an agricultural and coal region, and contains 7 churches, 3 public-school buildings, a business college, water and electric-light plants, a national bank with capital of $50,000, a State bank with capital of $50,000, and a semi-weekly and 3 weekly newspapers. Pop. (1880) 952; (1890) 2,880; (1900) 3,986.
EDITOR OF "CHIEF."

Perry: village (incorporated in 1814); Wyoming co., N. Y. (for location, see map of New York, ref. 5–D); at the outlet of Silver Lake; on the Silver Lake Railway; 40 miles S. S. W. of Rochester. There are 7 churches, united free academy and union school, a national bank with capital of $50,000, a State bank with capital of $50,000, a school library, a weekly newspaper, and salt and reaper works and a knitting-mill. The lake affords good power for manufacturing. The Silver Lake Assembly, a noted summer resort with over 200 cottages and a population of more than 2,000 in the height of the season, is 2 miles from the village. Pop. (1890) 1,528; (1900) 2,763. EDITOR OF "HERALD."

Perry: city (settled in 1893); capital of Noble co., Okl.; on the Atch., Top. and S. Fé Railroad; 30 miles N. of Guthrie, 60 miles S. of the Kansas border (for location, see map of Oklahoma, ref. 2–D). It contains a U. S. land-office, several churches, public and private schools, a board of trade, a State bank, 2 private banks, and 3 daily and 3 weekly newspapers. It has a large general trade, as nearly all settlers within a circle of 50 miles do their outfitting here. Pop. (1900) 3,351.

Perry, ARTHUR LATHAM: economist; b. at Lyme, N. H., Feb. 27, 1830; graduated at Williams College 1852; became Professor of History and Political Economy there in 1854, and in 1875 pastor of a church at Williamstown. He wrote *The Elements of Political Economy* (1865), an exponent of free-trade doctrines; *Introduction to Political Economy* (1877); and *Williamstown and Williams College.*

Perry, EDWARD DELAVAN: Sanskrit scholar; b. at Troy, N. Y., Dec. 20, 1854; educated at Columbia College, and at the Universities of Leipzig and Tübingen; successively tutor in Greek, instructor in Sanskrit, and Professor of Sanskrit in Columbia College. His chief works are *Indra in the Rigveda* (in *Journal American Oriental Society*, vol. xi.), and *A Sanskrit Primer* (1885; 2d ed. 1886). B. I. W.

Perry, ENOCH WOOD: See the Appendix.

Perry, MATTHEW CALBRAITH: commodore; b. at Newport, R. I., Apr. 10, 1794. Known as an upright and energetic naval officer, he was intrusted by President Fillmore in 1853 with a letter to the ruler of Japan, its object being to establish international relations, especially with the view of protecting shipwrecked mariners. By an employment of the "gunboat policy," but happily without having to resort to actual bloodshed, he induced the frightened Japanese to sign their first foreign treaty at Kanagawa Mar. 1, 1854. Shimoda and Hakodate were opened to trade with the U. S., and good treatment was promised to shipwrecked crews. Perry died in New York, Mar. 4, 1858. See Perry and Hanks, *Narrative of the Expedition of an American Squadron under Commodore Perry*, and Griffis, *Matthew Calbraith Perry* (Boston, 1887). J. M. DIXON.

Perry, NORA: poet; b. at Dudley, Mass., in 1841. She was Boston correspondent of *The Chicago Tribune* and of *The Providence Journal*, and published *After the Ball and Other Poems* (1875); *Book of Love Stories* (1881); *For a Woman*, a novel (1885); *New Songs and Ballads* (1886); and other works. D. May 13, 1896. H. A. B.

Perry, OLIVER HAZARD: naval officer; b. at South Kingston, R. I., Aug. 23, 1785; entered the U. S. navy as midshipman, Apr. 7, 1799; cruised with his father, a naval officer, in the West Indies 1799–1800; was engaged in the war against Tripoli 1804–05; became lieutenant Jan. 15, 1807, and at the outbreak of the war of 1812 was in command of a flotilla of gunboats on the Atlantic coast, when in Feb., 1813, he was transferred at his own request to serve under Commodore Isaac Chauncey on Lake Ontario. He took an active part in the attack upon Fort George; was appointed to fit out a squadron upon Lake Erie, which he successfully accomplished at Presque Isle (now Erie), Pa.; and having equipped nine small vessels, attacked and captured the British fleet near Put-in-Bay, O., Sept. 10, 1813. This action, known as the "battle of Lake Erie," or more commonly as "Perry's victory," obtained him an immense popularity, partly attributable to the sententious manner in which it was announced by the famous dispatch, "We have met the enemy, and they are ours." Congress rewarded him with a vote of thanks, a medal, and the rank of captain. Perry co-operated with Gen. Harrison in his operations at Detroit and at the battle of the Thames, Oct. 5, 1813, and in the following year was employed upon the Potomac and in the defense of Baltimore. He commanded the Java in Decatur's squadron in the Mediterranean 1815; was sent to the Spanish Main in command of a squadron, June, 1819; ascended the Orinoco to Angostura in July; was seized with yellow fever, and died at Port Spain, on the island of Trinidad, the day of his arrival there, Aug. 23, 1819. His remains were removed to Newport in a ship of war by order of Congress, and buried in the cemetery of that city, Dec. 4, 1826, where an imposing obelisk was erected by the State of Rhode Island. In Sept., 1860, a marble statue of Commodore Perry was erected at Cleveland, O., and on Sept. 10, 1885, a fine bronze statue was unveiled at Newport, R. I. See the *Life*, by Capt. Alexander S. Mackenzie (2 vols., New York, 1843).

Perry, THOMAS SERGEANT: critic; b. at Newport, R. I., Jan. 23, 1845; graduated at Harvard in 1866 and was for some years instructor there in English and German. He has resided much abroad, and has studied at French and German universities. His writings are mainly contributions to literary history, biography, and criticism, and include *Life and Letters of Francis Lieber* (Boston, 1882); *English Literature in the Eighteenth Century* (New York, 1883); *From Opitz to Lessing* (Boston, 1885); *The Evolution of the Snob* (1887); from 1872 to 1874 he edited the *North American Review.* H. A. BEERS.

Perry, WILLIAM STEVENS, D. D. (Oxon.), LL. D., D. C. L: bishop; b. in Providence, R. I., Jan. 22, 1832; graduated at Harvard College in 1854; studied at the Virginia Theological Seminary and privately in Boston, preparatory for orders; ordained deacon in Mar., 1857, at Newton, Mass.; priest in Boston, Apr. 7, 1858; was rector of churches in Nashua, N. H., Portland, Me., Litchfield, Conn., and Geneva, N. Y., 1858–76; was Professor of History in Hobart College, Geneva, N. Y., 1871–73, and president of that institution for a few months in 1876. He was unanimously elected Bishop of Iowa in May, 1876, and was consecrated to the episcopacy in Trinity church, Geneva, Sept. 10; refused the bishopric of Nova Scotia in 1887. He was for nearly twenty years occupied in general church work in addition to his

parochial labors. He was deputy from New Hampshire in 1859; from Maine in 1862; assistant secretary to the House of Deputies in 1862; secretary in 1862–74; was appointed historiographer of the American Church in 1868, and retained that position until his death, in Dubuque, Ia., May 13, 1898. He declined the foreign secretaryship of the board of missions in 1876; also the presidency of Kenyon College. Besides degrees received from seven institutions of learning in the U. S. and Canada, he received that of D. D. Oxon., at the encenia of the University of Oxford. In 1894 he received the degree of LL. D. from the University of Dublin. His writings, chiefly historical, number more than one hundred. Among them are *Journals of the General Conventions of the Protestant Episcopal Church* (Philadelphia, 1861) and *Documentary History of the Protestant Episcopal Church in the United States of America* (2 vols., New York, 1863–64), in which he was aided by Dr. Francis L. Hawks; *Historical Collections of the American Colonial Church* (1871–78); *Some Summer Days Abroad* (Davenport, Ia., 1880); *The History of the American Episcopal Church, 1587–1883* (2 vols., Boston, 1885); *Life Lessons from the Book of Proverbs* (4th ed. 1885). He was an associate editor of *Johnson's Universal Cyclopædia*. S. R. J. Hoyt.

Seph'one, or **Proserpina** (in Gr. Περσεφόνη, Κόρη): in Grecian mythology, a daughter of Zeus and Demeter, the wife of Hades. Along with Hades she ruled over the shades of the dead and the monsters of the lower world, and listened to the curses of men. When, as a maiden, she was gathering flowers near Enna, in Sicily, she was seized by Hades with the consent of Zeus and carried in his chariot to the realm of the dead. In pity for the grief of Demeter (see Ceres), who vainly sought her daughter the world over, Zeus sent Hermes to bring Persephone back; but as she had tasted a pomegranate (the symbol of marriage), offered to her by Hades, it was decreed by Zeus that she should remain one half of the year with Hades and the other half with Demeter. Persephone is thus the symbol of life and death in the vegetable kingdom, and because the decay and death of the corn must precede a new and more fruitful life, she became in the Eleusinian Mysteries (*q. v.*) the symbol of the immortality of the soul. For a discussion of Persephone in art, see the article *Demeter und Kora* in Baumeister's *Denkmäler*. J. R. S. Sterrett.

Persep'olis: the Greek name of the ancient capital of Persia, whose Persian name is not known. It stood in a vast and fertile plain (now called Merdusht), 35 miles N. E. of Shiraz, near the Medus (now Polwár), about 14 miles above its confluence with the Araxes (now Bendemir). Of the age and history of the city very little is known. It was not the residence of Cyrus, who had his palace at Pasargada, unless this be the same city, as assumed by some antiquarians; but Xerxes, Darius Hystaspes, and others of the Achæmenidæ resided here, and in their time the city was known to the Greeks as a wonder of splendor and magnificence. It was said to be completely destroyed by Alexander the Great, and it is mentioned in history only once afterward, when Antiochus Epiphanes visited it for the sake of plunder (2 Macc. ix. 1). Of the city itself no traces can now be found, though it is probable that it occupied the same site as afterward the Mohammedan fortress Iṣṭakhr; but of the palaces some very interesting ruins are still extant, known by their local name, *Chehel Minár* (Forty Columns), or Hall of Xerxes. They consist of a stupendous substructure of cyclopean masonry, forming a platform about 1,500 feet long, about 800 feet wide, and divided into three terraces, to which magnificent flights of stairs give access. Of the buildings, a magnificently sculptured staircase, the entrance to a propylæum, and a number of columns, 60 feet high, are still standing. See Fergusson's *Palaces of Nineveh and Persepolis Restored*; Rawlinson's *Five Great Monarchies*; and *Persepolis* (Berlin, 1882), by Stolze and Noldeke.

Per'seus (in Gr. Περσεύς): in Grecian mythology, the son of Zeus and Danaë, daughter of Acrisius, King of Argos; was driven into exile together with his mother, and educated in Seriphos, one of the Cyclades; conquered Medusa, by the aid of Hermes and Athene, and cut off her head; returned after many adventures to Argos, from which Acrisius fled to Thessaly; settled afterward at Tiryns and founded Midea and Mycenæ. In ancient art he is represented as similar to Hermes. See Andromeda, Grææ, Gorgon, and Pegasus.
Revised by J. R. S. Sterrett.

Perseus: the last king of the Macedonians; son of Philip V.; b. about 212 B. C.; succeeded to the throne in 179 B. C., and confirmed the treaty which his father had made with the Romans. After a preparation of seven years he commenced war against Rome with an excellent army, a full treasury, and important alliances. P. Licinius Crassus, the consul, was sent against him, but was defeated, and the Romans were generally unfortunate throughout the war. Perseus, however, lacked the energy to follow up his victories and the war dragged on for several years without decisive result. At last, L. Paulus Æmilius was sent as commander-in-chief to the theater of war. He arrived in March, began active operations in June, and finished the war, after a campaign of thirteen days, by the battle of Pydna, 168 B. C. The Macedonian army, although fighting with great valor, was completely routed, and Perseus fled with his money-chest to Samothrace. He was afterward delivered up to the Romans, and held in captivity at Alba, in Italy, where he died a few years later. F. M. Colby.

Persia [= Lat., from Gr. Περσίς, from O. Pers. *Pārsa* (> Pers. *Fars*, or *Pārs*), a province of Persia]: a country of Western Asia, called by the natives Eron or Iran. It lies between lat. 25° and 39° 45′ N. and between lon. 44° and 63° 20′ E. By the Treaty of Turkomanchai the boundary between Russia and Persia, W. of the Caspian Sea, follows the bed of the river Araxes, from near Little Ararat to lon. 48° E.; thence southward the line has an irregular course to the Caspian near Astara. By the same treaty Persia renounced her right to float ships of war on that sea, thus virtually making the southern shore of the Caspian a boundary. The river Atak (Etrek) and the Domine Kuh, by acknowledgment of Russia, form the boundary on the N. E. The border-line of Afghanistan and Baluchistan was long a matter of dispute, but the question was referred to Great Britain for arbitration, and, after surveys, a decision and settlement was made by which Seistan proper and part of Baluchistan were given to Persia. The Arabian Sea, the Gulf of Ormuz, and the Persian Gulf give a continuous seacoast to Persia on the S. The boundary between Persia and Turkey was unsettled until 1880, when Turkey accepted the decision of a commission which had been appointed by Great Britain and Russia, and had made extensive surveys. The area of Persia has been estimated at 640,000 sq. miles. The greatest extent from N. to S. is 973 miles, and from E. to W. about 1,042.

Physical Features.—The topographical outline is that of a vast plateau surrounded by mountain ranges. The plateau consists of elevated plains separated from one another by mountain spurs and ridges. The central portions are the most elevated, where the plain of Hamadan attains an altitude of 6,000 feet above the level of the ocean. Ispahan, Shiraz, Tabriz, and Oroomiah (Urumeyah), towns widely separated, have each an altitude of 4,200 feet, and Teheran 3,500 feet. The great ranges of mountains on the N. are the network of the Kara Dag and the Elbruz. The latter rises near the steppe of Mogan, and in a well-defined range follows the contour of the southwestern shore of the Caspian and thence pursues an eastward course through Northern Persia. On the E. are the Domine Kuh, the Shamshire, and the chain extending southward from near Mashhad. The Cotrells are rugged cliffs near the Persian Gulf, cut and worn by the drainage of the great plateau. In the S. E. the Zagros, in many parallel ranges, run diagonally S. by E. from the mountains of Kurdistan, which form a rugged border on the N. W. The highest peaks are Damavand, the cone of an extinct volcano, 18,600 feet above sea-level; Savalan, 11,000 feet; Sahund, 10,000 feet; and Elvand, 9,500 feet. There are no great rivers in Persia. The Kizil Uzen, or Safeed, in the N., the Zanda Rud in the interior, and the Karun and Khirkah in the S. W., are small rivers, but are the chief streams of the country. The Euphrates, the Araxes, and the Helmund are rivers of the border. Many streams flow from the mountains to the desert of Khorassan, where they form kabeers or salt marshes, and disappear in the hot season. The only inland seas worthy of note are the Shahee Sea (Lake Urumeyah) in the N. W., and Niris and Mahala Seas in Farsistan. Nearly all the interior of Persia is described as desert, but nearly every part of the land, except Khorassan and Kerman, is so inhabited that the term desert applies properly to parts of those provinces only. The desert of Khorassan is 200 by 400 miles in extent.

Geology and Mineral Products.—The most common rocks are trap, shale, and limestone in nearly vertical strata. The beds of the valleys are to a great depth composed of gravel and clay and loam. Bituminous coal is found in the Elbruz

TURKEY
RUSSIA
MEDITERRANEAN SEA
MESOPOTAMIA
KURDISTAN
AZERBIJAN
ARDELAN
KERMANSHAH
ARABIA PETREA
Peninsula of Sinai
GREAT SYRIAN DESERT
BADIEN EL ARAB
Nomadic Tribes of Aneizeh
ALGWAF
Desert of Edhami
NEDJED
EL HASA
EL YEMAMA
EL KASYM
EL WOSHEM
EL ZEDEYR
HEDJAZ
RED SEA
YEMEN
HADRAMAUT
GULF OF ADEN
Tropic of Cancer
Konieh
Adana
Marash
Aleppo
Cyprus
Ladikiyeh
Tripoli
Palmyra
Damascus
Jerusalem
Jericho
Dead Sea
Alexandria
Cairo
Suez
Isthmus of Suez
Petra
Akaba
Diyarbekr
Orfah
Bitlis
Van
Mosul
Nisibin
Kerkook
Tabreez
Hamadan
Bagdad
Babylon
Kut el Amarah
Basrah
Mohamrah
Dezful
Shuster
Hail
Aneyzeh
El Derayeh
Medina
Yambu
Mecca
Jiddah
Thebes
Kench
Cosier
Erment
Redesieh
Assouan
Ruins of Berenice
El Wojeh
Kassala
Massawah
Zoulla
Tokar
El Mekhier
Abu Ahmed
Blue Nile
R. Atbara
Setil Riv.
Sana
Aden
Mocha
Hodeida
Loheia
Marib
Ras Bir
Perim
Babelmandeb Strait
R. Tigris
R. Euphrates
River Nile

Longitude H 55 East I from 60 J Greenwich K 65 L 70 M

PERSIA AND ARABIA

Scale of Miles

30 0 100 200 300

Longitude H 132 I Longitude J 137 East from K Washington L 142 M

Mountains, and mines of it are worked near Casveen and Damavand. White and green marble are found in Khorassan; sulphur on Damavand; lead at Bast; gold near Nikpey; and iron and copper ores in several places. Rock salt and gypsum are abundant. The turquoise mines of Madan, near Nishapur, have been long considered the best mines of that gem.

The climate is distinguished by dryness, except along the seacoast, where moisture is excessive, by equability, salubrity, and heat. The greatest degree of cold on the plain of Teheran is 8° to 10° F. The cold of the northern sections is intense in winter on the elevated plains, and on the mountains. Malaria is excessive in widely irrigated sections and where drainage is deficient. The prevalent diseases are malarial fevers, typhoid, pneumonia, ophthalmia, and cutaneous diseases. Smallpox and measles are seldom of a malignant type.

Soil and Products.—The soil of the plains is a loam very fertile when irrigated. The northern slopes of the Elbruz are covered with pine, spruce, and olives; the lowlands on the border of the Caspian are noted for dense growth of forest, in which the oak, sycamore, boxwood, orange, and sugar-cane abound. Date-palms grow in the southern sections. In the interior the vine, pomegranate, mulberry, fig and olive trees flourish, also the peach, apple, quince, and other fruit-trees. The desert blossoms in many places with the poppy and rose. The chief agricultural crops are wheat, barley, rice, hay, cotton, tobacco, opium, and a great variety of cucurbitaceous and leguminous plants.

The fauna is much the same as that of Southern Europe, but the lion is found in the S., and the tiger and leopard in the N., and wild asses frequent the desert. Domestic animals include the camel (in all sections), horse, ass, and buffalo. Of the birds, besides those commonly found in like latitudes, may be mentioned the flamingo, stork, and nightingale. Brook trout abound in the mountain streams and salmon in the waters of the Caspian coast. Vipers, scorpions, tarantulas, and centipedes are numerous.

Population.—The people of Persia are of many races, Iranian, Turkish, Kurd, Arabic, Armenian, and Hebrew. The dominant races, however, are the Iranian or Persian and the Turkish, the latter of many tribes. The population was estimated in 1872 at 5,000,000; in 1881 at 7,653,600; in 1891 at 9,000,000; in 1894 at 10,000,000. In the absence of any census, for none is ever taken by the Government, these estimates are only approximate. The people are chiefly occupied in agricultural and pastoral pursuits, though a few are engaged in manufacturing woolen, silk, and cotton fabrics. Many are soldiers, but few are engaged in maritime pursuits. A large part of the population is nomadic, and robberies and insurrections are frequent.

Political and Administrative Divisions.—No survey and accurate territorial division has ever been made. The country has through many ages been divided into several great provinces, but these are not now necessarily administrative divisions. They are Khorassan (202,872 sq. miles, including Seistan), Astrabad (28,980), Mazanderan (9,660), Gilan (4,830), Azerbaijan (38,641), Irak-Ajemi (94,182, including Ardelan), Luristan (19,253), Khuzistan (28,981), Fars (57,963), Laristan (19,321), and Kerman (135,317, including Kohistan and Mekran). A subdivision of provinces is into mahäls, formed by grouping together villages or tribes. The administrative divisions are changed often to suit local interests or the wish of a governor.

Principal Cities.—These are Teheran (pop. estimated at 210,000), Tabriz (180,000), Mashhad or Meshed (60,000), Ispahan, Kashan, and Barfurush (each about 50,000), Kerman, Yezd, and Casveen or Kasbin (each about 40,000), and Hamadan, Shiraz, Kom, Bushire, and Resht (each from 25,000 to 30,000).

Education.—There is, strictly speaking, no educational system. Private schools are formed by the mollahs (priests) for teaching the Koran and writing. There are schools for the education of mollahs, usually built and sustained by a patron. The shah sustains a college in Teheran where students are taught, in part, the curriculum of European schools, and receive an allowance of clothing and funds.

Religion.—The national religion is Mohammedanism, of that branch of the Sheahs known as Athna Ashara, or the *Twelve*, but there are many other sects. Of non-Mohammedans there are Jews, Armenians, Guebers, and Nestorians, in regard to the number of whom no two authorities agree. Missions in Persia are sustained by the American Presbyterians, Church of England, and Roman Catholics. The religious and social customs are intimately connected—religion is associated, in form at least, with every phase of life. Each sect has its own social laws and customs. All have in common certain customs distinguished as Oriental; these, however, are being modified by the introduction of European civilization and manners. The chief national observances are the mourning of Moharram, the fast of Ramazan, and the feast of No Ruz, or the New Year's Day of the secular and solar year. Both the Mohammedan era and the era of Yezdegird are observed.

Government.—This is an absolute monarchy. The reigning monarch, called shah, is Nasr-ed-din, who ascended the throne soon after the death of his father, on Oct. 20, 1848. He is assisted by a privy council, appointed and dismissed at his own pleasure. There is no representation of the people. The affairs of the general Government are supervised by a number of ministers, and departments of state are created and abolished at the shah's pleasure, and are constantly changing in number. The most permanent heads of departments are Ministers of the Interior or Finance, of War, of Foreign Affairs, and of Public Works, and Master of the Mint. The office of Prime Minister is periodically created and as frequently abolished. The governors, called *hoikim*, are appointed by the shah, as are many of his subordinates. Mollahs may exercise the judicial function, and their court is termed Sharah, or religious law. The Imäm Jumah and Sheik ul Islam are appointed by the shah under honorary titles, but they have no authority over other mollahs, except in their own mosques. The standing army is formed in general, as far as possible, on the European system of organization, and officers of the Austrian, French, and other armies are employed as drill-masters or commanders. Theoretically, the number of troops is 100,000, but it is rarely the case that the regiments have their complements. Arms are repaired and manufactured in Teheran, but most of the equipments are imported.

Finance.—The chief sources of revenue are the taxes—paid in money or produce—rents, presents, and customs. The tables or statistics of revenue are deficient in omitting known sources of income; also imperfect by reason of reckoning some of the income of districts separately, and also in the totals of provinces. In the course of fifteen years the maximum of revenue was £1,950,000, and the minimum £1,368,000. Under ordinary conditions the income slightly exceeds expenditures. The money of the country until 1889 was gold and silver only. At that date a bank was authorized by the shah. It now has branches in the principal cities and issues paper money.

Trade and Commerce.—The exports are wheat, cotton, tobacco, rice, opium, fruit, oil (olive), wood, wool, hides, silk, and carpets. The imports are chiefly cotton and woolen goods, tea, coffee, sugar, petroleum, and notions. The great routes of traffic and communication are, in the north, the caravan road viâ Mashhad, Teheran and Tabriz, thence to Erzeroum, and N. from Tabriz to Tiflis; the route from Resht on the Caspian viâ Teheran, Kom, Kashan, Ispahan, and Shiraz to Bushire on the Persian Gulf. Another route is from Mohammerah, at the head of the Persian Gulf, to Teheran viâ the Karun river. A route pursued by the pilgrims is from Teheran to Bagdad. The only wagon roads are from Teheran to Kom, and from Teheran to Casveen. Concessions have been made from time to time by the shah for the construction of a railway from Resht to Teheran, but though offered to companies to be formed under British, French, Austrian, or American auspices, no one has ventured to prosecute the plan. A company is (1894) undertaking the work under Russian protection. There is a railway 12 miles long (with extensions) from Teheran to the village of Shah Abd al Azim.

History.—A sketch of the early history of Iran is given in the article IRANIANS (*q. v.*). Since the Mohammedan conquest in the seventh century the Persians have been governed almost wholly by alien dynasties—Ommyiad, Abbassid, Ghiznevid, Mogul, Timurid, Suffavean, and others. During this period the boundaries of Persia were often changed. It was sometimes a province of a larger empire, and sometimes divided between two or more independent states. The present (Kajar) dynasty began with Aga-Mohammed, a eunuch, in 1795. His nephew, Fath-Ali, lost in wars with Russia the provinces of Georgia, Armenia, and Erivan. Mohammed Shah, the next ruler, failed to regain Herat on account of the resistance of Great Britain. Nasr-ed-din, the present shah, also failed for the same reason, but succeeded in extending his territories to the S. E. During his reign Eu-

ropean improvements have been introduced to some extent. See Parsees, Mohammedan Art, Persian Language, etc.

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Persian Berries: See French Berries.

Persian Gulf: an inlet of the Arabian Sea through the Gulf of Oman and the Strait of Ormuz, and between Arabia and Persia. It is 650 miles long, 250 miles broad, receives the water of the Shat-el-Arab, and contains many islands, most of which are barren and desolate. The pearl-fisheries along the Arabian coast are celebrated.

Persian Inscriptions: See Persian Language and Cuneiform Inscriptions.

Persian Insect Powder: See Feverfew.

Persian Language: in its broadest sense, the speech of the greater part of Iran from the period of the Achæmenian kings, five centuries before the Christian era, down to the present time. When no qualification is added, Persian is usually employed to designate simply the modern speech. Three stages in the history of the language may be recognized: (1) The language of the Old Persian inscriptions, (2) Middle Persian or Pahlavī, (3) Modern Persian.

1. *Old Persian inscriptions* (b. c. 521–335) are the great monuments of the Achæmenian dynasty preserved in cuneiform rock-cuttings, tablets, on vases and on some seals. These records are the oldest remains of the language of Western Persia, and they present an Iranian tongue closely allied to the idiom of the Avesta (*q. v.*). The closeness of the relationship may be illustrated by such a sentence as this in Old Persian: *þātiy Dārayavauš ḫšayaþiya, ima tya adam akunavam vašnā Auramazdāha āha*, which would be represented in Avestan by *saŋhaiti Dārayaţvaŋhuš ḫšaþryō, imaţ yaţ azəm akərənaom vasna Ahurahe Mazdāo aŋhaţ*—"saith Darius the king: that which I have done was accomplished by the grace of Ahura Mazda." In its phonology the ancient Persian is characterized by a tendency to drop final consonants, e. g. Old P. *abara*, Av. *abaraţ*, Skt. *ábharat*, Gr. ἐφερε (τ), he bore, Old P. nom. sing. *puþra*, Av. *puþrō*, Skr. *putrá-s*, son; most of the phonetic features resemble the Avesta. (See Iranian Languages.) The declensional system is like the Avestan and the Sanskrit, though less complete; the dative, for example, is missing in Old Persian, the genitive having to assume its functions; in syntax the Old Persian is somewhat less perfect than the two languages mentioned.

The ancient Persian inscriptions are written in wedge-shaped characters. The oldest and most important monument is the noble rock-record of the great deeds of Darius, an inscription of a thousand lines engraven on the side of a mountain which rises 1,700 feet above the plane at Behistan, near Ecbatana. This record is inscribed in three languages: (1) In Old Persian, (2) in a language variously designated as Scythian, Median, or better New-Susian, and (3) in Assyrian. There are also tablets and inscriptions at Persepolis, Van, Susa, and elsewhere in Persia, preserving briefer memorials of Cyrus, Xerxes, and Artaxerxes; but the later monuments, especially those of the last Artaxerxes (Ochus), b. c. 335, show distinct signs of a decadence of the ancient speech. On the deciphering of the Old Persian inscriptions, see Grotefend.

2. *Middle Persian or Pahlavī.*—After the fall of the Achæmenidæ and the triumphant invasion of Alexander the Great there follow five centuries during which Iran was under the dominion of the Seleucidæ and of the Parthian Arsacids. From this period we have no literary remains of the Persian language other than a few names or words preserved on coins or in some similar manner. Toward the close of the Parthian sway and on the rise of the Sassanian dynasty (a. d. 226) the national spirit of Persia revived and there succeeded a period from the third to the seventh century of our era during which the Persian is represented by the Pahlavī with its literature of no inconsiderable extent. (See Pahlavī.) This period shows a form of language much worn down as compared with the ancient Persian, and characterized by a very considerable infusion of Semitic (Aramaic) words; the presence of this foreign element is more apparent than real, as discussed in the article Pahlavī (*q. v.*). The stage of the language during the Sassanian period is nearer the Modern Persian than it is the ancient Persian.

3. *New or Modern Persian.*—The Mohammedan conquest of Iran in the seventh century was linguistically to Persia what the Norman conquest was to the English speech. The decay of the inflectional side of the tongue was still further hastened, and there was a large influx of Arabic words which tended to increase rather than to decrease with time. The oldest form of the Modern Persian is represented by Firdausī (*q. v.*), the tenth century epic poet. The native purism of Firdausī in his *Shāh Nāmah* is not kept up in later writers, yet, in spite of the Semitic admixture of Arabic elements, Modern Persian has remained a true Iranian speech, just as much as English has remained true Germanic. The language has not preserved any more of its inflections than has the modern English, consequently Modern Persian in its syntax has passed from the synthetic stage of the inscriptions into that of an analytic speech. In phonetics a marked change from the Old Persian tongue may be noticed, e. g. Old P. *puþra-*, Pahl. *pusar*, Mod. P. *pusar*, boy; Av. *mahrka-*, Pahl. *mark*, Mod. P. *marg*, death; Old P. *naiba-*, Pahl. *nēvak*, Mod. P. *nēk*, beautiful; Av. *Vəhrka-* (cf. Old P. *varkāna-*, Hyrcania), Pahl. *gurg*, Mod. P. *gurg*.

The alphabet employed in writing Modern Persian (the *ta'lik* character) is a modification of the Arabic script (*neškhi*); there is current also a more running style of handwriting known as *šikastah*. The modern vernacular of Persia shows a number of dialects, among which is the antique Darī dialect, still preserved by the Zoroastrian guebers of Iran. (See Parsees.) Consult also Cuneiform Inscriptions, Pahlavī, and Iranian Languages and Literature.

Bibliography.—On the Old Persian inscriptions, consult Rawlinson's *Cuneiform Inscriptions* (in the *Royal Asiatic Society's Journal*, London, 1846); Spiegel, *Die altpersischen Keilinschriften* (Leipzig, 1881); Weisbach and Bang, *Die altpersischen Keilinschriften* (Leipzig, 1893–). (For references to Pahlavī, see under that language.) Modern Persian grammars are by Lumsden (Calcutta, 1820); Sir William Jones (ed. Lee, London, 1828); Chodzko (Paris, 1852); Vullers (Giessen, 1870); Fleischer (Leipzig, 1875); and Salemann and Shukowski, *Persische Grammatik* (Berlin, 1889). Dictionaries are: Richardson, *Persian and Arabic Dictionary* (London, 1852); Vullers, *Lexicon Persico-Latinum* (Bonn, 1855–64); Palmer, *Concise Dictionary, Persian-English English-Persian* (London, 1875); Steingass, *Persian-English Dictionary* (London, 1892); and Horn, *Grundriss der Neuperischen Etymologie* (Strassburg, 1893). On the dialects, consult Browne, *A Year among the Persians* (London, 1892), pp. 187, 388, where bibliography is given. In Geiger and Kuhn's *Grundriss d. iran. Philologie* (Strassburg) Shukowski is to treat the subject of Modern Persian dialects. A. V. Williams Jackson.

Persian Literature: in the broader sense, all literary records, monuments, and writings of Iran from the earliest times to the present; the more ancient forms of the literature are discussed under Avesta, Pahlavī, and Persian Language. In the more usual and restricted sense Persian literature in its modern form may be said to date from about the ninth century of our era, although the real beginning is to be sought earlier, as there was no actual severing of the link between Pahlavī and Modern Persian by the Mohammedan conquest of Iran.

Modern Persian literature can justly boast of having fine examples of the epic and lyric poetry, of the romantic, the satiric, and of mystic poetry; the drama, however, is practically wanting, being a growth of the nineteenth century. As to the real origin of the national poetry of Persia, we are in uncertainty; the invention of metre and rhyme is attributed by legend to the popular Sassanian monarch Bahrām Gōr, or Bahrām V. (a. d. 420–439). Almost all modern Persian literature, even history, as in the case of the Arabs also, is written in verse.

Modern Persian Historical Literature.—For the history not only of Persia, but of the whole Eastern world, Persian literature possesses the amplest materials. Under the monarchs of the Sassanian dynasty (beginning 226 a. d.) materials had been collected for a history of Persia, and Yezdigird I. early in the fifth century ordered an abstract of them

to be made. This was translated from the Pahlavī, and continued by later princes up to the account of the Mohammedan conquest. From these old records the poet Firdausī (b. 940 A. D.; d. 1020) composed the *Shāh-Nāmah* or Book of Kings, for the conqueror Mahmūd of Ghazni. This is a magnificent epic of 60,000 couplets, embracing the whole of the legendary history of Persia from the remotest times until the death of Yezdigird. See FIRDAUSĪ.

The oldest of the prose historians is Tabarī (b. 838 A. D.; d. 922), who wrote a history of Persia down to the times of the khalifate. His work has been translated for the Oriental Translation Fund. (*Chronique d'Abou Djafar Muhammed Tabari*, by Zotenberg, Paris, 1867–74.) The book was originally written in Arabic, but only the Persian version of it exists in a complete state. In the fourteenth century Yahya ibn Abd-ul-latif, Cazwini (d. 1351 A. D.), published a comprehensive general history entitled *Lubb-et-tawarikh*, or Pith of History. Mohammed ibn Khavand-shāh Mirkhond (b. 1433; d. 1498 A. D.) was author of the *Rauzat us Safa* (Meadow of Purity), a history of Persia from the Creation to A. D. 1471. (See MIRKHOND.) His grandson, Khavandamir, who was attached to the court of Bāber soon after the invasion of India (1528), wrote an abridgment of this work under the title *Khulasat el Akhbar* (Abstract of Information). It is in ten books, and is an excellent epitome of Eastern history. The *Habib us Siyar* (Biographer's Friend) is another esteemed historical work by the same author. There is a very excellent history of Persia, written about 1300 A. D. by Wassāf of Shīrāz; an account of it is given by Sir Gore Ouseley in his *Notices of Persian Poets* (Oriental Translation Fund, London, 1846), where, among other extracts from the work (p. 232), he gives a story which is the exact counterpart of the well-known English legend of Whittington and his cat. Besides these general histories, there are a great many histories of particular reigns and periods.

All these are purely Persian works, but there is in addition a large number of works written in that language in India, and relating for the most part to the affairs of that country. Of these, the most important are the *Ayin i Akbari* (Institutes of Akbar the Great, Emperor of Hindustan); *Tarikh i Ferishta*, a general history of India by Muhammed Kasim Hindu Shah (d. about 1612 A. D.), who was surnamed Ferishta, ed. by Gen. Briggs (2 vols., Bombay, 1831), translated by A. Dow (London, 1770–72), and by Gen. Briggs (4 vols., London, 1829); and the *Siyar ul Mutaakkherin* (Modern Biography), a history of India down to recent times (Eng. trans. by Gholam Hossein, 3 vols., Calcutta, 1789, and by J. Briggs, London, 1832). A complete account of the native historians of Persia is given in *A Descriptive Catalogue of the Historical Manuscripts in the Arabic and Persian Languages preserved in the Library of the Royal Asiatic Society of Great Britain and Ireland*, by W. H. Morley (London, 1854).

Poetry.—Of the various forms of Persian poetry the most important are—(1) the *Masnavī* (rhyming couplets), which answer to our own "heroics," epic, narrative, and didactic pieces being generally written in this meter. (2) The *Ghazal* (ode). These are for the most part ostensibly anacreontic songs, love and wine being the constant theme, but they are really highly metaphorical religious writings, expounding the peculiar theosophic views of the most extraordinary sect the East has ever produced, the Sūfī dervishes. (3) The *Kasīdah* (idyl), which is generally employed in panegyric. Among the principal poets of Persia is Rūdagī. He lived in the reign of Nasr, grandson of Ismael Samani, founder of the Samany dynasty (about 940). He was born blind, but wrote magnificent lyrics, some few of which have come down to us. (See RŪDAGĪ.) Firdausī has already been mentioned in the account of the historians. In addition to his great work, the Shāh-Nāmah, he wrote a bitter satire on his ungrateful master, Mahmūd, which is usually prefixed to the epic itself, and a poem entitled *Yūsūf u Zuleïkha* (The Loves of Joseph and Potiphar's Wife), a favorite subject with the Persian bards. (See FIRDAUSĪ.) One of the most original and extraordinary poets of Persia was Omar Khayyām (d. 1123). He was a great astronomer and mathematician, and to him we owe the work called *Aljebr u el Mukabileh*, on the science which still bears the name "algebra" which he gave it. His poems consist entirely of *rubāiyat*, or quatrains. They breathe a spirit of advanced free thought, which sometimes, indeed, verges on atheism; but they have at the same time a strange admixture of refined sentiment, philosophical cynicism, and manly feeling which makes them unlike any other composition of the kind. (See OMAR KHAYYĀM.) Omar Khayyām in his youth was an intimate friend of Hasan Sabah, the original "Old Man of the Mountain" and founder of the celebrated sect of Hashashin or Assassins. Auhad-ud-dīn Anvarī (d. about 1200) attracted the notice of Sultan Sanjar, the sixth of the Seljukian dynasty. He was an astrologer as well as poet, but having predicted a terrific storm on the occasion of the conjunction of the seven planets in Libra (Sept. 16, 1186), and failed signally, he relinquished the former profession. His principal works are *Kasīdahs* (odes), which enjoy even now a great reputation in Persia. They are full of fine and even sublime conceptions, nervous and elegant language, and original conceits. The whole *dīvān* or "collected works" of Anvarī were lithographed at Tabriz during the reign of Nasr-ed-dīn. (See ANVARĪ.) Sa'dī Muslih-ud-dīn of Shīrāz (b. about 1184 A. D.; d. 1291–92 A. D.), next to Hāfiz enjoys the greatest reputation of any Persian poet. He is a master of elegant style, and many of his works are marked by a very high tone of moral sentiment. That by which he is best known in Europe is the *Gulistān* (Rose-garden), a beautiful collection of moral stories in prose and verse. Mention should also be made of his *Būstān* (Fruit-garden.) (See SA'DĪ.) Ferīd-ud-dīn Attār (d. at a very advanced age 1230 A. D.) was an eminent Sūfī and poet. His principal work is a collection of tales and parables in verse entitled *Mantik ut Tair* (The Language of Birds).

Abū Mohammad ibn Yūsuf, generally ealled Shaikh Nizāmī of Ganjah (d. 1203 A. D.), wrote a *Khamsah*—i. e. a collection of five didactic poems embodying Sūfiistic doctrines. Of these the most celebrated are perhaps the *Laila u Majnūn*, an Arabian love-story, and the *Sikandar-Nāmah* (History of Alexander the Great). Nizāmī's style is terse and rather difficult, but at the same time very forcible. Few poets contain more subtle thoughts and pregnant expressions; and while other Persian poets generally err on the side of verbiage and prolixity, Nizāmī frequently falls into the opposite extreme. Besides the five poems above mentioned, Nizāmī wrote a *dīvān*, or collection of odes, elegies, etc. (See NIZĀMĪ.) Maulavi Rumi, Jelāl-ud-dīn Rūmī, the founder of the sect of Mevlavī dervishes (b. 1207; d. 1273), is the great exponent of the mystic doctrines of the Sūfīs. He was a contemporary of Sa'di, the author of the *Gulistān*. His immortal work, the *Masnavī*, consists of six long books in rhyming couplets. It contains a complete exposition of the Sūfī doctrines, and forms a perfect *répertoire* of all the tales, legends, fables, and apologues current in the East. This narrative portion of the work is written in a lively, unaffected style, but the long speculative digressions, to which the stories serve merely as introductions, though instructive and often beautiful, are somewhat tedious to a European reader. So highly is the book esteemed throughout the Mohammedan world that it has acquired the title of the *Koran of Persia*. In addition to the *Masnavī*, Jelāl-ud-dīn wrote a *dīvān* of beautiful lyrics. The collection of Maulavi Rumi's minor poems is generally known in India by the name of *Kulliyat Shems Tabriz*, Shems Tabriz being his *takhallus* or *nom de plume*. (See RŪMĪ.) To the fourteenth century belongs the famous lyrical poet Hāfiz, or Shams-ud-dīn Mohammed, of Shīrāz. His poems for the most part are short odes, or *ghazals*, and the collection of these, under the title *Dīvān i Hāfiz*, is the best known in literature. His death occurred in 1388. (See HĀFIZ.) Jāmī (b. 1414 A. D.; d. 1492 A. D.) wrote a *Khamsah* in imitation of Nizāmi, including a *Sikandar Nāmah*, a History of Alexander the Great, and *Yūsuf u Zuleïkha*, a subject also treated by Firdausī; it is by the last-named poem that he is best known. Jāmī also published a *dīvān* of lyrical odes. His poetry is much more light and elegant in character, and more full of feeling, than Nizāmī's, but it lacks the stately grandeur and profound thought which distinguish the latter. (See JĀMĪ.) Hatifi (d. about 1520 A. D.) was a nephew and pupil of Jāmī, and wrote many beautiful poems, among them one entitled *Laila u Majnūn*, which has been edited by Sir William Jones (Calcutta, 1787); his works gave promise of peculiar excellence, but he died prematurely. Khāḳānī, Afzal-ud-dīn Ibrahim (d. 1199 A. D.), was perhaps the most forcible writer in the Persian language, and his poetry is distinguished by a peculiar loftiness of thought and sublimity of style. He is best known by his odes and satires, and by a charming poem containing an account of the countries through which he passed on his way to Mecca, and called *Tuh fat ul Irāḳain* (A Present from Persian and Arabian Irak). Amir Khosru of Dehli (b. 1253 A. D.; d. 1324 A. D.) was of Tartar origin, be-

ing sprung from the tribe of Hazara Lachin, near Balkh. He went to Hindustan, and settled at Puttiala, near Dehli, where, thanks to the influence of his father-in-law, he obtained an important post at the court of Tughlak Shah in Dehli. He was a very voluminous writer, and his poetry is marked by great wit and exuberance of fancy. He is best known by five Sūfiistic romances after the model of the *Khamsah* of Nizāmī. We must not omit to mention the wild and stirring improvisations of the robber-poet Kurroglou, who flourished about the middle of the seventeenth century, and who, although writing in a half-Turkish *patois*, may yet be considered as a representative of the rustic muse of Persia. The reign of Nasr-ed-dīn produced a poet of no mean pretensions, Hakim Kaani, poet-laureate to the shah. His poems have been printed at the imperial press at Teheran, and form a large folio volume. Kaani has an astonishing command of language and rhythm, and while following closely the ancient traditions of Persian poetry as to the form, he has not disdained to infuse into his works a spice of modern learning which imparts a novel and pleasing character to his style. There is an immense crowd of minor poets in the ranks of Persian versifiers, but those mentioned above are the most important ones.

The aim of the Oriental poets is not, as with our own, to discover and produce new conceits and new trains of thought. Indeed, the introduction of an entirely novel and original simile is considered rather a breach of good taste than otherwise. Upon the other hand, the wealth of the language enables them to clothe a single idea in an almost infinite variety of forms of expression, and it is in this direction that their ingenuity and invention are exercised. In order, then, to become able to read any fresh poet with ease, it is necessary for the learner to adopt the native method, and make himself perfectly acquainted with all the minutiæ of the works of *one* of the standard classical writers, and this will give him a ready key to all the rest. Dr. A. Sprenger's *Catalogue of the Arabic, Persian, and Hindustany MSS. in the Library of the King of Oudh* (vol. i., Calcutta, 1854), and Rieu's *Catalogue of the Persian MSS. in the British Museum* (3 vols., London, 1879–83), contain short biographical notices and accounts of the works of all the principal Persian poets.

Ethics, Science, Fiction, and Miscellaneous Works.—The number of these works which Persian literature contains is so numerous that it would require a large volume to give anything like an adequate account of them. The modern Persians, like other Oriental nations, have been stimulated into intellectual activity in recent times by their increased communications with the West, and the result has been that a number of useful works on educational and scientific subjects have been translated from the various European languages. The old standard authors, however, still hold their ground, and are studied with as much ardor as ever. The most esteemed and best-known miscellaneous works are *Akhlak i Jelali*, a treatise on Persian moral philosophy, by Jelāl-ud-dīn, translated by W. F. Thompson (1839); the *Akhlak i Muhsini*, by Hussein Vā'iz Kāshifī (translated by Keene, Hertford, 1852), another much esteemed work on the same subject, the *Gulistān* of Sa'dī, already mentioned in the notices of poetical works; the *Anwar i Suheili*, the Persian version of the fables of Bidpai, by Hussein Vā'iz Kāshifī; the *Dabistān i Mazahib*, by Muhsin Fani, an interesting account of the rise, progress, and doctrines of various religious sects throughout the East. It contains, among others, a history of the ancient religion of Persia, of Hinduism, and of the different sects of Mohammedanism (translated by Shea and Troyer, Paris, 1843). The *Behāristān*, or Spring Garden, of Jāmī, is a charming collection of tales, anecdotes, and aphorisms, and contains, besides, short biographies of twenty-eight of the principal poets of Persia. One of the most interesting works in Persian is the *Tezkerah i Ahuara*, or Memoirs of the Poets, by Daulat Shah, who finished it about 1486 A. D. It is divided into a preface and nine chapters, each chapter containing biographies of about twenty poets, written in a most entertaining style, with extracts from and criticisms upon their works. It is also filled with historical details of great interest and importance, and displays great research and critical acumen in its compilation. It forms the groundwork of von Hammer's *Geschichte der schönen Redekünste Persiens.* E. H. Palmer.
Revised by A. V. Williams Jackson.

Persigny, pār'sēn'yee', Jean Gilbert Victor Fialin, Duc de: statesman; b. at St.-Germain-Lespinasse, Loire, France, Jan. 11, 1808; entered the army, but was discharged in 1830 on account of insubordination; became a contributor to the *Temps*; founded in 1834 *L'Occident français*, a Bonapartist organ; became very intimate with Louis Napoleon; took part in the affair of Strassburg, from which he escaped, and about which he wrote *Relation de l'Entreprise du Prince Napoléon-Louis* (London, 1837); took part also in the descent on Boulogne, where he was captured and imprisoned for several years, during which time he wrote *Utilité des pyramides d'Égypte* (1844), a rather singular performance, in which he tried to demonstrate that those gigantic structures had been reared in order to defend the Nile valley against the sand-flights; was restored to liberty by the Revolution of 1848, and at once set himself to work in the interest of Napoleon, who, on becoming president, appointed Persigny his aide-de-camp. In 1849 he was elected a member of the Legislative Assembly; played an important part in the *coup d'état* of 1851, and was Minister of the Interior from Jan., 1852, to Apr., 1854, and again from Nov., 1860, to June, 1863, having in the interval been ambassador to Great Britain. He was created a duke in 1863. D. at Nice, Jan. 13, 1872. The letters on public affairs which he now and then published are believed to have been inspired by Napoleon himself. See Delaroa's *Le Duc de Persigny et les Doctrines de l'Empire*, 1865, and Delord's *Histoire du Second Empire*, 1868–75. F. M. Colby.

Persim'mon [from Virginia Ind. name]: a tree of the U. S., the *Diospyros virginiana*, of the order *Ebenaceæ*, and its fruit. The common persimmon-tree has a fruit which is excessively astringent until over-ripe, but after hard frosts have brought it to the verge of decay it is a very sweet and agreeable fruit. The wood is used for last-making and other turnery. The kaki or Japanese persimmon (*D. kaki*) is the leading fruit-tree of Japan. It is now planted in California and the southern parts of the U. S. in many varieties, and its fruit is becoming of importance. See Diospyros. Revised by L. H. Bailey.

Per'sius, Aulus Persius Flaccus: satirist; b. at Volaterræ, in Etruria, Dec. 4, 34 A. D., of a rich equestrian family; received a careful education in the schools of Rome; became a pupil of Cornutus the Stoic; moved in the most elegant circles of the capital; was acquainted with Lucan and Seneca. D. Nov. 24, 62. Six satires by him, comprising 650 hexameter lines, are extant, edited by Jahn in 1843 and by Heinrich in 1844; and it is probable that he wrote no more, and even left these in an unfinished state, as he wrote seldom and slowly. They were edited after his death by his friend the poet Cæsius Bassus, to whom the sixth satire is addressed. In antiquity these satires were read and appreciated more than any other production of Latin literature; they were studied and quoted, not only by the pagan authors, but also by the Christian Fathers, such as Augustine, Lactantius, and Hieronymus. In the darkest periods of the Dark Ages they were still read, and their present standing is indicated by the circumstance that there are fourteen English and twenty French translations of them. They are, nevertheless, not easy to understand. The language is obscure and pedantic, the metaphors often grotesque, the connection of ideas difficult to follow. Much is borrowed from Lucilius and Horace, and there is a constant straining after novel and piquant effects. On a more intimate acquaintance, however, a pure, enthusiastic, and earnest soul reveals itself, which, feeling itself fettered by the corruption and depravity of the age, fights the foe as best it can. There are later editions, with English commentary, by Gildersleeve (New York, 1875) and by Conington with an English translation (3d ed. revised by Nettleship, Oxford, 1893); revised text with Juvenal, by Bücheler (Berlin, 1893). Revised by M. Warren.

Personal Equation: See Equation, Personal.

Personal Property: See Property.

Person and Personality [*person* is viâ O. Fr. from Lat. *perso'na*, theater-mask, part (in a play), personage, person; loan-word from Gr. *πρόσωπον*, mask, face, adapted to presumed etymology of *per*, through + *sona're*, sound (i. e. speak)]: the word person is still sometimes used to denote the corporeal appearance of a man rather than his inner attributes, as when we say that he possesses an agreeable person, or is personally repulsive. Later, the relations that a man might sustain in the world as a "personage," *personam agens*, or *gerens*, became prominent, and later still the spiritual functions became the essential content of the notion. In common parlance to-day "person" means an individual

man in his typical completeness as uniting a human body to a free and rational soul. From this point of view personality has been denied to pure spirits and to the souls of the departed awaiting the resurrection, because they are bodiless; also to idiots because they are irrational; to maniacs because they are not free; and to animals, however intelligent, because they are not human. By emphasizing one feature of the conception or another, psychology, ethics, law, and theology have all developed the conception of personality in different ways.

In psychology "personality" designates individuality, or what is called "personal identity," and various opinions have been held concerning the foundations of this. It is either an ultimate and self-subsistent principle at the core of a man, or it is a result derived from other principles. Already in Hindu philosophy we have this opposition in the contrast between the Sankhya system, with its absolute plurality or independent finite souls, and the Vedanta system, for which there exists only one self, the supreme Drahman, with whom all particular selves (Atman) are really coidentical, but (until they are redeemed by knowledge) dwell in the illusion of finite personality through not distinguishing themselves from the organisms with which they are severally conjoined. These organisms have their psychic as well as their physical side. Their grosser body is resolved at death into its elements, but a finer body, together with the senses and active powers, the *manas*, or organ of consciousness and will, the breath, and the *karma*, or moral worth acquired, form principles of continued individuality which ever enter into other bodies, so that through an indefinite series of transmigrations the finite personal life is kept up. The *modern theosophists'* doctrine of personality is derived from the Vedantic system.

Among the Jews the spiritual principle of personality was the "spirit" (*Ruach*) or warm breath of life which animated the dust, when breathed thereinto by Jehovah. This breath-spirit, which we find as the ruling conception in all primitive thought, maintains its place in both Greek and Christian philosophy, developing into the more physiological conception of "animal spirits" on the one hand, and into the Pauline doctrine of the "Spirit," or *pneuma*, on the other. The animal spirits filling the arteries, nerve-tubes, and brain cavities were supposed to mediate between the rational soul and the body; the theological "spirit" mediates between God and the soul or *psyche*.

In the Greek philosophy, passing over the confused utterances of the pre-Socratic masters, we find the *pneuma* or fiery air-current to play a great part in the systems of the *Stoics*. Being of a nature both material and immaterial, it was well calculated to serve as the animating principle of the world at large as well as of the individual person in it. *Plato and Aristotle* subordinated the principle of the breath to the immaterial and rational *psyche*. In Plato we find the germ of later spiritualistic conceptions of personality. The man is composed of two almost hostile principles, of which the soul is the one that is essential, being superior to Nature, pre-existing to the body, and possessing an immortal destiny to be attained by a course of rational and moral development. The body here is the soul's vessel or prison, and, although its necessary servant, is also the source of its errors and faults. This dualistic view was in Aristotle's psychology developed into that wonderful conception of soul as "form" and body as "matter" which dominated all Christian philosophy until the time of Descartes. For Aristotle the person is this organic unity of form and matter, this animated body in its completeness, this subject of biology and psychology in one; and nutrition becomes a function of the soul as much as thinking is. *Scholastic peripateticism* here, as elsewhere, elaborated the Aristotelian ideas into greater hardness and articulateness. Soul and body, separately taken, are incomplete substances. Only their union is a concretely *subsistent* substance, *suppositum* or *hypostasis*; and since in the case of the human soul the nature of the substance is rational, the *suppositum rationale* thus composed is what is meant by *person*. *Individua substantia naturæ rationalis* is the definition of "a person," often quoted from Boethius.

It is not till Descartes's time that we find consummated with perfect sharpness the distinction, now so familiar to us, of Consciousness and the Unconscious. In the Cartesian philosophy the Conscious and the Extended, having absolutely nothing in common with each other, were raised to the rank of two mutually exclusive substances, and the commerce of soul and body in the human person, mediated for Descartes himself by the animal spirits, had to be carried on for Malebranche and other Cartesians by a perpetual miracle of "divine assistance." The person was thus broken in two, or rather became a purely spiritual entity, while the rest of nature, including the body, was materialistically treated. In Cartesianism, however, as in Peripateticism, the finite souls still constitute a multitude of distinct substances, and are not, as with Spinoza, lost in the one substance of God. Personal identity, in a word, is *real* —a principle, not a result.

In Locke's *Essay Concerning Human Understanding* the great revolution toward empiricism begins. Personality is now explained as a result, and not assumed as a principle. It is not something which, by simply being, gives rise to consequences, but something which is made from moment to moment by a cause which can be assigned. Locke believes, indeed, in souls as substances and in their identity; but the mere ontological self-identity of such a soul would, he says, make no *personal* identity unless a recollecting consciousness were joined thereto. "Consciousness" is what makes a *person*, when it remembers past experiences, as having been also its own. If the same consciousness with its memories could migrate from one soul to another, we should have personal identity without identity of substance. And conversely, if one man were to have distinct incommunicable consciousness at different times, he would make different persons. As personality is annexed to consciousness, so punishment ought to be annexed to personality, and in the great day, wherein the secrets of all hearts are laid open, no one should be made to answer for what he knows nothing of, but should receive his doom, his conscience accusing or excusing. The importance of Locke's doctrine lay in this, that he eliminated "substantial" identity as transcendental and unimportant, and made of "personal" identity (the only practically important sort) a directly verifiable empirical phenomenon. Where not actually experienced, it *is* not. Hume went beyond Locke in discarding substances, whether spiritual or material altogether. Our sense of *gradual* change in the succession of our particular "ideas," in which "there is properly no simplicity at one time nor identity in different," is what Hume means by our personal identity. Locke's and Hume's views have been carried out both in Germany and England by the *associationist psychology*, which in consequence has been dubbed a "psychology without a soul."

Since Kant's time the consciousness of subjection to moral law, and the autonomy and freedom implied by such a consciousness, have often been referred to as the specific marks of personality. On this view "person" means a being with inner ideal ends, to which it freely acknowledges responsibility. Here the psychological notion passes over into the ethical and juridical conceptions of personality.

Recent psychology has, in the main, elaborated itself on Lockian lines. The succession of associated ideas inwardly held together by memory is regarded by all schools to constitute the content of the *empirical self*. For some writers these ideas themselves are compounds of simpler psychic units, so that the psychic person is a purely secondary result, with no special principle of unity. Others contend for such a primordial principle, either in the shape of a real spiritual being or soul, which owns the ideas, or in that of a "transcendental Ego" which performs their synthesis.

Multiple Personality.—That something beyond the mere contemporaneous connection of many ideas with one organism is needed to make one personal consciousness result, is shown by certain phenomena which psychologists are but just beginning to study with care. In a variety of ways one and the same "man" may successively or simultaneously have different consciousnesses that are, in Locke's words, incommunicable. The most familiar cases of this are ordinary forgetfulness, absence of mind, and rapid oblivescence of dreams, where subsequent recollection proves the apparently lost ideas to have been there all the time. In somnambulism, either natural or "hypnotic," the rule is for the subject to forget on waking all that he has done, but to remember it again on re-entering the somnambulistic state. He may thus live two alternating personal lives with a distinct system of memory in each. It was first proved by Edmund Gurney that the memories of the hypnotic consciousness may coexist, after waking, with the normal consciousness of the subject, but be unknown to the latter. Taking subjects to whom it had been "suggested" in trance that they must perform certain acts after waking when a signal should be given (see HYPNOTISM), but whose waking

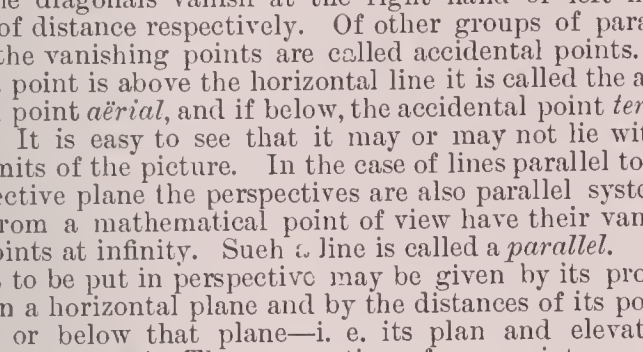
consciousness ignored the suggestion, he set their hands, when they woke, upon a *planchette* and got the order automatically and "unconsciously" written, while their normal consciousness was occupied in reading aloud, or in conversation. At about the same time Janet, Binet, and others found phenomena in connection with the anæsthetic surfaces of hysteric patients, which proved the anæsthesia to be relative only to the subject's principal consciousness, another consciousness appearing present which took cognizance of the apparently lost sensations. Thus one patient's anæsthetic hand can feel her toilet articles and handle them skillfully; in others, if the attention be distracted, the anæsthetic hand adapts its movements to objects that are placed in it, as scissors, matches, etc. Or if figures be traced on the anæsthetic palm, the patient will *see* them, vicariously, as it were; but the chief proof, as with Gurney, is by automatic writing. Janet used what he calls the "method of distraction" in these cases. In this the patient is kept absorbed in conversation with a third party, while the operator, approaching her quietly, whispers questions in her ear. The consciousness engaged in talking ignores the questions, but, if a pencil be placed in the hand, answers to them are automatically written. It is as if one consciousness animated the speaking mouth and another the writing hand, both, however, using the ear. Myers has given the name of *subliminal selves* to consciousnesses supernumerary to the principal one; and Janet and others have found that painful reminiscences split off from the principal consciousness, persisting thus subliminally and revealing themselves in the hypnotic trance, are prime factors of the hysteric condition. Cases of *alternating personality*, in which the man or woman passes at intervals into a "second" state with its own peculiarities, of which the normal state, when resumed, knows nothing, have been recorded at great length. "Léonie," "Felida X.," "Lurancy Vennum," "Ansel Bourne," and "Louis V.," may be named as types. In the last-named case there were as many as five different personalities with exclusive systems of memory and peculiarities both of bodily sensibility and character. A very large number of men and women can readily become *automatic* writers, either with *planchette* or pencil. The writing hand becomes sometimes anæsthetic, sometimes not; and there are all degrees of detachment of the principal consciousness from what is written. In no case, however, is the subject's "will" felt to be concerned. These writings tend in most cases to assume the character of messages from spirits who sign their names; and in its most developed degree automatic writing passes into *mediumistic trance* and may be succeeded by "*speaking under control*." Here again there are degrees; but the medium's normal consciousness usually remembers nothing of the trance-utterances, which may assume a character very unlike the medium's own. (See SPIRITUALISM.) The phenomena of *demoniacal possession*, so rife in ancient times and in primitive societies, seems to be essentially the same thing as our trance-mediumship, obeying, however, a different inspiration as regards its moral content. In both phenomena the "attacks" are short, no memory of them remains, and the patient between them is well. The subjects have nothing in common with the insane, technically so called.

All these facts have brought the question of what is the unifying principle in personality to the front again. It is certain that one human body may be the home of many *consciousnesses*, and thus, in Locke's sense, of many *persons*; but much in the temperament of the secondary persons seems unaccountable if they are only accidental improvisations, produced by certain groups of the patient's "ideas" separating from the rest and leading a quasi-independent life. They have a generic similarity in many cases, as in automatic writing and trance-speaking, which suggests some common cause as yet imperfectly known, or at any rate a context which if explored might make the phenomena, with their peculiar regularity, appear more rational. It is clear already that the margins and outskirts of what we take to be our personality extend into unknown regions. Cures and organic effects, such as blisters, produced by hypnotic suggestion show this as regards our bodily processes; while the utterances of mediums and automatic writers reveal a widespread tendency, in men and women otherwise sane, to personifications of a determinate kind; and these again, though usually flimsy and incoherent in the extreme, do, as the present writer believes, occasionally show a knowledge of facts not possessed by the primary person. The significance and limits of these phenomena have yet to be understood, and psychology is but just beginning to recognize this investigation as an urgent task.

BIBLIOGRAPHY.—For opinions before Locke see all the histories of philosophy, especially Siebeck's *Gesch. d. Psychologie*; and for Hindu ideas, see Deussen's *System des Vedanta*. Locke's statements are in book II., chap. xxvii. of his *Essay*; Hume's in part iv., § vi. of his *Treatise on Human Nature*. In modern psychology Ladd's *Physiological Psychology*, part iii., and James's *Principles of Psychology*, chap. x., may be referred to, the one defending a Real Being as the principle of personal unity, the other placing it in the function of memory. General defenses of the spiritual view are A. W. Momerie's book *Personality*, and F. A. Shoup's *Mechanism and Personality*. The theosophic doctrine is conveniently expressed in Blavatsky's *Key to Theosophy, passim*. Binet's *Altérations de la Personnalité* and various essays by Myers in the *Proceedings of the Society for Psychical Research* give the facts of multiple personality in much detail. WILLIAM JAMES.

Perspec'tive [from Lat. *perspi'cere*, look through; *per*, through + *spi'cere*, look]: the art of representing an object upon a plane surface, so that the representation shall exhibit the same appearance as the object itself. To conceive what is meant by the perspective of an object, imagine a transparent plane to be placed between the eye and the object, and let straight lines be drawn from every point of the object to the eye. Each of these lines will intersect the transparent plane in a point; and if each small area determined by an assemblage of such points is properly tinted, the resulting picture will present the same appearance as the object itself. The art of perspective is thus divided into two parts: (1) the correct delineation of the lines of the object, (2) the proper shading and coloring of the picture, so as to produce the desired effect of distance and tint. The first, which alone is considered here, is called *linear perspective*, and the second *aërial perspective*. The importance of attending to perspective becomes apparent if we consider the appearances presented by objects under certain conditions. For instance, two parallel rows of objects of equal size, if seen from a point midway between the rows, seem to converge as well as to grow smaller and smaller; and a circle, if seen obliquely, appears to be an ellipse. In what follows we suppose the perspective drawing to be made upon a vertical plane between the eye and the object. This plane is called the perspective plane, and any object lying on the same side as the eye is said to be in front of the perspective plane, and any object lying on the other side is said to be behind. The lines that are drawn from the different points of the object to the eye are called *visual rays*; all the visual rays that are drawn from a right line or from a curve in a plane passing through the eye make up a *visual* plane; and all the visual rays that are drawn from any other curve make up a visual cone. The art of linear perspective consists in passing visual planes and visual cones through the principal lines of the object, and finding their intersections with the perspective plane. The method of proceeding depends upon a few simple principles of geometry, of which the following are most frequently used: (1) If two lines are drawn through any point of an object their perspectives intersect, and the point of intersection is the perspective of the given point; (2) if visual planes are passed through any number of parallel lines of the object, they intersect each other in a visual ray parallel to the given lines, and the point in which this ray intersects the perspective plane is a point, called the vanishing point, common to the perspectives of all the given lines. If the perspective plane were made of glass, a sketch made on it by following with a pencil all the lines and shades of the objects seen by the observer would give a representation in absolute perspective; but this method is not practicable for various reasons. A series of rules, founded on observation and experience, has been formed by which painters are enabled to copy nature faithfully. After the objects to be introduced into the picture and the distance from which they are to be viewed have been determined, it is necessary to draw certain lines upon the perspective plane, (1) the *base line*—that is, the base line of the sketch—which is the boundary nearest the observer of the objects to be represented; (2) the *horizontal line*, representing the ordinary position of the horizon. It is supposed to be level with the observer's eye. When the latter is on a level with the horizon it is generally drawn at a height of about one-third of the entire height of the picture, but it will rise together with an increase in the elevation of the observer; (3) the *vertical*

line; it is perpendicular to both the other lines and meets the horizontal line in the *point of sight*. This point is generally placed so as to be the center of the picture—that is, on a line half way between the two sides. All lines in nature perpendicular to the perspective plane, called *perpendiculars*, are represented by lines intersecting in the point of sight, which is thus their vanishing point. The points of distance are two points on the horizontal line, twice as far apart as the eye is from the picture; they are equidistant from the point of sight when the horizontal lines, called *diagonals*, of which they are the vanishing points, are inclined to the base line at an angle of 45°. As a visual ray parallel to a system of diagonals inclines to the right or the left, the diagonals vanish at the right hand or left hand point of distance respectively. Of other groups of parallel lines the vanishing points are called accidental points. If such a point is above the horizontal line it is called the accidental point *aërial*, and if below, the accidental point *terrestrial*. It is easy to see that it may or may not lie within the limits of the picture. In the case of lines parallel to the perspective plane the perspectives are also parallel systems, and from a mathematical point of view have their vanishing points at infinity. Such a line is called a *parallel*. The object to be put in perspective may be given by its projection on a horizontal plane and by the distances of its points above or below that plane—i. e. its plan and elevation. (See PROJECTION.) The perspective of any point may be most easily determined as the intersection of the perspectives of a diagonal and a perpendicular passing through the point; and the perspective of the shadow of a point upon a horizontal plane may be determined as the intersection of the perspectives of a ray of light passing through the point and of the projection of that ray upon the given plane. As an illustration, let us find the perspective of a cube and the perspective of the shadow which it casts on the horizontal plane of its base, the rays of light being parallel. Take the perspective plane through the front face of the cube, and let A B represent the intersection of the plane of the lower base of the cube with the perspective plane. Let C be the center of the picture, and let D C, parallel to A B, represent the horizon; also let D be the left-hand vanishing point of diagonals, R the vanishing point of rays of light, and R′ the vanishing point of horizontal projections of these rays; R′ is in a perpendicular through R to A B, and also in the line D C. Construct the square H L to represent the front face of the cube, and it will be its own perspective. The edges of the cube that pierce the perspective plane at H, K, L, and M are perpendiculars, and their indefinite perspectives may be found by drawing lines from these points to C. The diagonal through the upper left-hand vertex of the back face pierces the perspective plane at M and M D in its perspective; the point O in which M D cuts L C is therefore the perspective of this vertex. The edges of the cube parallel to L M and K H are parallel to the perspective plane, as are also the edges parallel to L K and M H, and consequently their perspectives are parallel to the lines themselves. Hence, if we draw O N and O P parallel to L M and L K, and then construct a square on these lines, it will be the perspective of the back face of the cube. The figure H O is then the required perspective of the given cube.



To find the perspective of its shadow on the horizontal plane A B, we draw M R, which will be the perspective of the ray of light through M, and H R′, which will be the perspective of the horizontal projection of that ray; the point S in which these lines intersect is the perspective of the shadow of the point M, and H S is the perspective of the shadow of H M. The shadow of the edge M N is a perpendicular; hence, we draw S C and N R, intersecting at Q; then is S Q the perspective of the shadow cast by M N. The shadow of N O is a parallel; hence, we draw Q T parallel to O N, and limited by a line from O to R; then is Q T the perspective of the shadow cast by N O. The line T P is the perspective of the shadow cast by the edge O P. The perspective of the shade and shadow of the cube, so far as they are visible, are indicated by the shaded part of the drawing. Revised by R. A. ROBERTS.

Perspiration: See SWEAT.

Per Stirpes: See DESCENT.

Perth: county-town of Perthshire, Scotland; at the foot of the Grampian Mountains, on the Tay; 43 miles N. N. W. of Edinburgh (see map of Scotland, ref. 10–H). It is a handsome city, with several fine buildings, including St. Ninian's Episcopal Cathedral and St. John's church, an old cruciform Decorated structure restored in 1891. The principal industries are dyeing, brewing, and manufactures of ink and linen. The salmon-fisheries are important. Pop. (1891) 30,525; (1901) 32,872

Perth: capital of the colony of Western Australia: on the Swan river, 12 miles above its mouth (see map of Australia, ref. 6–B). It is the financial center of the colony, and is connected by rail with Albany. The town was constituted a city in 1856, is the seat of Anglican and Roman Catholic bishoprics, and has a number of fine public buildings. Pop. (1892) 10,040.

Perth Amboy: city (incorporated in 1784); port of entry; Middlesex co., N. J. (for location, see map of New Jersey, ref. 4–D); at the mouth of Raritan river; on Raritan Bay, Staten Island Sound, and the Cent. of N. J., the Lehigh Valley, the Penn., and the Staten Island Rapid Transit railways; 21 miles S. W. of New York. It is in a fire-clay and kaolin region; has a large and excellent harbor; and contains 5 terra-cotta works, 2 large dry-docks, 4 machine-shops, iron-foundry, oil-refinery, chemical-works, emery-works, cork-factory, and immense coal and freight shipping dépôt and wharves of the Lehigh Valley Railroad. There are a Young Ladies' Seminary, a State bank with capital of $50,000, a savings-bank, and a daily and 3 weekly newspapers. Pop. (1880) 4,808; (1890) 9,512; (1900) 17,699.

EDITOR OF "MIDDLESEX COUNTY DEMOCRAT."

Perthshire: a central county of Scotland. Area, 2,528 sq. miles. It is greatly diversified by mountains, forests, valleys, rivers, and lakes. It is largely occupied by the Grampian Mountains, whose highest peak, Ben Lawers, rises 4,000 feet. Hardly a fifth of the surface is in tillage, the rest being pasture, woods, deer-forests, grouse-moors, etc. Pop. (1901) 123,255.

Per'tinax: a Roman of humble birth who rose to a position of the highest esteem in military and civil life during the reigns of Marcus Aurelius and Commodus. On the assassination of the latter he was chosen to succeed him as emperor, Dec. 31, 192 A. D., but was himself murdered less than three months later (Mar. 28, 193 A. D.).

G. L. H.

Perturbations [from Lat. *perturba'tio*, disturbance, deriv. of *perturba're*, disturb greatly; *per*, through, thoroughly + *turba're*, disturb]: deviations in the motion of a planet from its elliptic orbit, produced by the attraction of other planets upon it. Were a planet attracted by no body except the sun, it would, in accordance with Kepler's laws, describe an ellipse, having the sun in one of its foci. In consequence of the attraction of other planets, every planet deviates from such an ellipse, and these deviations are called perturbations. Periodic perturbations are those which, in the long run, tend to compensate each other. Secular perturbations are those changes in the form of the orbit which go on in the same direction from century to century. The mathematical theory of perturbation forms the most difficult subject in astronomy, and has taxed the powers of the greatest mathematicians in modern times. Laplace's *Mécanique Céleste* and other works of this kind are mostly devoted to the subject. S. NEWCOMB.

Pertz, GEORG HEINRICH: historian; b. at Hanover, Mar. 28, 1795; studied at Göttingen; published in 1819 a learned monograph on the Merovingian *majores domus*; was appointed in 1823 secretary of the royal archives at Hanover, and devoted the rest of his life to the collection and critical editing of the oldest sources of German history. In the execution of that great work, whose results appear in the famous *Monumenta Germaniæ Historica*, he was supported by the King of Hanover and other German princes. Among his other works is a biography of Stein (Hanover, 1849–54). D. at Munich, Oct. 7, 1876. F. M. COLBY.

Peru': a republic in the western part of South America, bordering on the Pacific, between Ecuador on the N. and Chili on the S. In the N. a tract of about 90,000 sq. miles, on both sides of the Marañon or upper Amazon, is held by Peru, but is claimed by Ecuador. Tacna and Arica, formerly southern provinces of Peru, are held by Chili. It is impossible to calculate the area even approximately; the estimate of Reclus is 378,000 sq. miles.

Mountains.—The great mountain system of the Andes follows the coast, northwesterly, in two parallel chains—the Cordillera, with its base generally about 20 miles from the coast; and the Andes, 70 to 110 miles farther inland. Between these is a region of plateaus and high valleys, varied by numerous spurs from both chains, and cut by the Vilcañota Knot or cross range near lat. 14° 30′ S., and the Cerro de Pasco Knot near lat. 9° 15′ S. From Cerro de Pasco the Andes give off an eastern branch, sometimes called the Eastern Cordillera. The Cordillera proper has two crests in many parts, especially toward the S.; between them is a cold, arid table-land or *puna* over 13,000 feet high. The Cordillera is unbroken, and forms the divide between the short rivers which flow to the Pacific and the large ones which unite in the Amazon. Near the Ecuadorian frontier few of the mountains in either range exceed 10,000 feet in height; but from lat. 8° S. there is a succession of snowy peaks, with passes often 15,000 feet high. The highest summits are near lat. 10° S. in Ancachs; according to Hindle the Cerro de Huascan attains 22,050 feet. The limit of perpetual snow is from 15,500 to 16,500 feet.

Regional Divisions.—The parallel mountain ranges divide Peru into three habitable regions called the Montaña, the Sierra, and the Costa. The Montaña includes the lower eastern slopes of the Andes, together with the vast plains bordering the upper Amazon and its tributaries in the N. E. Here there are very heavy and frequent rains and a luxuriant forest growth. The few civilized inhabitants are gathered near the great rivers. The Sierra includes all the region between the Andes and the Cordillera. The southern part, to the Vilcañota cross range, is included in the Titicaca basin; it is nearly 13,000 feet high, and so cold that corn will not ripen. Between the Vilcañota and Pasco cross ranges is the finest and most thickly populated part of Peru, and the ancient center of Inca civilization; a wonderfully varied region of plateaus, mountain-slopes, and fertile valleys, from 3,000 to 12,000 feet high. The northern part of the Sierra includes the deep gorge of the upper Marañon and the head of the Huallaga valley, a wild and rather thinly settled region of difficult access. Rains are never abundant in the Sierra, and there is no true forest; but the valleys are well watered by streams from the mountain snows. The Costa, the narrow strip between the Cordillera and the Pacific, is a terrace a few hundred feet high, abutting on the coast in cliffs and varied by spurs and isolated headlands. It is an almost rainless desert, but crossed by valleys of great fertility wherever a stream comes down. The climate is temperate rather than tropical, and the winter months (May to October) are characterized by frequent thick mists (*garruas*), sometimes with a light drizzling rain, which brings out a sparse growth of herbs on the desert lands. Peru has few well-sheltered harbors, the most important being Callao. Several groups of small rocky islands—the Lobos, Chinchas, etc.—adjoin the coast; they are important only as shelters and for their deposits of guano, now nearly exhausted.

Volcanoes and Earthquakes.—The Peruvian volcanoes, only three or four of which are active, are all gathered in the southern part of the Cordillera; among the best known are Misti, Omate, and Ubinas. The region about them, with the whole of the Costa, is subject to frequent and sometimes severe earthquakes. Lima and Callao have been nearly destroyed four times, the most disastrous shock being that of Oct. 28, 1746. Arequipa and the coast cities have suffered even more, notably in 1868 and 1877. In the Sierra earthquakes are much less frequent and severe, and in the Montaña they are almost unknown.

Rivers and Lakes.—The short rivers of the Pacific slope are all unnavigable. E. of the Cordillera the streams at first follow the axes of the mountain-chains, generally N. or N. N. W.; ultimately they break through the Andes in deep gorges, and reach the northeastern plains, where they become navigable. The principal trunks are the Marañon or upper Amazon, the Huallaga, and the Ucayali. The Javary is a river of the plains on the boundary of Brazil: and the Madre de Dios, one of the four great branches of the Madeira, rises not far from Cuzco. These rivers, owing to the difficulty of communication over the mountains, are used only for the small commerce of the Montaña, but they form the shortest routes from Peru to Europe. Lake Titicaca (*q. v.*), between Peru and Bolivia, is navigated by small steamers, forming part of the mixed route from La Paz to the Peruvian coast. There are several small lakes in the Sierra.

Fauna and Productions.—The Montaña animals are similar to those of Brazil. The mountain region has many peculiar animals, the most noteworthy being the domesticated llama and alpaca (the former used as a beast of burden, the latter for its fleece), with their wild congeners, and the condor, the largest bird of flight. At present rubber and cinchona are about the only utilized products of the Montaña forests. Coca, quinoa, and the potato grow wild, and are cultivated at higher altitudes. The Sierra and coast valleys, and nearly all the Montaña, are very fertile; owing to the diversity of climate almost any plant can be raised, but the principal agricultural products are sugar-cane, cotton, grapes (used for brandy), and tobacco in the Costa; maize and coca in the Sierra, with potatoes and quinoa at higher altitudes; and maize and manioc in the Montaña. Peru is pre-eminently a country of minerals, almost every department being rich in deposits, but in its output it is surpassed by Bolivia and Chili. Heretofore the silver mines have been the most important; the veins occur principally in the Cordillera. The celebrated mines of Cerro de Pasco yielded about $475,000,000 worth of silver from 1630 to 1850; the yield in 1877 was 1,427,592 oz. Gold is found principally on the eastern slope of the Andes, and the washings have been only slightly developed. Other important metals are quicksilver (now but little mined), copper, and lead. Coal (Jurassic) is now mined near the coast, and occurs inland; extensive petroleum deposits have been found in the northwestern department of Piura, and are worked to some extent. The guano deposits have been a source of great wealth; from 1853 to 1872 8,000,000 tons were taken from the Chincha islands alone. The known residue is only a few hundred thousand tons, and has been transferred to a private company. See Peru in the Appendix.

People and Government.—The population in 1894, besides some 150,000 wild Indians, was about 3,100,000. Most of these are descended from the ancient Kechua tribes or, in the Titicaca basin, from the Aymaras. In the cities there is an intermixture with Spanish blood, and a comparatively small proportion is of pure Spanish descent. The educated and ruling class includes portions of all these. Negroes (descended from the slaves who were finally liberated in 1855) are nearly confined to the coast, where, also, there are many Chinese. Spanish is the common language in the coast cities, but Kechua is still universally spoken in the Sierra, where many of the Indians retain their tribal organization under the Peruvian Government. The wild tribes are nearly confined to the Montaña, and few of them are hostile. The constitution now in force was adopted in 1859–60, but has been somewhat amended. Peru is a centralized or unitarian republic, all the principal powers being concentrated at Lima. The president is elected for four years, is not eligible for immediate re-election, and is assisted by a council of responsible ministers. Congress consists of a Senate and a House of Deputies. The state religion is the Roman Catholic, and the public exercise of other cults is forbidden. The University of San Marcos at Lima is the oldest in the New World, and is still well attended. The Government supports *colegios*, or high schools, in the principal cities, but popular education is still very backward. The better class of Peruvians are intelligent, well-read, generous, and sociable, but they are somewhat impulsive, and commonly hot partisans. See Spanish-American Literature.

Commerce, etc.—The leading exports in the order of their value are sugar, silver ore, cotton, wool, and hides. More than half the trade is with Great Britain, and hardly one-fifteenth with the U. S. The total exports in 1899 were valued at 33,615,311 sols, total imports at 21,230,183. There are some 1,000 miles of railways, the most important being the Oroya route from Lima over the Cordillera (projected to Cerro de Pasco and the Montaña), and that from Mollendo to Arequipa and Lake Titicaca. The old Inca roads are still used in parts. There is telegraphic communication between the principal cities and by cable to other countries. The metrical system of weights and measures is legalized, but the old Spanish ones are used. The principal coin, the *sol*, is nominally worth a dollar, but really about forty-nine cents.

Finances.—In Jan., 1890, the whole of the foreign debt, then amounting with arrears to £22.998,651, was, by agreement, assumed by the Peruvian Corporation, a private company; in return, the state railways and other public works, and nearly all the remaining guano, were transferred to the company for sixty-six years, the Government agreeing to pay the bondholders £80,000 sterling annually for thirty years. The internal liabilities were estimated in 1900 at 46,003,000 sols.

History.—Vague traditions relate that a powerful dynasty, the Pirua, held the highlands of Peru and Bolivia in very ancient times; to it are ascribed the remains at Tiahuanaco and some near Cuzco. The Pirua empire is said to have been broken up about A. D. 1000. The INCAS (*q. v.*) established their power at Cuzco about 1230, and at the beginning of the sixteenth century ruled the Andean highlands and the Pacific coast from lat. 35° S. to beyond the equator. The empire was weakened by its division between Huascar and Atahualpa in 1525, and a civil war in which the former was defeated. PIZARRO (*q. v.*) reached Peru in 1527; he invaded it in 1532, captured and killed Atahualpa, and easily conquered the country, securing an immense booty. This led to the conquests of Quito (Ecuador), Southern New Granada, Charcas (Bolivia), and Chili. Pizarro founded Lima as his capital in 1535; a formidable uprising of the Indians was repressed in 1537; and after the rebellions led by the ALMAGROS, GONZALO PIZARRO, and GIRON (*qq. v.*) Peru settled down under the quiet rule of the viceroys. It was the most valued of the Spanish possessions, but few improvements were introduced, and the riches of the country were constantly drained into the Spanish treasury. The viceroyalty embraced the whole of Spanish South America and Panama, with audience divisions corresponding, in part, to the modern republics. The separation of New Granada (1718) and La Plata (1776) reduced the rule of the viceroy to Peru proper, Chili, and Quito (Ecuador), with full powers only in the first. In 1781 the formidable Indian rebellion under Tupac Amaru was repressed with unspeakable cruelties. Peru, the center of Spanish power in South America, was the last region to throw off the yoke. Independence was declared at Lima, July 28, 1821, and the victory of Ayacucho, Dec. 9, 1824, practically ended Spanish rule in South America. Ecuador and Chili had already separated, and Bolivar's rule in Peru ended in 1827. The country, under military rulers, was distracted by civil wars. Santa Cruz, president of Bolivia, interfered, conquered Peru 1835–36, and united the two countries; but Gamarra and other malcontents, aided by Chili, overthrew him in 1839 and re-established the old division. Gamarra, made president, invaded Bolivia, and was defeated and killed in 1841. A firm government was finally established by Ramon Castilla in 1845. His successor, Echenique, was deposed after a civil war, in 1855, and Castilla was again president until 1862. Prado, by a bloodless revolution, usurped the Government in 1865, but was deposed in 1868; meanwhile a Spanish fleet, sent to enforce alleged claims, was brilliantly repulsed at Callao, May 2, 1866. The rich proceeds of the guano and nitrate beds induced a spirit of extravagance; railways and other vast works were undertaken by the Government, and the public debt was enormously increased; interest payments were suspended in 1876, but with constantly increasing revenues and more economical administrations the future seemed secure. This hope was destroyed by the disastrous war with Chili. That country suddenly claimed the coast lands of Bolivia and Southern Peru, and refusal led to a war for which neither Peru nor Bolivia was prepared. Their united armies were disastrously defeated in the south; the Peruvian navy was annihilated after a gallant struggle; by two bloody battles the Chilians took Lima, Jan. 17, 1881; public buildings, including the fine library, were sacked, and the rural districts were desolated. At length Iglesias, as nominal president, agreed to a peace by which Tarapacá was unconditionally ceded to Chili, the provinces of Arica and Tacna were ceded conditionally, and a great share of the guano beds was given up; the ceded territory included all the nitrate deposits. The Chilians evacuated Lima in Oct., 1883. Cáceres, who was the constitutional president, refused to acknowledge Iglesias, seized Lima Dec. 1, 1885, and, his claim being ratified by election, became president. Since then the country has been slowly recovering. The "revolutions" frequently chronicled by newspapers have been slight disturbances connected with elections.

AUTHORITIES.—Raimondi, *Geografía física del Perú*; Paz Soldan, *Diccionario geográfico estadístico del Perú* (1877); Reclus, *Nouvelle géographie universelle*, vol. xviii. (1893); Markham, *Cuzco and Lima* (1856), *Travels in Peru and India* (1862), *The War between Peru and Chili* (1883), and *A History of Peru* (1892); Prescott, *The Conquest of Peru*; Mendiburu, *Diccionario histórico-biográfico del Perú* (1874–78); Llorente, *Historia del Perú* (1860); Squier, *Peru* (1877); the works of von Tschudi, Mariano Rivero, and Wiener.

HERBERT H. SMITH.

Peru: city; La Salle co., Ill. (for location, see map of Illinois, ref. 3–E); on the Illinois river at the head of navigation, the Illinois and Michigan Canal, and the Burlington Route and the Chi., Rock Is. and Pac. railways; 17 miles S. of Mendota, 100 miles W. S. W. of Chicago. It is in a coal-mining region, is an important trade center, and has several manufactories, a national bank with capital of $50,000, a State bank with capital of $25,000, and a daily and a weekly newspaper. The river is navigable to this point at all seasons, and is here crossed by a railway bridge. Pop. (1880) 4,632; (1890) 5,550; (1900) 6,863.

Peru: city; capital of Miami co., Ind. (for location, see map of Indiana, ref. 4–E); on the Wabash river, the Wabash and Erie Canal, and the Lake Erie and West. and the Wabash railways; 56 miles W. S. W. of Fort Wayne, 75 miles N. of Indianapolis. It is in an agricultural region, and contains a woolen-mill, carbon-works, flint-glass works, basket-factory, artificial-ice works, bagging-mills, carriage-factories, foundries, a brewery, 2 national banks with combined capital of $200,000, and 2 daily and 2 weekly papers. Pop. (1890) 7,028; (1900) 8,463. EDITOR OF "JOURNAL."

Peru Balsam: a balsamic exudate obtained from a handsome tree (*Toluifera pereiræ*) of the natural order *Leguminosæ*, growing in San Salvador, Central America. Portions of the bark are bruised by beating with blunt instruments, and subsequently charred by flame. A week or so later the injured bark comes away, and the balsam, which now begins to exude from the exposed wood, is collected on cloths, from which it is afterward separated by gentle boiling in water. Peru balsam is a dark-brown, viscid substance, like thick molasses, of a rather fragrant odor, and a warm, bitterish taste. It is insoluble in water, but mixes perfectly with absolute alcohol and chloroform. It is combustible, giving forth white fumes and a fragrant balsamic odor. It contains a resin, a volatile oil, and cinnamic and benzoic acids. Balsam of Peru was probably introduced into Europe as a medicine about the year 1524, and was considered of great value in bronchial and other respiratory affections, and locally upon ulcers or wounds; but its medicinal virtues are feeble, and in the U. S. other balsams have almost completely superseded it in practice.

Revised by H. A. HARE.

Perugia, pā-roo'jăă (anc. *Perusia*): city; in the province of Perugia, Italy; 11 miles from the historic Lake Trasimenus (now Lake of Perugia); on a hill near the right bank of the Tiber, 1,600 feet above the sea-level (see map of Italy, ref. 5–D). The air is healthful, and the surrounding country is picturesque from the old towns, churches, and castles everywhere scattered over it. It is well walled, and entered by gates mostly mediæval or modern; but among them is one of the Etruscan period, bearing the inscription "Augusta Perusia," placed on it by Augustus. Some remains of the old Etruscan walls also still exist. The streets, though often steep, are broad, and the squares are flanked by imposing public and private edifices. In the Piazza del Duomo there is a superb fountain, the work of Niccolò and Giovanni Pisano, and a statue of Pope Julius III. (1555). Among the numerous churches are the Cathedral of San Lorenzo, a Gothic building in the plan of a Latin cross; San Domenico, a Gothic edifice rebuilt in 1632, containing a monument of Benedict XI. by Giovanni Pisano, and San Pietro de' Casinensi, a basilica with a triple nave and walnut stall-work designed by Raphael. Some of the palaces contain choice works by renowned artists, especially the Palazzo del Collegio del Cambio, which is rich in frescoes by Perugino. The Palazzo Publico has a fine Gothic façade dating from the fourteenth century. From many of the suppressed convents and other sources a valuable collection of pictures by the best masters of the Umbrian school, such as Perugino, Raphael, etc., has been brought together in the Academy of Fine Arts near the university. Perugia has always been renowned for love of art and literature, and its university (established in 1307) had (1891) 21 teachers and 179 students. Without the gates there are some remarkable

antiquities; among others, the Torre di S. Manno, on which is a celebrated Etruscan inscription. The chief industry of the city is silk-manufactures; there are also manufactures of woolens, liqueurs, wax candles, etc. Perugia was one of the oldest of the twelve chief Etruscan cities, and one of the last to fall before the Romans. In the quarrel between Anthony and Octavianus this town espoused the cause of the former, and was cruelly punished by the latter, who afterward rebuilt it. During the Middle Ages it was alternately independent and subject to the papacy. It is said to have been an episcopal see from the earliest Christian times, and continues such to the present day. Though always restive under the papal yoke, this town was not united to the kingdom of Italy till 1860. Pop. (1893) 54,500.

Perugia, Lake of (anc. *Lacus Trasimenus*): a lake of Central Italy; in the province of Perugia. It is 30 miles in circumference, and is surrounded by beautifully wooded hills. Here Hannibal defeated the Romans in 217 B. C.

Perugino, pā-roo-jec'nō, PIETRO VANNUCCI: called Perugino, or the Perugian; painter; b. in Castello della Pieve, a dependency of Perugia, 1446. It is disputed who his teacher was, probably Verroehio. He became a remarkably skillful painter and a master of technical execution, and was one of the first Italians to use oil-painting freely. A gentle and rather meaningless grace and sweetness characterizes his female heads, and his whole composition is rather formal and deliberate than truly inventive. His great celebrity is caused by his having preceded Raphael in some of that great painter's peculiarities; and, indeed, Raphael was his pupil for a time. D. probably at Perugia in 1523. Among his important existing pictures are, at Florence, in the Uffizi Gallery, a *Madonna with Saints*; in the Academy, an *Assumption of the Virgin*, with many figures; in the Pitti Palace, a *Pietà* and a *Madonna Adoring the Infant Christ*; in the National Gallery in London a *Virgin and Child with the Archangels Michael and Raphael*; and in Rome, in the Sixtine Chapel, a large fresco of the *Delivery of the Keys to St. Peter.* RUSSELL STURGIS.

Perunite, or **Terrorite**: See EXPLOSIVES.

Peru, Upper, or **Alto**: See BOLIVIA.

Peruvian Bark: See CINCHONA.

Peruvians, Ancient: See INCAS and INDIANS OF SOUTH AMERICA.

Peruzzi, pā-root'see, BALDASSARE: painter and architeet; b. at Accajano, near Siena, Italy, in 1481. His early training in art was received in Siena, but he became noted in Rome in the beginning of the pontificate of Julius II. He is sometimes supposed to have been a pupil of Raphael, with whom he became intimate, and whose manner of painting he emulated, especially in his designs for holy families and his fresco-painting. The chapel of the high altar at Sant' Onofrio, Rome, is one of his most important works. He designed the Villa Farnesina, and probably the Farnesino palace also, for Agostino Chigi, and decorated certain parts in fresco. The *Sybil Preaching to Augustus*, in the Church of Fontegiusta at Siena, is one of his most admired compositions. He succeeded Raphael as architect of St. Peter's, and has higher rank in architecture than in painting. D. in Rome in 1536. W. J. STILLMAN.

Peruzzi, UBALDINO: statesman; b. in Florence, Apr. 2, 1822; was educated at the École des Mines in Paris; and in 1848 was appointed gonfalonier of Florence. He was a Liberal in politics, and strongly in favor of the unity of Italy under the house of Savoy. After the overthrow of the grand duke in 1859 (to which Peruzzi himself contributed) he was elected member of the Tuscan Assembly; afterward deputy from Florence to the Italian parliament. In 1861 Cavour offered him the post of Minister of Public Works, an office which he retained until the fall of the Ricasoli ministry. While Rattazzi was in power Peruzzi threw himself into the opposition, but under the presidency of Minghetti he took the portfolio of the interior, and thus became a member of the ministry which negotiated with Napoleon III. the convention of Sept. 15, 1864, for the transfer of the capital from Turin to Florence. Peruzzi succeeded Count Cambray Digny as syndic of Florence, and showed great energy in suggesting and executing important projects for the improvement and embellishment of the city. In 1882 he was president of the commission appointed to examine the project of a commercial treaty with France. D. at Florence, Sept. 9, 1891. F. M. COLBY.

Pesado, pā-saa'dō, JOSÉ JOAQUIN, de: poet; b. at San Agustín de Palmar, province of Puebla, Mexico, Feb. 9, 1801; d. in the city of Mexico in 1861. His youth and early manhood were passed at Orizaba. As a young man he took an active part in public affairs, being Minister of the Interior in 1838, and Minister of Foreign Affairs in 1846. With advancing years he became more conservative in politics and more intensely Catholic in belief; and in 1854 he withdrew from office to take the chair of Belles-lettres in the University of Mexico. As a poet he was the chief representative in Mexico of the sentimental neo-Catholicism which in France began with Lamartine and reached its perfection in Montalembert and de Maistre. He delighted in biblical subjects, though he was perhaps quite as much an artist in his descriptions of nature. Three editions of his poems have appeared in Mexico, *Poesías originales y traducidas*, in 1839, 1840, and 1886 (the last much the fullest and most satisfactory). A. R. MARSH.

Pesarese, SIMON, da: See CANTAVIUS, SIMONE.

Pesaro, pā'saă-rō (anc. *Pisaurum*): town; in the province of Pesaro and Urbino, Italy; on the right bank of the Foglia, 1 mile from the Adriatic and 37 miles by rail N. W. of Ancona (see map of Italy, ref. 4–E). Pesaro is strongly walled and commanded by a citadel, and from the promenade upon the ramparts the view embraces the neighboring hills dotted with castles and villas, the distant peaks of the Apennines and the near Adriatic. The streets are broad and well paved, and the town contains many churches and private palaces of interest. The cathedral is remarkable as showing by its three superimposed pavements the great changes of level which have taken place on this coast. Rossini, who was a native of Pesaro, left all his fortune to found a musical lyceum here. The maritime trade of Pesaro is of some importance, and there is an active traffic in fruits, grain, beans, silk, and hemp. There are manufactures of leather and majolica. Pesaro is probably of Pelasgian origin, was enlarged and adorned by the Romans, and had a bishop as early as 251 A. D. It suffered from barbarian invasions, and its mediæval life was much agitated. Pop. (1893) 24,500.

Pesellino, pā-sel-lee'nō, FRANCESCO: painter; b. at Florence, Italy, in 1422; grandson of Francesco Peselli, who gave him his artistic training. He is supposed to have been a pupil also of Fra Filippo Lippi. He painted for Santa Croce a beautiful altarpiece now in the Louvre, representing St. Francis of Assisi receiving the stigmata and St. Dominic visiting a sick man. His works are in private collections for the most part, and are distinguished by great beauty of color and delightful invention. He died in Florence in 1457. W. J. STILLMAN.

Peshaw'ar: a town in the Punjaub, India; on the border of Afghanistan, opposite the mouth of the Khyber Pass (see map of N. India, ref. 3–C). It is a British defensive military station, famous as "the bulwark of the Indian empire against Afghanistan." Pop. (1891) 84,181. C. C. A.

Peshi'to, or **Peshitto** [from Syriac *peshīttā*, simple]: the standard Syriac translation of the Old and a part of the New Testament. It was probably made in the second and third centuries of the Christian era, and is now generally believed to be the work of Christian Jews. It is a generally faithful and scholarly piece of work. Jude, 2 Peter, 2 and 3 John, and the Apocalypse are wanting, as they are not in the canon of the Syriac Church, but were translated into Syriac in much later times. The Peshito of to-day is a revision of a primitive text, of which the Gospels were discovered in the convent of Mt. Sinai in 1892 by Mrs. Agnes Smith Lewis, and published in London, 1894.

Revised by S. M. JACKSON.

Pessimism [from Lat. *pes'simus*, worst]: in popular usage, a term often applied to any doctrine or opinion, or even to any mood, which appears to be predominantly gloomy, especially when such a view or state of feeling leads the one who possesses it to make an unhappy forecast of the future.

Philosophical Pessimism.—In technical philosophical usage pessimism denotes any doctrine concerning the universe, and especially concerning the life of man as a whole, which leads to an explicit condemnation of the world, and of life, as being essentially and radically evil. Philosophical pessimism has almost always laid considerable stress upon the assertion that pain, as a most obvious and important form of evil, is predominant in the world; but it is by no means a logical necessity that a pessimist should

condemn the world merely because of the supposed prevalence of painful experience involved in its existence. The moral ideals of philosophers have varied widely, as well as the æsthetic criteria that have governed their judgments of reality, and it would be quite possible that one should be a philosophical pessimist not at all because of his belief in the painfulness of conscious existence, but solely because he was assured that the highest ideal (e. g. the ideal of rationality of life) which his doctrine recognized was doomed to such disastrous defeat in the actual world as to warrant his condemnation of the real, because of its radical opposition to this ideal. As a fact, while the painfulness of existence has played a large part in pessimistic literature, few pessimists have given this painfulness as the *sole* reason for their criticism of reality. Philosophical pessimists have frequently coördinated with the painfulness of life the necessary failure of finite beings to attain satisfactory knowledge; and this inevitable "ignorance" has been a fruitful source of pessimistic condemnation of existence. Yet some thinkers, not pessimists, have made pain a prominent and, in fact, a predominant feature in finite existence, as such, and have nevertheless explicitly defined the universe as essentially good, on the ground that the realization of the ideal, at least in some due measure, is possible, despite, or even through, the very presence of pain in the world. Such views, for instance, are represented in the doctrine of Hegel.

In any case, in order to avoid numerous vulgar misapprehensions, it is well to remember that no one is a pessimist merely because he calls life painful, but rather because he regards life as a "failure." Pessimism depends, then, upon first assuming or maintaining some sort of ideal of what life ought to be or to become, and upon then asserting that this ideal can not be attained, owing to the radically evil constitution of the world.

Hindu Pessimism.—Pessimism as a universal doctrine is first known to us in Hindu thought. In the post-Vedic period of Brahmanical speculation a belief that all finite existence is an evil, from which some sort of "deliverance" is required, became a prominent notion of the Hindu mind —a notion which early received philosophical expression, and which has continued, as a sort of insistent national idea, ever since, leading to developments of great importance for the history of religion. The doctrine of transmigration associated itself with Hindu pessimism from the outset, and the endless succession of births through which every one must pass unless he should be "delivered" is constantly made use of by Hindu teachers to emphasize the weariness of existence, and the need of the "deliverance" itself. The radical evil of finite existence, from which one needs to be "delivered," is very often defined as pain; but it is also often defined as ignorance; and the fault of all finite life appears, even in the very early philosophical and religious writings called the *Upanishads*, as in large measure due to the fact that, in this consciousness of ours, knowledge is necessarily sundered from its objects, so that nobody here knows the true "Self," or Absolute, whom to know would be peace. Hence the essential restlessness and worthlessness of all definable life. Deliverance from particular existence thus appears as identical with absolute knowledge, which no one can reach who remains in this world, or who retains the life that belongs to the world. (See Transmigration.) In Buddhism the philosophical formulations of the earlier Hindu schools were neglected, and the doctrine of deliverance was given a more distinctly practical form; but the essential pessimism still remained, and in fact was even more decidedly emphasized than before. Life is always an evil, being full of pain. The deepest root of pain is desire. Desire once "seen through" and absolutely negated, the peace of Nirvana is attained; and hence comes the release both from the endless succession of births and from all the other intolerable responsibilities of our world.

Pessimistic Tendencies in Greek Philosophy.—In European thought pessimistic tendencies were never prominent until after the Christian era. Classic Greek philosophy was acquainted, in a measure, with some portions of the problem of evil, but, except in a few scattered passages, does not appear disposed to regard the highest good as out of human reach; but after the Christian era the Neoplatonic school, with which the history of ancient philosophy closes, comes nearer to a consciousness of something essentially evil about finite existence, and seeks a deliverance through an union with the absolute—a notion which reminds one in many ways of the thoughts current among the Hindus. Plotinus, the leading Neoplatonic thinker, explicitly declares that the finite world, although indeed a world with much evil in it, is an emanation from the highest good itself, and is therefore as good as the nature of its own finitude will permit; yet he declares that no wise man can remain content to live as a finite being, but, finding all more or less evil here, longs for superconscious union with the divine "One," which union is above all explicit knowledge or definition, although the "One" is the source of all things.

Christian Mysticism.—While it would be wrong to call this doctrine of Plotinus pessimism in the strict sense, its historical importance lies in the fact that the severe condemnation of finite existence in which the Neoplatonic thinkers indulged was later influential in determining the formulations current among the Christian Mystics, who all followed Neoplatonic traditions; and, as a fact, Christian mysticism has very frequently made use of language nearly as pessimistic as that of the Hindus. Mysticism, widely represented both in the Catholic and later in the Protestant branches of the Christian Church, has often indeed tended toward actual heresy; but even in its more orthodox or less heretical forms it has often insisted upon the doctrine that, in order to get into real "union with God," one has to "despise," or to forsake, every possible form of finite existence, not only as represented in this present lower world, but also as represented in any future or heavenly world. All "creatures," so the Mystics of the Church have often been disposed to say, must first be regarded as "naught" or as "worthless," or even as "evil"; else one can never learn to love God aright, and to attain the final superconscious oneness with him.

General Relations between Christianity and Pessimism.—Much stress has been laid, both by supporters and by opponents of pessimism, upon the assertion that the condemnation of all finite existence thus insisted upon by the Mystics was really involved, as a conscious motive, in the fundamental ideas of orthodox Christianity itself; and there can indeed be no doubt that the tendency to condemn and forsake "the things of this world," which has always formed one motive of Christian piety, has been easily confused in some minds with an actually pessimistic condemnation of the whole finite universe; and it is necessary to mention this confusion here, from the light that it tends to throw upon the history of modern pessimism; for there can be no doubt, in any case, that the importance given to the problem of evil by the whole Christian consciousness has had much to do with making pessimism a prominent topic of discussion in the recent generations of religious unrest.

Pessimism in Earlier Modern Philosophy.—In modern thought Leibnitz is well known as the author of a carefully considered reflective doctrine which he intended as a "theodicy," or proof that the present world was chosen by its creator as "the best of possible worlds." This optimism of Leibnitz was a favorite topic of discussion in the eighteenth century, and was satirized, together with other less philosophical forms of optimism, by Voltaire in *Candide*. Kant, although upon ethical grounds an optimist, still, during his critical period, regarded all attempts at a theoretical theodicy as necessarily doomed to failure. In his own analysis of the worth of life Kant lays stress upon the necessary prominence of the painful in our sentient existence, and distinctly asserts that, viewed as a mere experience, our life is full of conflict, and has no abiding worth. Its true worth, however, lies in what our free will can give it—namely, conformity to a moral ideal, which we seek without any reference to happiness. This worth, the worth of a "good will," is indeed absolute. Meanwhile it is a "postulate" of our moral faith that in an immortal life happiness will be apportioned according to desert.

The ethical optimism of Kant, joined as it was with a strong realization that, viewed merely as sentient experience, life is rather an evil than a good, determined the interesting syntheses of ethical and religious optimism with a frankly avowed pessimism concerning life viewed as mere finite experience, which were above referred to as present in the doctrine of Hegel. The life in union with the moral ideal, or with the knowledge of the absolute, is good; but finite life, as such, apart from its union with the ideal, is essentially painful and worthless; this is the classic doctrine of German idealism, in which many still see the solution of the whole problem.

Schopenhauer.—It was reserved, however, for Schopenhauer, while actually building on the basis of the general tendencies of the idealism of his country, first to deny the rationality of the world-principle, or absolute, and then, in

consequence of the first denial, to affirm that the evil of all existence is radical. Schopenhauer is consciously affiliated with Hindu pessimism. The world is the expression of an irrational and blind principle called the Will, similar in tendency to the "desire" of the Buddhists, but defined in more explicit and positive metaphysical terms. The expression of this Will is a world of insatiable striving and longing, which, being in the main planless, can come to consciousness only as a desire to change whatever it finds into something else, and so to enter into an endless conflict with itself, and pain is simply the experience of unsatisfied desire. The only remedy for the life of the Will lies in a certain transcendent form of self-possessed knowledge, only attainable by a sort of supernatural accident, an absolute resignation, identical with the insight that led Buddha to Nirvana. This resignation Schopenhauer called "the denial of the will to live."

Von Hartmann.—More recently von Hartmann, in his *Philosophy of the Unconscious* and in other of his numerous philosophical essays, has attempted, with great ingenuity, an exposition of pessimism whose metaphysical basis lies in an union of Schopenhauerian with other elements, largely Hegelian in their source, while the method undertakes to be mainly one of induction. Schopenhauer's proof for pessimism is in great measure rejected by von Hartmann, and a more empirical estimate of the "balance" of pleasure and pain in life is substituted. The result of this estimate is, however, once more the condemnation of all conscious life. The escape from the world-evil can be attained only in the far-off future, when, in the course of evolution, consciousness, wise enough to see the necessary evil of existence, becomes predominant in the universe. Then, by the general consent of conscious beings, who will then be wise enough to have the springs of existence under their control, a common act of self-denial can annihilate not only the then existent sentient life, but its whole physical basis, and so bring the world to an end.

The minor defenders of pessimism are numerous, and its influence upon modern literary tendencies is considerable. For a fuller account the reader may be referred to James Sully's *Pessimism: A History and a Criticism* (2d ed. 1891).

JOSIAH ROYCE.

Pessi'nus (now *Bala Hissar*): ancient city of Galatia; in Asia Minor; on the Sangarius; the center of the worship of Rhea or Cybele, mother of the gods. The almost shapeless stone image of the goddess, fabled to have fallen from heaven, was kept in her chief temple and attracted worshipers from all over the eastern world. The temples and public buildings of Pessinus then surpassed in magnificence those of any other city in Asia Minor. The image of Cybele was taken to Rome in consequence of an oracle which foretold that the Roman state would endure forever if once possessed of it. Thereupon Pessinus rapidly declined and is not mentioned after the sixth century. Its splendid and extensive ruins have been identified by Texier. E. A. G.

Pestalozzi, JOHANN HEINRICH: educational reformer and chief founder of modern pedagogy; b. at Zurich, Switzerland, Jan. 12, 1746. Always enthusiastic and philanthropic, he studied first theology, then law, and, finally, his health somewhat impaired, turned to farming. In 1767 he bought a farm near the village of Birr and built a house, Neuhof. Hither in 1769 he brought his bride, Anna Schulthess, after one of the strangest and frankest courtships ever recorded. The farming was a failure, the firm that advanced the money withdrew from the enterprise, and finally in 1775 Pestalozzi, who from the first was deeply impressed by the abject condition of the peasantry and had been greatly interested by the doctrines of Rousseau's *Émile*, started a kind of pauper school. He housed, boarded, and clothed the children in return for such work as they gave in the field. By 1780 this experiment had failed. His wife's fortune was now exhausted, and the next eighteen years were a period of great distress. He turned now to writing, and in 1780 published *Abendstunde eines Einsiedlers* (Evening Hour of a Hermit); in 1781 appeared *Lienhardt und Gertrud* (Leonard and Gertrude), a simple tale of life in a Swiss village, which shows incidentally and strongly the effects of right education. The book was an immense success, and on it Pestalozzi's fame as an author mainly rests. The vicissitudes of war settled Pestalozzi in 1798–99 in charge of an orphan asylum in Stanz, where from stern necessity in one year the main elements of his educational system were developed. In 1799 he joined Krüsi in opening a new school in Burgdorf Castle, for which he obtained Government aid in 1802. In 1801 appeared the result of his educational experience in his work *Wie Gertrud ihre Kinder lehrt* (How Gertrude Teaches Her Children). In 1802 he was elected a member of the deputation sent by the Swiss people to Paris. In 1804 he was obliged to remove his school to Münchenbuchsee. The chief authority here being given to Fellenberg, the same year he moved on to Yverdun. The Yverdun Institute very soon had a worldwide reputation. His chief helpers here were Niederer, Ramsauer, Schmid, Steiner, and Krüsi. Schmid, though a famous teacher of mathematics, was not calculated to appreciate his leader, or his methods. He ultimately obtained complete ascendency over Pestalozzi's mind, finally causing the departure of the other masters and the downfall of the institute. In 1825 Pestalozzi retired to Neuhof. He died at Brugg, Feb. 17, 1827, and is buried near the schoolhouse at Birr, where, Jan. 12, 1846, on the 100th anniversary of his birth, a memorial was erected to him. It is impossible to summarize Pestalozzi's services to education, for he rather set on foot ideas than originated methods. He was pre-eminently a man of feeling and imagination. He would never admit that he had a carefully thought-out system. Judged by ordinary standards, he would have been considered anything but a good teacher. His true function was to educate ideas. Raumer sums up the services Pestalozzi did for education in these words: "He compelled the scholastic world to revise the whole of their task, to reflect on the nature and destiny of man, and also on the proper way of leading him from his youth toward that destiny." Doubtless the best single biography in English is *Pestalozzi, his Life and Work*, by Roger De Guimps. A very interesting and valuable biography is *Pestalozzi, his Life, Work, and Influence*, by Hermann Krüsi, son of Pestalozzi's assistant (New York, 1875); *Pestalozzianism*, by Henry Barnard (New York, 1862), contains a great amount of valuable material selected from Barnard's *Journal of Education*. See also Quick's *Educational Reformers* and Williams's *History of Modern Education*. German literature on the subject is extensive. C. H. THURBER.

Pesth: See BUDAPEST.

Pestilence: See EPIDEMICS and PLAGUE.

Petals: See FLOWER.

Petalu'ma: city; Sonoma co., Cal.; at the head of navigation on Petaluma Creek; on the San Fran. and N. Pac. Railway; 16 miles S. of Santa Rosa, 42 miles N. by W. of San Francisco (for location, see map of California, ref. 7–B). It is in an agricultural, stock-raising, and wine-making region; has a daily line of steamers to San Francisco; and contains 8 churches, high school, 3 grammar schools, Ursuline convent, an academy, a public library (founded in 1867), a national bank with capital of $200,000, 3 State banks with capital of $600,000, and 2 daily and 3 weekly newspapers. There are flour, planing, silk, and woolen mills, tannery, and fruit drying, canning, and distilling works. Pop. (1880) 3,326; (1890) 3,692; (1900) 3,871. PROPRIETOR OF "IMPRINT."

Petasos: See HEAD-DRESS.

Petau, pe-tō', DENIS (*Dionysius Petavius*): chronologist and Catholic theologian; b. at Orleans, France, Aug. 21, 1583; became professor at Bourges in 1603, in Rheims 1612, in La Flèche 1613, in Paris 1617; died there Dec. 11, 1652. Following in the footsteps of Sealiger, but equipped with a profounder mathematical knowledge, he endeavored with singular success to systemize and harmonize the numerous chronological eras of the ancients by ascertaining with the aid of mathematics the various cycles upon which they were based. The results of his labors are laid down in his *Opus de doctrina temporum* (2 vols., 1627), and in the more famous *Uranologium* (Paris, 1630). Both are combined in the Verona edition of 1734. His *Tabulæ chronologicæ* (Paris, 1628) and the *Rationarium temporum* (1633; new ed. 1849) remained standard schoolbooks for centuries. He is also the author of a celebrated theological work *De theologicis dogmatibus* (5 vols.). The best edition is by Thomas (Bar-le-Duc, 1864). See F. Stanonik, *Dionysius Petavius* (Gratz, 1876). ALFRED GUDEMAN.

Petch'ora: a river of European Russia, rising in the Ural Mountains. It flows through wild forest regions to the Arctic Ocean, which it enters through a large estuary in lat. 68° N. and lon. 53° E.

Peter, SAINT [*Peter* is via Lat. from Gr. Πέτρος, liter., masc. form of πέτρα, rock, stone]: the first in the list of the twelve apostles; b. in Galilee, at Bethsaida, on the shore of

the Lake of Gennesaret, whence he removed to the adjoining village of Capernaum. He was a fisherman, like his brother Andrew, and, like him, he was probably a disciple of John the Baptist, but he followed Christ immediately when called. His original name was Simon, which Christ changed, declaring, "Thou art Peter, and upon this rock I will build my Church" (Matt. xvi. 18). From his call to the office of apostle, and up to the time of the apostles' council in Jerusalem, the events of his life are told in the Gospels and the Acts, and are familiar to all. His personal character is so distinct and strongly marked that there probably are no readers of the Bible who have not a vivid conception of it, or any two whose conceptions differ very much; but after the apostles' council in Jerusalem (50 A. D.) he is only heard of at Antioch (52), when his inconsistency exposed him to Paul's stern rebuke (Gal. ii. 11), and in 57, when he is incidentally referred to by Paul (1 Cor. ix. 5). From that point on tradition is the only authority, and the circumstance that the papal see rests its whole claim of primacy on events related by this tradition has caused it to be very much doubted by Protestants. Jerome (*De viris illustribus*) relates that Peter was Bishop of Antioch for several years, preached in Pontus, Galatia, Bithynia, and Cappadocia, and spent the last twenty-five years of his life in Rome, where he suffered martyrdom; but Paul makes no reference to such a fact in his Epistle to the Romans, and the long residence can only be maintained by denying a tradition that both Paul and Peter suffered martyrdom there under Nero. At the time of the Reformation it was even contended—for instance, by Spanheim—that Peter never was in Rome; but at present most critics, Protestant as well as Roman Catholic, agree in accepting the tradition in its principal traits—namely, the residence of Peter in Rome and his suffering martyrdom there—though it has not been possible to establish an agreement with respect to the dates of these events. The most probable date is 66 or 67. Ramsay maintains that he survived the Neronian persecution and was living in 80. Revised by S. M. Jackson.

Peter I., the Great: Czar of Russia; b. at Moscow, June 12, 1672; son of the czar Alexis Michailowich; in 1682 succeeded Feodor, but Ivan V., Peter's brother and the lawful heir, was soon after announced as joint-sovereign through the efforts of their sister Sophia, who for several years directed the affairs of the empire. After seven years of tutelage Peter thrust the princess-regent into a convent, where she died twenty-two years later, and the inactive Ivan in 1689 abdicated his share of the government. The new czar aided by his able minister Le Fort (*q. v.*) reorganized the army; built a small navy; went to sea in person on Dutch and English ships, so as to learn the practical part of navigation, and took Azof from the Turks 1696, thus realizing his ambition of gaining for Russia a port on the Black Sea. He lived abroad (1697–98), chiefly at Saardam in the Netherlands and at Deptford and London; worked as a shipcarpenter and blacksmith, and for some months studied the sciences. In 1698 he took 500 English mechanics, engineers, etc., to Russia, and in the same year, the Strelitzes having revolted, he ordered them all to be put to death, and assisted the executioners with his own hands; but pardoned a few upon the scaffold, noteworthy among whom was the young Orloff, founder of the princely house of Orloff. The czar now reformed the calendar, founded schools, introduced arithmetic (hitherto unknown in Russia), compelled rich merchants to engage in foreign commerce, and enacted rules for dress and deportment; entered upon a war of conquest against Sweden, supported by Denmark and Poland, 1700, and in the same year was defeated by Charles XII. at Narva; founded St. Petersburg 1703; invaded Courland 1705; overthrew the Swedes at Pultava 1709; seized the Baltic provinces 1710, and Finland 1713; married Catherine I., his mistress, 1707, and declared her czarina 1711; waged an unsuccessful war against the Turks 1711; finally gave up most of Finland in the peace of 1721; made the tour of Europe 1716–17, and returned with many books and works of art; put to death his son Alexei 1718, on the ground of treasonable conduct; conquered three Caspian provinces from Persia 1722. D. Feb. 8, 1725. He was succeeded by Catherine I., his wife. Peter was the first Russian to take the title of emperor 1721. See Eugene Schuyler's *Peter the Great* (2 vols., 1884).

Peter II., Alexeievitch: Czar of Russia; b. at St. Petersburg, Oct. 22, 1715; a grandson of Peter the Great, a son of Alexei; succeeded Catherine I. in 1727. The most prominent features of his short reign were the desperate intrigues between the families of Mentchikof and Dolgoruki. The czar was only twelve years old and completely under the sway of Mentchikof, who had him betrothed to one of his own daughters and jealously kept him away from the court and all business; but the Mentchikofs were overthrown by the Dolgorukis, who planned a marriage between the czar and a daughter of their house; this was prevented by Peter's death, which occurred Feb. 9, 1730.

Peter III., Feodorovitch: Czar of Russia; b. at Kiel, in Holstein, Jan. 29, 1728; a son of Peter the Great's daughter Anna, who had married a duke of Holstein; was designated as heir to the Russian crown in 1742 by his aunt, the Empress Elizabeth; married, in 1745, the Princess of Anhalt-Zerbst, afterward Catherine II.; ascended the throne Jan. 5, 1762. He had two very prominent passions—admiration of Frederick II., with whom he immediately made peace, restoring to him the conquered provinces, and hatred of the royal dynasty of Denmark, against which he was on the point of waging war when a revolution, headed by his wife, broke out at St. Petersburg. Taken completely by surprise, he was deposed, and Catherine was proclaimed empress. He was strangled in his bed at Ropscha by the brothers Orloff, July 17, 1762.

Peterboro: town; Hillsboro co., N. H.; on the Contoocook river, and the Boston and Maine and the Fitchburg railways; 18 miles E. by S. of Keene, 33 miles S. W. of Concord (for location, see map of New Hampshire, ref. 10–E). It contains several cotton and woolen mills, iron-foundries, and shoe-factories, and has a town library (founded in 1833), a national bank with capital of $100,000, a savings-bank with deposits of over $875,000, and a weekly newspaper. Pop. (1880) 2,206; (1890) 2,507; (1900) 2,527.

Peterborough: town; capital of Peterborough County, Ontario, Canada; on the river Otonabee, and on the Grand Trunk and Canadian Pacific railways; 85 miles N. E. of Toronto (see map of Ontario, ref. 3–F). It is handsomely built on a fertile plain; has good water-power, manufactures of lumber, leather, machinery, castings, farm implements, etc. It has a good trade in grain, pork, lumber, and flour. A handsome bridge connects it with the village of Ashburnham. There are 2 daily and 2 weekly newspapers, and a monthly periodical. Pop. (1881) 6,812; (1891) 9,717.

Peterborough: city; partly in Northamptonshire, partly in Huntingdonshire, England; on the Nen, 76 miles N. of London (see map of England, ref. 9–J). It is celebrated for its beautiful cathedral, built between 1118 and 1528, chiefly in the Norman style. Its length is 476 feet; the height of the nave to the ceiling 81 feet, and of the lantern-shaped tower 135 feet; its breadth is 202 feet across the transept. The Early English west front, consisting of three arches, is one of the grandest products of mediæval architecture. The town has a large trade in agricultural produce, coal, and malt. It is the seat of a bishopric and returns one member to Parliament. Pop. (1891) 25,172.

Peterborough, Charles Mordaunt, Earl of: soldier; b. in England about 1658; joined Narborough's fleet in the Mediterranean; won distinction in Cloudesley Shovel's engagement with the dey's fleet off Tripoli; took part in the defense of Tangier, and on returning to England became an active politician, working in the Whig interests. He joined William, Prince of Orange, and accompanied him to England in 1688. He was appointed First Lord of the Treasury and created Earl of Monmouth, but retired from office Jan., 1690. He fell into disfavor with the court, and in 1697 was imprisoned in the Tower by order of Parliament, on an accusation of complicity in Sir John Fenwick's plot against the king's life. In the same year he succeeded to the earldom of Peterborough by the death of an uncle. Restored to favor on the accession of Queen Anne, he was placed in command of the land forces sent to the aid of the Archduke Charles of Austria in asserting his claim to the Spanish crown, and sailed for Spain in May, 1705. His chief exploit was the capture of Barcelona, to which against his judgment he had been obliged to lay siege. Early in September the siege was about to be abandoned as impracticable, when Peterborough obtained leave to undertake a seemingly desperate night-assault upon the citadel of Monjuich, one of the strongest fortresses in the world. This was successfully executed, and led to the capture of Barcelona. He then began a brilliant campaign, overran Catalonia, Aragon, and Valencia with the greatest rapidity, and successfully defended Barcelona against the formidable army of Philip

V. (1706), but resigned in 1707, in consequence of dissensions with his associate commanders. Employed for some years in diplomatic posts, he became governor of Minorca 1713, sided with the Tories during the last years of Anne, lived in retirement during most of the reigns of George I. and George II., was an associate and friend of the chief literary celebrities of the time, and became general of the marine forces of Great Britain 1722. D. at Lisbon, Oct. 25, 1735. Peterborough was a chivalrous and eccentric character, of vast military genius, and considerable literary taste, as shown by several occasional publications. He wrote his own *Memoirs*, but they were destroyed by his widow, the celebrated singer, Anastasia Robinson. See Macaulay's *Essays*, Lord Mahon's *History of England*, and Eliot Warburton's *Memoir of Charles Mordaunt, Earl of Peterborough* (1853), which contains selections from Peterborough's correspondence. Revised by F. M. Colby.

Peter, Epistles of St., The First: one of the catholic or general epistles; was written from "Babylon" (perhaps symbolical for Rome, but more likely the name of the actual city, which contained many Jews), about 64 A. D. Ramsay maintains that it was not written till 80 A. D.; cf. his *Church in the Roman Empire*, pp. 279, *seq.* It is evidently the product of perilous times and inculcates the duty of patience under suffering. It is a practical epistle, and addresses itself to various classes of readers, to each assigning the appropriate duty. It is the subject of one of the great religious classics—the commentary by the saintly Archbishop Leighton.—Peter, Epistle of St., The Second, has suffered more from doubts as to its authenticity than any other book of the New Testament. It is directed against heretics and corrupt men, and the second chapter, in which they are described, bears a striking resemblance to the Epistle of St. Jude. There is, however, no good reason to abandon the Petrine authorship. The author claims to have been a witness of the transfiguration, and uses Petrine expressions. Upon both epistles a good commentary is that by J. Lillie (New York, 1869). Revised by S. M. Jackson.

Peter, Gospel and Revelation of: two apocryphal writings contained in very fragmentary form in a Greek MS., found in a tomb of a monk at Akhmim in Egypt, the site of Panopolis, and not far from Assiout, by U. Bouriant in the winter of 1886–87. The MS. dates from the eighth century. The writings were previously only known by allusions in early Christian literature. Of the Gospel, the fragment is but about 150 lines long, and gives only, and that very imperfectly, the passion and resurrection history of Jesus. The date of original composition is the early part of the second century; the place is somewhere in Western Syria. The Revelation fragment is still shorter, only about 131 lines, but dates from the same time and place. It is mostly a description of a revolting character of the punishments of hell. Naturally most attention has been given to the Gospel, which is valuable. See for text and translation J. A. Robinson and R. J. Montague, *The Gospel according to Peter and the Revelation of Peter* (London. 2d ed. 1892); H. B. Swete, *The Akhmim Fragment of the Apocryphal Gospel of St. Peter* (1893); H. von Schubert, *The Gospel of Peter, Synoptical Tables with Translations and Critical Apparatus* (Edinburgh, 1893); *The Gospel according to Peter*, by the author of *Supernatural Religion* (London, 1894). Samuel Macauley Jackson.

Pe'terhead: a seaport and burgh in the district of Buchan, Aberdeenshire, Scotland; 44 miles by rail N. N. E. of Aberdeen (see map of Scotland, ref. 6–J). It stands on a narrow peninsula, across which a canal has been cut connecting its three rock-hewn harbors. The town is irregularly built, chiefly of granite. Among its buildings may be mentioned the town-hall, built in 1788, with a spire 125 feet high, the parish church, with a spire 125 feet high, a free library and museum, and an academy. It was formerly the chief seat in Scotland of the seal and whale fisheries, and is now noted for its herring-fishery, in which over 500 boats and 5,000 persons are employed. An immense harbor of refuge was begun, chiefly for their benefit, in 1886, and will be finished in 1921. The chief industries of the place are woolen manufactures, boat-building, and granite-polishing. Peterhead unites with Elgin, Banff, Cullen, Inverurie, and Kintore in sending one member to Parliament. Pop. (1891) 12,198. R. L.

Peterhof: an imperial palace in the government of St. Petersburg, Russia, on the Bay of Cronstadt, built by Peter the Great. It contains a fine collection of pictures, and is surrounded with beautiful parks and gardens. A small town has grown up around it.

Petermann, pā'ter-măn, August: geographer; b. at Bleicherode, in Prussian Saxony, Apr. 18, 1822; received a gymnasium education and entered (1839) the geographical institution of Prof. Berghaus at Potsdam, where he assisted in the preparation of Berghaus's *Physical Atlas*, and prepared the maps to A. von Humboldt's *Asie Centrale*; in 1845 went to Edinburgh to superintend the English edition of the *Physical Atlas*, and in 1847 to London, where he became a member of the Royal Geographical Society, and wrote a number of geographical essays and articles; in 1854 returned to Germany as director of Justus Perthes's geographical institution in Gotha, and (1855) began the publication of *Mittheilungen*, a monthly which is considered as the central organ and the highest authority in present geographical literature. D. by suicide (like his father and brother before him) at Gotha, Sept. 25, 1878.

Peters, Christian August Friedrich: astronomer; b. in Hamburg, Germany, Sept. 7, 1806. On the foundation of the Pulkowa Observatory he became one of the principal astronomers, and published noteworthy papers on the parallaxes of stars, the constant of nutation, etc. In 1849 he resigned and went to the Königsberg Observatory, but left to become director of the observatory at Altona and editor of the *Astronomische Nachrichten*. He continued the publication of this journal until his death, at Kiel, May 8, 1880. S. N.

Peters, Christian Henry Frederick, Ph. D.: astronomer; b. at Coldenbüttel, Schleswig, Germany, Sept. 19, 1813; graduated at the University of Berlin; engaged in scientific researches, after which he settled in the U. S.; was employed upon the Coast Survey; became Professor of Mathematics and Astronomy at Hamilton College 1859, where he took charge of the Litchfield Astronomical Observatory, and made very extensive investigations concerning comets and asteroids, discovering more than forty of the latter bodies; catalogued 16,000 zodiacal stars, and recorded over 20,000 solar spots. He took a prominent part in the observation of the total solar eclipse of Aug. 7, 1869, at Des Moines, Ia.; was chief of the party sent by the U. S. Government to New Zealand to observe the transit of Venus of Dec. 9, 1874, and was the only observer on that island who had complete success, having obtained 237 photographs of the transit. D. at Clinton, N. Y., July 19, 1890. Revised by S. Newcomb.

Peters, John Charles, M. D.: b. in New York, July 6, 1819; studied homœopathy in Europe, and returned to New York to practice his profession. He edited the *North American Journal of Homœopathy* (1856–61), was one of the translators of Rokitansky's *Pathological Anatomy*, and was the author of medical treatises. S. T. A.

Peters, Phillis (*Wheatley*): a Negro poet; b. in Africa about 1750; was taken as a slave to Boston 1761; was taught to read by the family of her master, John Wheatley; made rapid progress in letters; soon displayed so much poetical talent, stimulated by the reading of Pope's *Homer*, that a volume of her verses was printed in London 1773, with a copperplate portrait and a dedication to the Countess of Huntingdon. She visited England in that year; wrote some notable verses to Gen. Washington. Her poem was printed by his direction in the *Pennsylvania Magazine* for Apr., 1776. She married a Negro named John Peters, who seems to have fallen into great poverty during the Revolution. D. at Boston Dec. 5, 1784. Her *Letters* were printed in 1864. Revised by H. A. Beers.

Peters, Richard: judge; b. at Belmont (now part of Philadelphia), Pa., Aug. 22, 1744; after graduating from college, studied law, and became a successful lawyer, distinguished for wit and brilliant social qualities; was a captain in the Revolution; secretary to the continental board of war 1776–81; was in Congress 1782–83; was U. S. district judge 1792–1828, and his decisions upon admiralty questions (published in 2 vols. in 1807) had much influence in shaping the admiralty law of the U. S. D. at Belmont, Pa., Aug. 21, 1828.—His son, Richard Peters (b. at Belmont, Aug., 1780; d. May 2, 1848), succeeded Mr. Wheaton as reporter of the U. S. Supreme Court, and published *Reports of the United States Circuit Court, Third Circuit, 1803–1818* (17 vols.); *Condensed Reports of Cases in the United States Supreme Court to 1827* (6 vols.); *Digest of Cases in the United States Supreme Court and District Courts to 1847* (2 vols.); and *Case of the Cherokee Nation against the State of Georgia* (1831). He also edited *Chitty on Bills* (1819),

Washington's Circuit Court Reports (*Third Circuit, 1803–27*; 4 vols.), and the *United States Statutes at Large*.

Revised by F. Sturges Allen.

Peters, Samuel: clergyman; b. at Hebron, Conn., Dec. 12, 1735; graduated at Yale College in 1757; went to England for ordination, and returned in 1760 to become the Church of England minister at Hartford. He fled to Boston in 1774 to escape molestation at the hands of the Sons of Liberty on account of his aggressive Toryism, and from Boston, in October, he sailed to England, where he obtained a small pension from the crown, and remained until 1805. In 1781 he published *A General History of Connecticut from its First Settlement under George Fenwick, Esq.*, etc., as being written "By a Gentleman of the Province," which book gave rise to the widespread misconceptions concerning the Connecticut Blue Laws (*q. v.*). In 1794 he was chosen Bishop of Vermont, but the Archbishop of Canterbury and the bishops of the American Church refused him consecration. On his return in 1805 to the U. S. he published *A History of Rev. Hugh Peters* (New York, 1807), alleged by him to be his granduncle, and also a short history of Hebron; in 1817 he endeavored to get possession of a tract of land in what is now Minnesota. D., in great poverty, in New York, Apr. 19, 1826. Peters was notorious for his habit of falsification, and his autobiography was wholly untrustworthy. He wrote his name variously Samuel Peters, Samuel Andrew, and Samuel A., and appended to it the letters LL. D., although how he came by the right to the title is unknown. Some books of reference make him D. D., and some books make him both D. D. and LL. D. He is the Parson Peter in Trumbull's *McFingal*.

F. Sturges Allen.

Petersburg: city (laid out by Abraham Lincoln in 1835); capital of Menard co., Ill. (for location, see map of Illinois, ref. 6–D); on the Sangamon river and the Chi. and Alton and the Chi., Peoria and St. L. railways; 20 miles N. W. of Springfield. It is in an agricultural, timber, coal-mining, and stock-raising region, and has medicinal springs, waterworks, public square, 2 flour-mills, a national bank with capital of $50,000, 2 private banks, and 2 weekly papers. Pop. (1890) 2,342; (1900) 2,807. Editor of "Observer."

Petersburg: town; capital of Pike co., Ind.; on the Evansville and Terre Haute Railroad; 20 miles S. E. of Vincennes, 44 miles N. N. E. of Evansville (for location, see map of Indiana, ref. 10–B). It is in a coal, dairy, tobacco, and stock-raising region, and has flour and woolen mills, brick and tile works, lumber-working and other factories, a State bank with capital of $25,000, and three weekly newspapers. Pop. (1880) 1,193; (1890) 1,494; (1900) 1,751.

Petersburg: city in Virginia (settled in 1733, incorporated in 1748, reincorporated in 1781); port of entry; formerly in Chesterfield, Dinwiddie, and Prince George Counties, but now independent; on the Appomattox river at the head of tide-water, and the Petersburg, the Norfolk and Western, the Richmond and Petersburg, and the Seaboard Air Line railways; 12 miles W. of the confluence of the Appomattox and James rivers, 22 miles S. of Richmond (for location, see map of Virginia, ref. 7–H). It is the third city in population in the State, is built on the declivities of a hill sloping to the river bank, and derives abundant power for manufacturing from the falls in the river. There are 38 churches, 2 high schools, 9 public-school buildings, public-school property valued at over $75,000, the Southern Female College, the Bishop Payne Divinity School (colored), 2 libraries containing over 13,000 volumes, 2 public parks, a national bank with capital of $100,000, 2 State banks with capital of $300,000, and a quarterly, 2 daily, and 4 weekly periodicals. The city has a copious supply of pure water for domestic purposes, has two telephone companies, electric-lighting and street-railway plants, and is the most important shipping-point for manufactured tobacco in the U. S. The census returns of 1890 showed that 223 manufacturing establishments (representing 56 industries) reported. These had a combined capital of $3,879,151, employed 5,315 persons, paid $1,283,612 for wages, and $4,200,936 for materials, and had products valued at $6,876,352. There are 6 large tobacco-warehouses, 13 tobacco-factories, 5 cotton-mills, 5 corn and 3 flour mills, 4 foundries and machine-shops for the manufacture of heavy machinery, silk-mills, 4 trunk factories, granite-quarries, and other industries. The city is on the site of an Indian village burned by Nathaniel Bacon in 1676; was twice occupied as headquarters by British commanders during the Revolutionary war; received the popular name of "Cockade City" from President Madison because of the gallantry of its company of volunteers in the war of 1812; and has been called the "last citadel of the Confederacy" from its heroic defense in the war of 1861–65. The Army of the Potomac, under Gen. Grant, being induced by the result of the second battle of Cold Harbor to abandon its advance upon Richmond by the line of the Chickahominy, crossed the James river below City Point June 14–16, 1864, and made formidable assaults on Petersburg June 15, 16, 17, and 18, carrying portions of the exterior lines on each of the first three days; but, being generally unsuccessful in the assaults of the 18th, the ground occupied at the close of the day was intrenched and held up to the close of the war, forming part of the line of investment. The Union loss in killed, wounded, and missing was 10,586. The siege began on June 19, and was continued by constantly gaining and intrenching ground to the left and moving against the railways with a view to isolating the city, combined with the explosion of a mine under one of the works, with the resulting "battle of the crater," and numerous other actions. The siege was continued until Apr. 2, 1865, when, the place being no longer tenable, Lee withdrew his army, the Union troops taking possession on Apr. 3, the surrender at Appomattox occurring Apr. 9. Pop. (1900) 21,810.

Revised by James Mercur.

Petersen, Dory: See the Appendix.

Petersen, pā'ter-sen, Johann Wilhelm: theologian; b. at Osnabrück, Hanover, June 1, 1649; studied theology at Giessen, Rosbach, and other German universities; became a disciple of Spener, with whom he met at Frankfort in 1675; was in 1677 appointed superintendent of Lübeek and in 1688 of Lüneberg. In the meantime he had made the acquaintance of Juliane von Asseburg, who claimed that the Saviour often revealed himself to her in visions and spoke to her of his second advent. Petersen, who was a strong and outspoken chiliast, put implicit confidence in those revelations, and laid them in a solemn manner before the German clergy. The municipal council of Lüneburg, however, took another view of the case. He was deposed in 1692, and lived afterward at Thymer, near Zerbst, where he died Jan. 23, 1727. Of his works, which are very numerous, the principal are *Wahrheit des herlichen Reiches Jesu Christ* (Magdeburg, 1692–93, 2 vols.) and *Geheimniss der Wiederbringung aller Dinge* (Frankfort, 1700–10, 3 vols. fol.). He also wrote exegetical works, Latin and German poems (the former edited by Leibnitz, who also showed great sympathy for Juliane von Asseburg), and an autobiography (2d ed. Frankfort, 1719). See H. Corrodi, *Kritische Geschichte des Chiliasmus* (Frankfort, 1871; 2d ed. 4 vols., Zurich, 1794).

Revised by S. M. Jackson.

Petersen, Niels Matthias: scholar; b. at Sanderup, island of Fünen, Denmark, Oct, 24, 1791; studied philology and history, and became Professor of the Ancient Scandinavian Language and Literature in 1845 at the University of Copenhagen. His works relating to ancient Scandinavian mythology, literature, history, and language, *Det Danske, Norske og Svenske Sprogs Historie* (1829), *Den Nordiske Mythologi* (1849), *Danmarks Historie i Hedenold* (1834), *Haandbog i den gammelnordiske Geographi* (1834), etc., though now superseded, exercised a great influence at the time of their appearance. His *History of Danish Literature* (5 vols., 1853–64; 2d ed. 1867–70) is the most elaborate work on that subject, and is the standard authority. D. at Copenhagen, May 11, 1862. Revised by D. K. Dodge.

Petersilea, Carlyle: See the Appendix.

Peterson, Frederick, M. D., Ph. D.: neurologist and poet; b. in Faribault, Minn., Mar. 1, 1859; studied medicine at the University of Buffalo, New York, graduating M. D. in 1879; Professor of General Pathology, University of Buffalo, 1882–84; lecturer on nervous diseases, New York Polyclinic, 1888–91; instructor in nervous and mental diseases, College of Physicians and Surgeons, New York, from 1888; Professor of Neurology, University of Vermont, 1893–94. He has published two volumes of poems: *Poems and Swedish Translations* (Buffalo, 1883); *In the Shade of Ygdrasil* (New York, 1893); and is the author of important monographs on neurological subjects.

Peterson, Peter Archibald, D. D.: b. at Petersburg, Va., Sept. 28, 1828; received only common school training; served as a lieutenant in Company E, First Regiment, Virginia Volunteers, in the Mexican War, 1846–48; in 1852 joined the Virginia Conference; was a member of every general conference from 1866 to 1890; served as chaplain in

the Confederate army 1861–62; delegate to Œcumenical Conference, Washington, 1891. His last pastorate was in Trinity church, Richmond, Va., where he died Oct. 6, 1893. He published *Handbook of Southern Methodism* (1882 and 1891). A. Osborn.

Peter's Pence, or **Romescot**: an ancient tax for the benefit of the pope, probably first levied as a tax for the support of the English school at Rome. (See Lappenberg's *History of England under the Normans.*) Peter's Pence was paid the pope, with some interruptions, until 1534, during the reign of Henry VIII., when it was finally abolished. The levy of Peter's Pence was customary in various other countries at different times. During the nineteenth century it has been revived as a voluntary popular contribution, and is one of the chief sources of the pontifical revenue, especially since the establishment of the Italian monarchy. See Cancellieri, *La visita de' sacri limini ed il danaro di S. Pietro* (Rome, 1821); Paul Fabre, *Étude sur le Liber Censuum de l'Église Romaine* (Paris, 1892).

Revised by J. J. Keane.

Peter's, St.: a basilica in Rome. It consists of a Latin cross 613 feet long and 450 feet across the transept, surmounted by a dome which rises 434¾ feet above the pavement with a diameter of 195½ feet. The façade is 368 feet long and 145 feet high. The building was begun under Pope Nicholas V., after a plan by Rosselini, in 1450, but the work was neglected for nearly half a century. Under Julius II., Bramante prepared a new plan, which was subsequently followed out in the main. Raphael had charge of the building for some time. Michelangelo designed the dome and nearly completed its erection. The façade is by Carlo Maderno, the colonnade by Bernini. The church was consecrated by Urban VIII. Nov. 18, 1626, the 1300th anniversary of the day on which St. Sylvester consecrated the basilica which originally occupied the site. This was built by Constantine the Great on the spot where, according to the tradition of the Roman Catholics, the apostle Peter suffered martyrdom. St. Peter's is the largest church in Christendom, and is exquisitely proportioned. See Fontana, *Tempio Vaticano*; Cancellieri, *De Secretariis Vaticanis*; Letarouilly, *Le Vatican et la Basilique de Saint Pierre* (Paris, 1882). Revised by J. J. Keane.

Peter the Hermit: religious leader; b. at Amiens in the middle of the eleventh century; was educated in Paris and Italy; served in the army in Flanders, but gave up the military career and married; became a monk after the death of his wife, and finally a hermit; made in 1093 a pilgrimage to Jerusalem, and, deeply impressed by the indignities and cruelties inflicted on the Christian pilgrims by the Mohammedan rulers of the city, he began immediately on his return to Europe, and with the authority of Pope Urban II., to preach a general war for the delivery of the holy sepulchre. His preaching in Italy and France stirred up the whole populace, and a crusade was actually determined upon by the Council of Clermont in 1095. Peter himself led the first army toward the Holy Land—an undisciplined and disorderly swarm, containing as many women and children as men. After unspeakable sufferings on their way through Hungary, Bulgaria, and Constantinople to Asia Minor, they were routed and massacred at Nice by Sultan Solyman. Next year a regular and brilliant army, comprising the flower of European chivalry, undertook the second crusade, under the command of Godfrey of Bouillon. Peter accompanied also this expedition, and after the conquest of Jerusalem in 1099 he preached to the crusaders on the Mount of Olives. Shortly after he retired to Belgium, where he founded a monastery, at Neu-Moutier, near Liége, and died there July 7, 1115. Some consider the story of his activity in inciting the crusades as unauthentic, and deny that Peter ever was in Palestine prior to his expedition. See H. Hagenmeyer, *Peter der Eremit* (Leipzig, 1879).

Revised by S. M. Jackson.

Peterwardein: city of the county Syrmia, Austria-Hungary; formerly capital of the Slavono-Servian military frontier; a strong fortress on the Danube with barracks for 10,000 men (see map of Austria-Hungary, ref. 8–H). Here (1096) Peter the Hermit reviewed the first crusade and (1716) Prince Eugene of Savoy disastrously defeated the Ottomans under Damad Ali Pasha. Pop. 3,603. E. A. G.

Petigru, James Lewis: lawyer; b. in Abbeville co., S. C., Mar. 10, 1789; graduated at Columbia College (now the University of South Carolina) in 1809; after his admission to the bar in 1812 settled in Charleston, S. C., and rapidly rose to the leadership of the bar in his State. He was a decided adherent to the principles of the Federal party, and in the days of nullification he was the acknowledged leader of the Union party. He opposed the doctrine of secession, but, by reason of his sincerity, integrity, and ability, retained the respect and esteem of his fellow-citizens, and held various public and private positions of trust. Upon the secession of South Carolina he remained loyal to the State, although he took no active part in the work of secession. He was appointed by the State Legislature to codify the laws of South Carolina, and completed the work a short time before his death, in Charleston, Mar. 3, 1863. See his *Biography*, by W. J. Grayson (New York, 1866), and the *Memorial* (1867) containing the proceedings of the Bar of Charleston, S. C., shortly after his death.

F. Sturges Allen.

Pétion, pā'ti'ōn', Alexandre: soldier and politician; b. at Port-au-Prince, Haiti, Apr. 2, 1770. He was a quadroon, the son of a wealthy planter; was educated in Paris; served with the French army in Haiti; joined the revolt of 1791, and was commandant of artillery under Toussaint Louverture, but went over to Rigaud in 1799, and was forced to leave the island with him in 1800. Going to France he was attached, as colonel, to Leclerc's expedition, destined to subdue Haiti; he did efficient service, but at the end of 1802 joined the new revolt of those who feared that slavery would be re-established. On the death of Dessalines, Christophe seized the government of the northern provinces, but the rest of Haiti remained in the hands of the mulatto party, which declared a republic and made Pétion president Mar. 10, 1807. He was re-elected in 1811 and 1815. Christophe and the black party, who still held the north, waged an almost continual war against Pétion, whose many enlightened measures were often defeated by ignorance and malice. He protected whites and opened the ports to all flags. D. at Port-au-Prince, Mar. 29, 1818. Herbert H. Smith.

Petit de Julleville, pe-tec'de-zhül'veel', Louis: historian; b. in Paris, July 18, 1841; graduated at the École Normale; studied in the French school at Athens; was instructor in the Collège Stanislas, Paris; then professor in the faculty of letters of Dijon; and in 1886 was called to a professorship in the faculty of letters of Paris. His best-known works are in connection with the dramatic history of France, *Histoire du Théâtre en France: Les Mystères* (2 vols., 1880); *Les Comédiens au moyen âge* (1885); *La Comédie et les moeurs en France au moyen âge* (1886); *Répertoire du Théâtre comique en France au moyen âge* (1886); *Le Théâtre en France* (1889). A. G. Canfield.

Petition of Right: (1) a celebrated English statute passed early in the reign of Charles I. (3 Car. I., c. 1, A. D. 1627) for the purpose of restraining and limiting the acts and prerogatives of the crown, and securing the personal and civil liberties of the subject. Although a legislative act, yet, as it does not profess to establish any new rule, but simply to reaffirm those already in existence, it is in the form of a petition, and is entitled, "The Petition exhibited to His Majesty by the Lords and Commons, etc., concerning divers rights and liberties of the subjects, with the King's Majesty's royal answer thereto in full Parliament." After reciting the most important provision of Magna Charta and certain old statutes passed in the reigns of Edward I. and Edward III., which prohibited unlawful taxes and assessments, and forced loans, and illegal arrests and imprisonments, and quartering of soldiers upon private citizens, and a resort to martial law in civil cases; and after reciting in detail the various acts done by or in the name of the king which violated all of these prohibitions—viz., his unwarrantable levies of taxes, his forced loans, his arbitrary arrests and imprisonments, his quartering of soldiers in private houses, and his commissions authorizing the use of martial law—the Parliament prays that all these acts and proceedings should be discontinued and not repeated, recapitulating the violations of law above mentioned in detail, and concluding in the following language: "That you would be pleased to declare your royal will and pleasure that in the things aforesaid all your officers and ministers shall serve you according to the laws and statutes of this realm, as they tender the honor of Your Majesty and the prosperity of this kingdom." The king's assent, given in full Parliament, is indicated by the formula, "*Soit droit fait come est desiré*" (Let right be done as prayed). This declaration of the legislature is justly considered one of the fundamental and

constitutional guaranties by which civil and political liberty is secured to the British people. Although it does not contain in express terms the statement of broad principles, but rather deals with particular instances of executive wrongdoing, yet it is regarded as including and establishing the principles of personal right and liberty in the most comprehensive manner.

(2) A common-law proceeding by which a subject sought to establish his title to and recover possession of property which was held by the crown. (See INQUEST OF OFFICE.) As the sovereign is not liable to an ordinary suit at law, a petition setting forth the facts of the case and praying for the proper relief is presented to him, upon which he indorses the words "*Soit droit al partie*" (Let right be done to the party), and delivers it to the law officers of the crown. The subsequent proceedings resemble those in an ordinary action between subject and subject; the issues are tried before a court, and judgment is rendered for or against the petitioner according to the merits of the case. The Petitions of Right Acts (20 and 21 Vict., c. 44; 23 and 24 Vict., c. 34; and 36 and 37 Vict., c. 69) provide an alternative remedy for the claimant in these cases. Revised by FRANCIS M. BURDICK.

Petit Mal: See EPILEPSY.

Petit-Thouars: See DUPETIT-THOUARS.

Petoskey: village; Emmet co., Mich.; on Little Traverse Bay, Lake Michigan, and on the Chi. and West. Mich. and the Grand Rapids and Ind. railways; 60 miles N. N. E. of Traverse City, 120 miles N. by E. of Reed City (for location, see map of Michigan, ref. 3–I). It is in an agricultural region, has lime-kilns and leather and woodenware factories, is connected by a line of steamers with Chicago, Detroit, Escanaba, Buffalo, and other lake ports, and is a popular summer resort. There are a State bank with capital of $50,000, a private bank, and a monthly and three weekly newspapers. Pop. (1880) 1,815; (1890) 2,872; (1900) 5,285.

Pe'tra [= Lat. = Gr. Πέτρα; cf. πέτρα, rock]: the Selah of 2 Kings xiv. 7, taken from the Edomites by Amaziah (839–810 B. C.), in the hands of the Moabites about 700 B. C., and the capital of the Nabathæans (descendants of Nebaioth, the eldest son of Ishmael) about 300 B. C., when the Greeks first knew it as Petra. During the reign of Trajan (in 105 A. D.) it was conquered by the Romans; is mentioned several times by Eusebius and Jerome as an ecclesiastical metropolis, but is not heard of after about 536 A. D. Whether destroyed by the Mohammedans in the seventh century, or previously by the hordes of the desert, is not known. Its identification, suggested by Ritter on the basis of facts gathered by Seetzen in 1807, was established by Burckhardt in 1812. A good description of the ruins may be found in Robinson's *Biblical Researches* (Boston, 1841), as also in Murray's (Porter's) *Handbook for Syria and Palestine* (London, 1875), and with numerous illustrations in E. L. Wilson's *In Scripture Lands* (New York, 1890). The little valley, now called *Wady Musa*, is about 28 hours N. E. of Akabah, the eastern head of the Red Sea. The ruins, shut in by cliffs from 150 to 300 feet high, occupy an area of about half a mile square, are approached through a narrow and dark cañon, and burst upon the traveler in a way never to be forgotten. A stream still flows through the valley. The ruins of tombs, a theater, and a building supposed to have been a temple are exceedingly picturesque, as all these were cut from the living rock, and not built. The Bedouins who infest Petra have a bad reputation, and dragomans are afraid to conduct small parties thither.

Revised by S. M. JACKSON.

Petrarch (Ital. *Petrarca*), FRANCESCO: Italian poet and scholar; b. at Arezzo, July 20, 1304; d. at Arquà, near Padua, July 18, 1374. At the time of the poet's birth his family was in exile from Florence, his father, Petracco (name later modified to Petrarca by the son), being, like Dante, one of the White Guelphs banished in 1302. The first seven years of the boy's life were spent with his mother at Incisa; in 1310 he went with the family to Pisa, where he began his studies under Convenevole da Prato; but in 1313 his father decided to settle in Avignon, in France, then the papal residence. For many years this last city was Petrarch's real home. From 1315 to 1319, however, he was studying at Carpentras under his old master, then removed to France. His father now destined him for the career of jurisprudence, and he went first to Montpellier (1319), then to Bologna (1323), to study for this. His tastes were all for letters, however, and he had already conceived that passion for the Latin classics which was to make him the first of the humanists, the true initiator of the intellectual life of the Renaissance. In 1326, after the death of his father and mother, the young man returned to Avignon, and there entered the Church, receiving, however, only minor orders. He continued his favorite studies, and also took part in the gay and licentious life of the place.

At Avignon, on Good Friday, Apr. 6, 1327, as the poet himself tells us (but in 1327 Good Friday was Apr. 10), occurred an event that affected his whole after-life. In the Church of Sta. Clara he saw for the first time the woman he was to celebrate in verses of more lasting fame than was to be obtained by any other product of his pen. Few literary questions have been more discussed than that of the reality or unreality of this lady, Laura, as the poet calls her. Like Beatrice, she has been made out to be almost every form of poetical abstraction; but, in spite of all, the probability remains that she was Laura de Noves, wife of Hugues de Sade, a lady of whom we know that she died in 1348, having been the mother of eleven children. Whoever Laura was, there can be no doubt that the poet's love for her was profound, and that it deeply affected his whole spiritual life. It did not, however, prevent him from intrigues of a lower kind or from bringing into the world illegitimate children by a nameless mother.

It was not long after he had first seen Laura that Petrarch began to feel that restlessness which for many years made him a constant traveler. We can not follow his many peregrinations, but the reader will find them briefly and clearly enumerated by d'Ancona and Bacci in their *Manuale della letteratura italiana*, vol. i., p. 361–372 (2d ed., Florence, 1893). Suffice it to say that before he died he had visited the most notable cities of Italy, France, and Southern Germany, and had even been as far as Prague in Bohemia. These journeys, however, did not impede his study of the classics; they rather helped it. Wherever he went he was ever on the lookout for manuscripts of his favorite authors, and he first rescued from oblivion Cicero's *Letters to Atticus* and several of his orations, as well as a considerable portion of Quintilian. He also inspired all those with whom he came in contact with a passion for collecting similar manuscripts, and thus he began the necessary task of gathering together the productions of the ancient world in order that they might really be studied and known. His letters, of which a great number are preserved to us, show us how eagerly and consistently throughout his mature life he labored for the restoration of classical learning, and how abundant were the results of his efforts.

Naturally the encyclopædic scholarship of the poet, as well as the remarkable beauty of his Italian verse, speedily brought him great fame. In 1340, while he was at his favorite retreat of Vaucluse, near Avignon, he received a striking evidence of this renown in the form of simultaneous invitations from the University of Paris and from Rome to accept the laurel crown. He decided in favor of Rome, and Apr. 8, 1341, he was with great solemnity crowned upon the Capitol. The next years of his life were spent in many places, mostly in Italy, though he several times returned to Avignon and his beloved Vaucluse. In 1353, however, he abandoned Avignon forever, and his last years were spent in Italy—in Milan, Padua, Venice, and other places. In 1370, full of rejoicing at the return of the papal curia to Rome, he undertook a journey thither, but fell ill on the way, and retired to Arquà, in the Euganean hills, twelve miles from Padua. Here he lived till the day when his friend Lombardo da Serico found him dead in his study, with his head reclining upon the pages of a book.

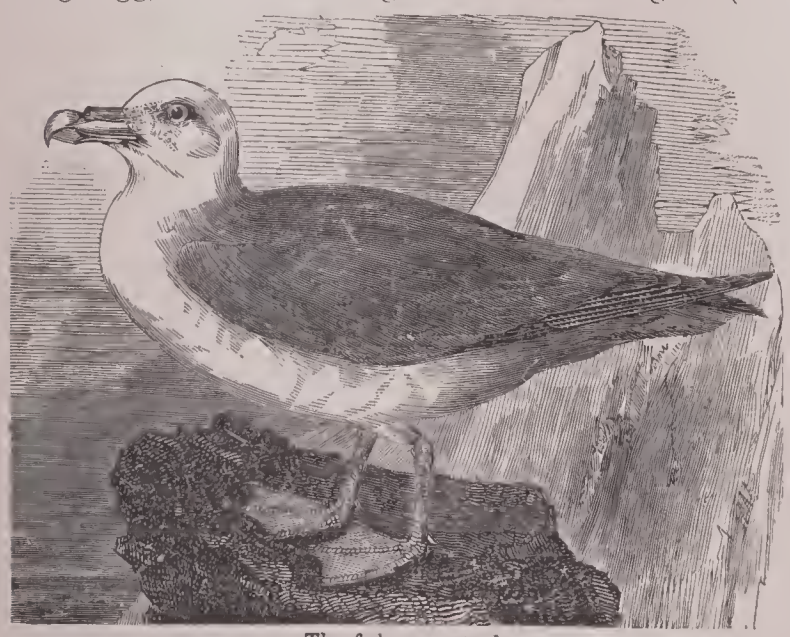
It is rare that a man obtains fame as great as Petrarch's in two distinct fields. It is chiefly as the poet, the singer of Laura, that he is known to the world at large; and, in fact, though he is far from having the high seriousness of Dante, it would be hard to exaggerate his importance in the history of Italian literature. Yet this is perhaps not his best title to the memory of men, but rather the fact that in him we have the initiator of the movement which has had such profound consequences for the modern world—the movement of return to the classics, to humanism, to the life and art of the natural man. Both he and his contemporaries were guilty of much exaggeration and misapprehension as to the true character of this movement. His own firm belief, for instance, in the superior excellence of his Latin epic, *Africa*, has not been justified by the judgment of posterity; and yet it is certain that from the huge mass of his Latin works have come influences of deeper im-

port than any that the *Canzoniere* gave rise to. The very titles of these works, however, are forgotten, except by the professed students of the Renaissance, and can be mentioned here only in the most cursory way. They fall into three groups—works of erudition, works of criticism or invective, and works of a personal or moral character. To the first group belong *Rerum memorandarum libri IV.*, *Itinerarium Syriacum*, *De viris illustribus*. In the second group fall *Invectiva in medicum*, *Invectiva in Gallum*, *De sui ipsius et multorum aliorum ignorantia*. The last group contains the poetical *Carmen bucolicum* (twelve eclogues) and *Epistolæ metricæ*, and the prose treatises *De contemptu mundi*, or *Secretum*, *De vita solitaria*, *De otio religiosorum*, *De vera sapientia*, *De remediis utriusque fortunæ*. Most of these last are in dialogue form. Finally should be mentioned the letters, *Epistolæ*, of which Petrarch himself made several collections.

The literature about Petrarch is now enormous, and can be found best enumerated in Willard Fiske, *A Catalogue of Petrarch Books* (Ithaca, N. Y., 1882). There are countless editions of the Italian poems, *Canzoniere*, e. g. edited by C. Pasqualigo, Venice, 1874. The Latin poem *Africa*, edited by F. Corradini, is printed in the volume *Padova a Francesco Petrarca nel quinto centenario dalla sua morte*, 1874. Of the other Latin works there is no good edition, the best being still that in folio, Basel, 1554. Of the *Epistolæ de rebus familiaribus* and *Epistolæ variæ* there is the excellent edition of G. Fracassetti (3 vols., 1859–63), and the same scholar has published an Italian translation of these and the remaining letters (7 vols., 1863–70). For Petrarch's life and literary character, see the following: A. Mézières, *Pétrarque*, etc. (Paris, 1867); L. Geiger, *Petrarka* (Leipzig, 1874); G. Koerting, *Petrarcas Leben und Werke* (Leipzig, 1878); G. Voigt, *Die Wiederbelebung des classischen Alterthums* (2d ed. 2 vols., Berlin, 1880); A. Bartoli, *Storia della letteratura italiana* (vol. vii., Florence, 1884); P. de Nolhac, *Pétrarque et l'humanisme* (Paris, 1892).

A. R. Marsh.

Pet'rel [from Fr. *pétrel*, dimin. of Lat. *Pe'trus*, Peter]: any member of a family (*Procellaridæ*) of sea birds belonging to the order *Tubinares*. The name was originally applied to the smaller species which, like the Mother Carey's Chicken (*q. v.*) flutter over the water with their feet just touching the surface, seeming, like Peter, to walk upon the sea. Petrels have long, narrow, pointed wings, hooked beaks with the nostrils opening in a tube. The plumage is thick, soft, rather oily, and has a peculiar, ineradicable musty smell. These birds feed on almost any animal matter, but are particularly fond of fat, and when captured not only defend themselves with beak and claw, but eject from their mouths a thick, oily, ill-smelling liquid. They dwell in communities and breed in holes, rarely laying more than a single egg, and come to and go from the nest at night. (For



The fulmar petrel.

a description of the nest of the fork-tailed petrel, see Nests of Birds.) Petrels are pre-eminently sea birds, only coming ashore to breed, and are found in all oceans, very sparingly in the tropics, most abundantly in the colder portion of the south temperate zone. The largest species is the giant fulmar (*Ossifraga gigantea*), frequently called the Cape-hen by sailors, a bird about 3 feet long and 7 feet in spread of wing, of a sooty color, lighter below. The bill is whitish. This species ranges N. in the Pacific to the coast of California, but the southern seas are its true habitat. The fulmar (*Fulmarus glacialis*) is the best known in the northern hemisphere, the Cape-pigeon (*q. v.*; *Daption capensis*) in the southern. Those petrels belonging to the genus *Puffinus* and related genera, which have a short nasal tube and rather slender beak, are commonly termed shearwaters, but it is rather a "book name." The Albatross (*q. v.*) is a near relative of the petrels.

F. A. Lucas.

Petrie, W. M. Flinders: Egyptologist; b. June 3, 1853; educated privately; engaged in mapping and measuring ancient British earthworks 1874–80; devoted much labor to the theory of the recovery of ancient measurements from monuments; has made several exploring expeditions in Egypt, in the third of which he discovered the city of Naukratis. Author of numerous works on Egyptology and archæology, among the most important being *Stonehenge: Plans, Descriptions, and Theories* (1880); *Tanis* (1885); an article on *Weights and Measures* in the ninth edition of the *Encyclopædia Britannica* (1887); *Historical Scarabs* (1888); *A Season in Egypt* (1888); *Hawara, Biahmu, and Arsinoe* (1889).

Petrifactions: a general name applied to fossils in reference to the mineralization of the organic tissues which were buried in the muds and sands from which the rocks were made.

Petrog'raphy [from Gr. *πέτρα*, rock + *γράφειν*, write]: that branch of natural science which has for its object the study of rocks. The terms *lithology* and *petrology* have thus far usually been used as synonyms with *petrography*, but some authors, as A. H. Green and Wadsworth, have attempted to differentiate their meanings. From their derivation it would be natural to divide these three terms so as to reserve *lithology* for the study of stones or rocks as hand specimens, especially with reference to their constituent minerals; *petrography* for the description of rocks both as mineral aggregates and in their broader field relations as geological bodies; and *petrology* for the philosophical discussion of questions of origin, relationships, metamorphism, etc., which can only follow a considerable advance in the two foregoing departments. Petrography is the most generally employed of these three terms to cover the entire field of rock study. See Rocks.

The investigation of rocks as a separate department of Geology (*q. v.*), though by no means new, dates its modern importance from the successful application of the polarizing microscope to the study of rock sections, cut thin enough to be transparent, the way to which was first pointed out by Sorby in 1858. Petrography includes the investigation of the nature, origin, composition and structure, genetic relationship, and secondary alterations in all rocks. The subject is one whose importance was clearly recognized at the dawn of geologic science, but for a long time it yielded no satisfactory results because of the lack of adequate appliances. It is now possible not merely to identify under the microscope (the most valuable appliance) the constituent minerals of even the finest-grained rocks, to determine their optical and other physical constants, and to make out their relative ages, modes of growth or the rock structures which they produce, but by means of various high specific-gravity solutions and the electro-magnet these constituents may be separated in a pure state and subjected to a complete chemical analysis. Much has also been done in the way of rock synthesis.

Rocks of a highly crystalline character have been most studied, both because, in the nature of the case, they are best suited to yield definite optical and chemical results, and because they are without those palæontological and stratigraphical aids to geological correlation which the sedimentary deposits possess. Field and laboratory study of rock masses have furnished and are still furnishing material for the comparative study of petrographic provinces, as well as for conclusions regarding the cause, extent, and nature of rock alterations, which promise to throw light on the darkest chapters of our earth's history.

George H. Williams.

Petro'leum [Gr. *πέτρα*, stone, rock + Lat. *o'leum*, oil]: the fluid form of bitumen, distinguished from maltha by its lessened viscidity, and its occurrence, in even its most dense forms, free from water. It is known also by the names rock-oil, mineral oil, and others. For its origin, see the article Bitumen.

History.—Although petroleum has been known in Persia, China, Japan, and other countries since the earliest times, the U. S. led in the production till 1898, when it was passed by Russia. In China it was obtained from artesian borings before the dawn of history. In Japan and Burma dug wells have been employed for centuries. In Persia it has been obtained from springs from a very remote period. Springs of petroleum early attracted the attention of travelers in the far East. Herodotus in 500 B. C. wrote of the springs of Zante, which are still flowing; and he describes how the oil was collected on a myrtle branch dipped into the spring. Pliny and Dioscorides mention the oil of Agrigentum, which was used in lamps under the name of "Sicilian oil." The wells of Amiano formerly supplied oil for lighting in the city of Genoa. At Point Apscheron, near Baku, on the Caspian Sea, at the eastern end of the Caucasus Mountains, springs of petroleum have been known from very early times. At Yenangyoung (earth-oil river), on the Irawadi, a heavy sort of petroleum has long been obtained from dug wells or pits, and sold under the name of "Rangoon tar."

The earliest reference to petroleum in North America is found in Sagard's *Histoire du Canada* (1632), in a letter in which a Franciscan missionary—Joseph de la Roche d'Allion—mentions the springs in what is now Alleghany co., N. Y. The oil of these springs, as well as that of Oil Creek, now in the State of Pennsylvania, was used by the Indians for medicinal and other purposes, and was sold under the name of Seneca oil. The early settlers in Northwestern Pennsylvania dug pits about the springs and curbed them.

From 1790 to 1820 numerous wells were drilled along the western slope of the Alleghany Mountains for brine, from which to manufacture salt. These were located along the Alleghany, the upper Ohio, the Muskingum, between Marietta and Zanesville, the Kanawha, above Charleston, the Big Sandy, and the head-waters of the Tennessee and Cumberland rivers. In all of these localities wells were occasionally drilled that yielded petroleum, and in some of them the amount was sufficient to spoil them for brine. One of these abandoned wells was drilled in Wayne co., Southeastern Kentucky, in 1819, and it has flowed a small quantity of black petroleum ever since. Another drilled on Little Rennox Creek, near Burkesville, Cumberland co., Ky., in 1829, was the first important flowing well in the U. S. The oil flowed out of the creek and into the Cumberland river, where it covered the water and was finally set on fire, burning for a distance of 56 miles. It ceased flowing in 1860, after other wells had been drilled in the vicinity. For many years the product ran to waste, but it was finally put up in bottles and sold as "American Medicinal Oil, Burkesville, Ky.," throughout the U. S., and in Europe.

As early as 1834 Selligue had manufactured in France shale oil that was used for lighting purposes. In 1850 James Young, of Scotland, introduced into commerce paraffin oils, made from the Torbane Hill shale, commonly known under the name of "Boghead coal." This industry soon extended to other European countries and to the U. S. Abraham Gesner in 1854 took out several patents in the U. S. for a process and apparatus for the manufacture of "kerosene." The manufacture of this article rapidly developed in the U. S. into an important industry. On the Atlantic coast of New England in 1860 there were forty establishments using Boghead coal, imported from Scotland, and albertite from New Brunswick. W. of the Alleghanies the rich cannel coals of Breckinridge co., Ky., those found at Cannelton on the Kanawha river, and at Canfield and Newark, O., were distilled for oil. The most extensive works for this purpose in the U. S. in 1859 were the Lucesco works in Westmoreland co., Pa., with a capacity of 6,000 gal. per day. The advent of petroleum finally caused all these concerns in the U. S. to abandon coal and take up petroleum. The Pennsylvania Rock-oil Company was organized in 1854 for the purpose of procuring petroleum on Oil Creek, Pa. After many vicissitudes, by 1858 this company had leased its land near where Titusville now stands to a portion of the stockholders, who employed Col. E. L. Drake to drill an artesian well. Drake first attempted to dig a well in one of the old timbered pits; but quicksands thwarting him, he drove an iron pipe 36 feet to the bed-rock. The following season men were engaged to drill, and, on Aug. 29, 1859, after many vexatious delays, the drill struck a crevice, into which it fell 6 inches. The next day the well was found to be nearly full of petroleum. Oil was struck in this well only 69 feet from the surface.

The success of this well was the signal for a grand rush. Speculators came from all directions, and in the next few years hundreds of wells were drilled along the tributaries of the Alleghany river. The farmers along Oil Creek, who could not have realized more than a few dollars an acre for their farms, suddenly found themselves wealthy. As the wells in one locality failed new ones were drilled to take their places, until they had exhausted the valley land in the neighborhood of Oil City, Tidioute, Titusville, and Franklin. Then borings were made on the table-land between Oil Creek and the Alleghany river, and at other places, without regard to the present configuration of the country. Test-wells were bored all over the country E. of the Mississippi river wherever an oil or gas spring rendered the production of oil possible. While a great many such enterprises proved fruitless, there were opened up a number of minor fields at some distance from the so-called "oil-regions of Pennsylvania," where the famous Pithole excitement was at its height. In Beaver co., Pa., the Smith's Ferry field was opened up, and in Ohio the Mecca district in Trumbull County, the Belden district in Loraine County, and the region that extends from the northern part of Washington co., O., southward through Pleasants and Ritchie into Wirt co., W. Va. Another locality in West Virginia was found along the Great Kanawha river, above Charleston, in Kanawha County. Still another region was developed in the southeastern part of Kentucky, near Glasgow, in Barren County. With the exception of the Mecca and Kanawha districts, which have been practically worked out, all of these localities are (1900) producing oil. From 1865 to 1875 operations in Pennsylvania gradually extended down the Alleghany river into Butler and Clarion Counties, and N. E. into Warren and McKean Counties. The Butler and Clarion, or "Southern Country," was at its height of production in 1872–75; then began the development of the Bradford field, which reached its height in 1880–81. In 1885–86 the Washington and Greene Counties, Pa., fields were opened up, and later the region in Alleghany and Washington Counties W. of Pittsburg.

In the northwestern counties of Ohio, particularly in the vicinity of Findlay in Hancock County, and Lima in Allen County, natural gas had been known since the settlement of the State. In drilling wells for gas in 1884 oil was encountered, often in such quantities as to prove troublesome. Wells for oil were first drilled in Lima and its vicinity in 1885, and their success soon led to the development of a large production over a wide area in Northwestern Ohio and Northeastern Indiana, known as the Trenton limestone or Lima oil-field.

On the Pacific coast another area next in importance has been developed in the Coast Ranges of Southern California. For more than a century bitumen has been observed floating upon the sea in the Santa Barbara channel. Exploration of the mainland E. of Point Conception and S. of the line forming the northern boundary of Santa Barbara County showed that an immense amount of bitumen was reaching the surface in the form of maltha that soon became asphaltum upon exposure to the elements. In 1865 companies were formed in New York, Philadelphia, and San Francisco, but their wells were improperly located, and failed to produce oil. In 1880–87 their properties passed into the hands of men of large experience in the oil-regions of Pennsylvania, and after several unsuccessful attempts, and a careful examination of the stratigraphy of the country, wells were obtained, principally in Ventura and Los Angeles Counties, which have produced steadily since. Other locally valuable regions are found in Wyoming and in Southeastern Colorado.

Outside the U. S. the regions furnishing petroleum to commerce are those of Russia, which extend along the Caucasus Mountains; those of Galicia and the Danubian principalities, Wallachia and Moldavia; and a small area in Peru. The Russian oil-fields are chiefly confined to a small area of very productive territory near Baku, which yields wells remarkable for their enormous output and for the long time during which it is discharged. Operations have been carried on here since 1873. The Galician and Roumanian oil-fields have been worked in a rude way for more than a century. Although attempts have been made for many years to utilize Peruvian petroleum, it is only quite lately that it has been imported in tank-steamers into San Francisco and sold in competition with the oils of California. See the article PETROLEUM AND NATURAL GAS, GEOLOGY OF.

Properties.—Petroleum is a liquid varying in color from

a light straw, through amber, red, and brown, to black; oils from the same locality are usually of nearly the same color. The Trenton limestone oils are very black; those of Oil Creek, Colorado, South America, Russia, Germany, Japan, and India are brown; the Bradford oils and those of the lower Alleghany and the vicinity of Washington, Pa., are amber-colored, as well as that of Amiano in Italy. The oil found at Smith's Ferry is a very light amber, and in a few instances natural petroleum has been obtained almost colorless. The colors given above are observed when the light is transmitted through the oil. The same oils, from the lightest to all but the darkest shades, when viewed by reflected light, are tinged with green. Hence petroleum is said to be dichroic, or of two colors. In specific gravity it varies from ·7 to 1·2, water being 1. As it escapes from the earth it is usually accompanied by water and a varying amount of gas, which latter it holds in solution. It is insoluble in water, but itself dissolves about 2 per cent. of water. It is partially soluble in all of the varieties of NAPHTHA (*q. v.*), in all varieties of alcohol, ether, chloroform, bisulphide of carbon, turpentine, and the other solvents of bitumen. The lighter colored varieties are highly refractive.

The chemical composition of petroleums varies greatly. Taken together they are found to contain nearly all the members of all the series of HYDROCARBONS (*q. v.*) known; but no single variety contains nearly all of them. The Trenton limestone oils of Canada and the U. S. consist of members of the paraffin and olefine series, holding in solution small quantities of more complex compounds, into which either nitrogen, sulphur, or oxygen enter as constituents. The oils obtained in the Devonian and Subcarboniferous rocks of Eastern Ohio, New York, Western Pennsylvania, and West Virginia are mixtures of paraffins and olefines, with only a trace of nitrogen or sulphur compounds. They are the most easily refined into commercial products of any petroleums known. The oils of Kentucky and Tennessee partake of the characteristics of both the Trenton and Devonian oils. The oils of Colorado contain paraffins. Those of the Pacific slope apparently consist of members of the benzole series, holding in solution considerable though varying amounts of pyridins and chinolins (basic oils containing nitrogen), combined with an acid resembling hippuric acid, in the form of an *ester* or compound ether. These nitrogen compounds make these oils very difficult to refine, and by their decomposition from natural causes cause the oils to pass rapidly into maltha and asphaltum. Russian oils consist of a mixture of the hydrides of the benzole series; Burmese petroleum (Rangoon tar) consists of a mixture of olefines and benzoles.

Development of Oil-territory.—The successful location of oil-wells on any proved territory requires sound judgment and experience. Each owner of a tract is likely to drill along the border of it, in order to draw oil from beyond the border. If the drilling is done under a lease, it is customary to give the owner of the land a royalty of a certain sum per barrel, or a certain proportion of the oil, or a certain percentage of the gross receipts. One well to 5 acres is considered a proper ratio, but they have been drilled as closely as five to an acre. Wells drilled so closely exhaust the oil-sand more rapidly; they have sometimes been exhausted in a few months.

Great differences are found in the oil-sand of different localities. The pebble sands of the Alleghany river and its tributaries are masses of rounded or flattened white quartz pebbles of the size of beans or grapes, that adhere at their points of contact, constituting a friable rock with large interstitial spaces. It varies in thickness from 10 to 125 feet. The Warren sand is blue, fine-grained, and muddy. The Bradford and Washington sands are coarse sandstones of a brown color. In California the sand is fine-grained, blue sandstone of marine origin. In Russia the sand is a sort of quicksand, very fine and blue in color. It often accompanies the oil in its outflow. It has been proved by experiment that the Venango pebble sand will hold about 1,000 barrels per acre for every foot in thickness.

For the method of drilling wells, see WELL-DRILLING. When an oil-well is drilled into a firm rock it is customary to introduce into the bottom of the well from 2 to 15 gal. of nitroglycerin and explode it by causing a mass of iron to drop on a fulminating cap. The effect of generating in the limited space a large volume of gas is to drive the oil, gas, etc., back into the rock until an equilibrium is established; then a reaction follows, and the expansion of the compressed gases forces everything before it up the drill-hole in a geyser of oil until the expansive force subsides. Torpedoes are not used in the oil-regions of California. After a well has been torpedoed it is prepared for flowing by introducing into it a 2-inch pipe, at the lower end of which is attached a strainer. At some point below the casing the pipe is arranged with a joint in such a manner that the portion above the joint will slide on that below. The joint is secured by a cylindrical mass of India-rubber, called a packer. The weight of the upper portion of pipe presses the rubber against the well in such a manner as to plug the drill-hole around the pipe, and prevent any oil or gas from escaping from the rock except by ascending the pipe. So long as the pressure of gas within the rock is sufficient to force the oil to the surface, the well will flow. When the well ceases to flow a pump is introduced, and the oil lifted to the surface until it ceases to be remunerative.

In the early days on Oil Creek the oil was transported in barrels holding 42 gal. each; along rivers bulk-barges were employed. In 1871 wooden tanks on flat cars came into use, and later these were followed by plain iron cylinders, holding about 5,000 gal. each, which are still used for transporting crude and refined oil in America and Europe. Crude oil is also transported by means of pipe-lines, which are best described in connection with the means employed for storing the oil. Every well is supplied with a tank holding 250 barrels, from which a 2-inch pipe connects with a larger tank holding perhaps 10,000 barrels. This large tank is connected by a 4-inch pipe, through a pumping-station, with a general system of 6-inch pipes, extending often for hundreds of miles. At convenient points along these main lines storage-tanks are placed, holding 35,000 barrels each; and pumping-stations are located about 40 miles apart. These pipe-lines are made of wrought iron, the sections screwed into couplings, the whole of which is tested to a pressure of 2,000 lb. to the square inch. Pipe-lines extend out of the oil-regions to Chicago, Cleveland, Buffalo, Jersey City, Philadelphia, and Baltimore. In California they extend from the wells in the mountains to Santa Paula and Ventura. In Russia a line has been laid from Baku on the Caspian Sea to Batum on the Black Sea, a distance of about 600 miles.

Petroleum in Commerce.—Petroleum, suitable for refining into illuminating oil, enters the market in enormous quantities through the pipe-lines. The more dense oils, which are suitable for use as lubricating oils in the crude state, and also as reduced oils, are handled in barrels and tank-cars. The handling of oil in pipe-lines has rendered banking in oil possible. This business is conducted as follows: When oil is run into the pipe-line the owner receives for it certificates, which, having been properly indorsed, are negotiable after the manner of certified checks. Certificates for 1,000 barrels are negotiable on the Stock Exchange, like any other declaration of indebtedness, and their purchase and sale makes speculation in oil possible. Certificates for less than 1,000 barrels are sold to consumers of oil. The oil is held against these certificates in storage-tanks, holding 35,000 barrels each, to the amount of millions of barrels, under regulations that insure its proper care.

Technology of Petroleum.—The apparatus employed for distillation consists of an iron still connected with a condenser of wrought-iron pipe, which is submerged in water. The first products of distillation are gases; at ordinary temperatures they pass through the condenser and escape. By cooling the condenser with ice and salt the very volatile liquid rhigolene is obtained; and by using a condensing-pump a still more volatile liquid, cymogene. The first fluids that condense at ordinary temperatures have a gravity of about 95° B.; in most establishments it is customary to run the product into one tank until the gravity of the distillate reaches 65°–58° B. This product is known as crude naphtha, and is subsequently separated by redistillation into gasoline and A, B, and C naphthas. When the stream of oil has a gravity of 59° B. it is run into the kerosene-tank until the gravity reaches about 38° B. or until the color becomes yellow. After taking off this second fraction, the kerosene, the stream is run into the paraffin-oil tank until there remains in the still only a thick, heavy tar, called residuum. The last products have a gravity of about 25° B. The paraffin oil is put into barrels and chilled, to crystallize the paraffin, and is then put into cloths and pressed, in order to remove the oil. The solid paraffin is purified by repeatedly melting it in naphtha, chilling, and pressing.

While this is a general outline of the process by distillation, it should be remarked that refiners differ in the de-

tails of the operation. A single firm at Rochester, N. Y., distill their oils in a vacuum, producing what are known as vacuum oils. Formerly very large stills were in use; at present the largest hold about 1,200 barrels. In these, by slow distillation, the heavier lubricating oils are "cracked" into lighter oils, so that the refiner need not produce any heavy oils, but only crude naphtha, illuminating oil, and residuum. The naphthas, burning, and lubricating oils are deodorized and decolorized for market by treatment, which consists in thoroughly agitating the crude distillate with strong sulphuric acid and allowing the mixture of the acid and the impurities of the oil, called sludge, to subside; the oil is removed, and then agitated with a solution of caustic soda, ammonia, or lime; this removes any free acid, along with any other impurities not removed by the acid. After treatment the burning oils are sprayed, in order to remove any light vapors that might render the oil unsafe. The lubricating oils, or reduced oils, produced by partial distillation, are sometimes treated and sometimes filtered through animal charcoal, to remove both color and odor; they are sometimes distilled with superheated steam. The residuum is distilled in small stills, and yields a large quantity of paraffin and paraffin oil, and a solid residuum that is run out of the still while it is hot, called coke-pitch, as it always contains a considerable percentage of coke. A variety of solid and semi-solid preparations are made by filtering the melted materials through animal charcoal; vaseline and various light-colored lubricating oils are examples. Nearly every natural petroleum is found to possess some peculiarity that renders some modification of this general technology necessary. Russian petroleum yields a second grade, as compared with the best American illuminating oil, excellent lubricating oil, and white solids, that are not paraffin, sold under the name of "Alboline." No first-class illuminating oil has ever been made from California petroleum, and very little, if any, is now being manufactured from that material. In the few refineries of the Pacific coast the articles turned out are gasoline, naphthas, lubricating oils, and several grades of both fluid and solid asphaltic residuums. These residuums resemble in some respects the natural asphalts; but in others they are very unlike. The dense black California petroleums are also reduced, and the fluid residuum is found to be especially valuable for use as an asphaltic flux in the preparation of street-paving.

The yield of these different products varies greatly with the variety of oil and with the refinery. The following is a fair average for Pennsylvania oil of about 45° B.:

	Per cent.
Gasoline	1½
Naphthas	14
Kerosene	55
Lubricating oil	17½
Paraffin	2
Loss, gas, and coke-pitch	10
Total	100

By cracking, the same oil could be made to yield:

	Per cent.
Naphthas	20
Kerosene	66
Loss, gas, and coke-pitch	14
Total	100

Kerosene is the most important product of petroleum. It is a mixture of many hydrocarbons, and has the consistency of the essential oils, a burning taste, and aromatic odor. It is nearly colorless by transmitted light, and slightly fluorescent by reflected light. Its density should be from 43°–45° B. At ordinary temperatures it should extinguish a match as readily as water. It should not evolve an inflammable vapor below 110° F., and should not take fire below 125° F. As kerosene containing even a small percentage of naphtha is very dangerous, it is almost universally required by law that kerosene be tested before it is sold. A suitable apparatus is required, consisting of a cup to hold the oil, surrounded by a vessel of water, which is heated by a small spirit-lamp. The bulb of a thermometer is immersed in the oil, not far below the surface. The oil should be heated very slowly; the temperature should not rise faster than 2° per minute. The oil should be stirred before applying the flame. The flashing test determines the lowest temperature at which the oil gives off an inflammable vapor. The burning test fixes the burning-point of the oil, or the lowest temperature at which it takes fire. One per cent. of naphtha will lower the flashing-point of an oil 10° without materially affecting the burning test. The burning-point of an oil is from 10° to 50° higher than the flashing-point. The flashing test should therefore be the only test mentioned in laws framed to prevent the sale of dangerous oils.

Uses of Petroleum.—The earliest use of petroleum, both in Europe and in the U. S., was as a therapeutic agent, in diseases of the skin of both men and animals, in rheumatism and consumption; it is still largely a constituent of embrocations in popular use. A filtered paraffin residue, under the name of vaseline, cosmoline, or petroleum ointment, is very extensively used, not only as a basis of medicated ointments by the apothecary, but very generally in households. Rhigolene has been used as an anæsthetic; cymogene has been used in ice-machines.

Various products of petroleum besides kerosene are used for purposes of illumination. Gasoline is used in large quantities in carburetors. These are machines in which air is made to bubble through the gasoline and dissolve a sufficient amount of the volatile liquid to form a combustible mixture, which may be burned like ordinary illuminating gas. Illuminating gas has been made by causing crude petroleum to drip into a retort upon red-hot coke. Naphtha is burned like gas in an apparatus in which it is vaporized by the heat generated during its combustion. A product of petroleum known as gas-oil, which consists of the naphtha and kerosene distillates run together without treatment, is used to enrich gas deficient in illuminating power. Astral oil is an oil of high flash-point, especially prepared with reference to illuminating power and safety. Mineral sperm" is an illuminating oil of very high flash-point, for use in lighthouses and on locomotives.

The paraffin and other lubricating oils prepared from petroleum, in innumerable brands, have largely superseded animal and vegetable oils throughout the world, while for coarse and heavy bearings the use of crude petroleum has become universal. Crude petroleum is used very extensively in Russia and on the Pacific coast of the U. S. for fuel, chiefly for steam purposes. The residuum of the refineries is also used on steamers on the Volga and the Caspian Sea, and on locomotives throughout Southern Russia. It has also been successfully used in the Eastern U. S. for steam purposes, but the low price of coal in the Mississippi valley renders competition impossible. On the Pacific coast coal is scarce and high-priced, and petroleum is used extensively for stationary boilers, petroleum having the advantage over coal in freedom from dirt, and the small expense for labor attending its use. Gasoline is very widely used for domestic heating and cooking, notwithstanding the well-known danger attending its use. It is more satisfactory than kerosene, which is also used for the same purpose, and, like gasoline, in stoves especially constructed for its combustion. The most volatile products of the distillation of petroleum are used for explosion in the cylinders of motors, after the manner in which gas is exploded in the cylinders of gas-engines. The asphaltic residues of California petroleum, as well as coke-pitch, are used for coating paper and in the manufacture of varnishes, paints, lacquers, etc.

The influence of petroleum and its products upon civilization is hardly less potent than that of the steam-engine and electricity. While thousands of wells have ceased to produce, and many localities in all of the regions that contribute to the world's supply have ceased to be important factors therein, still the aggregate amount appears to be sufficient to meet all of the enormous and varied demands; and, from a careful survey of the prospective supply, there seems to be no reason to fear that these demands of commerce will not be adequately met for an indefinite period.

The following statistics, from the *Mineral Resources of the United States for 1899*, show the annual production of petroleum throughout the world, in barrels of 42 gallons:

PRODUCTION OF PETROLEUM.

Appalachian Field	33,050,076
Lima-Indiana	20,225,356
Southern California	2,642,095
Florence, Colorado	390,278
Kansas and Texas	738,713
Wyoming	5,560
Other fields in the U. S.	18,722
Total barrels for the U. S., 1899	57,070,850

PRODUCTION OF PETROLEUM—CONTINUED.

Russia, Baku, 1899	66,452,240
Russia, elsewhere, 1899	2,300,000
Austria-Hungary, 1899	2,600,000
Roumania, 1899	1,470,000
Peru, 1899	891,666
Sumatra, 1899	861,610
Canada, 1899	704,794
Java, 1898	582,903
India, 1898	542,068
Japan, 1898	265,389
Germany, 1899	192,232
Italy, 1898	14,489
Other countries (estimated)	400,000
Total number of barrels	134,348,241

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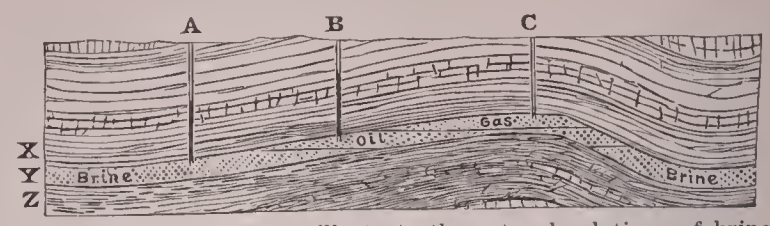
Petroleum and Natural Gas, Geology of: Petroleum and natural gas appear to be inseparably connected. Wherever large supplies of the one exist the other is in almost all cases not far distant. Hence any statements concerning the geology of the oil are equally applicable to that of the gas. Then, too, the flow of large petroleum-wells is always accompanied by an immense output of natural gas, which doubtless is dissolved in the oil under the great pressure of its rock reservoir.

The quantity of gas occurring immediately with the oil varies greatly, depending upon the depth of the oil-reservoir below the surface and the permeability of the overlying rocks. When the rock reservoirs lie near the surface, as at Volcano, W. Va., Mecca, O., and Franklin, Pa., most of their volatile contents escape into the air, leaving a heavy or lubricating oil, with little or no gas present, while if the reservoir lies upon the surface, or its included oil is transported to the surface in any manner, evaporation and oxidation reduce the liquid to the condition of asphaltum, as in the island of Trinidad and at many places in Kentucky, Tennessee, and the Western States and Territories of the U. S. In Ritchie co., W. Va., a vertical fissure from 2 to 3 feet wide and extending down to the oil-sand group has been thus filled with grahamite. From this universal occurrence of oil and gas together, or in close proximity to each other, it is evident that they have had a common origin, and that natural gas is one of the by-products in the genesis of petroleum. Until 1884 geology played a very insignificant part in guiding the drill in its search for oil and gas deposits. Since that date, however, the laws of oil and gas distribution and occurrence have been quite thoroughly worked out, and it is now possible to predict from geological structure the general regions where productive areas of oil and gas may be found, as well as to define the boundaries of nearly all those regions where a search for either must prove fruitless. These laws have been formulated under three heads—*Structure*, *Reservoir*, and *Cover*.

Structure.—All of the great areas of petroleum and natural gas occur along lines of disturbance in the rocks, where anticlinal arches have tilted the strata and thrown them into considerable relief, thus permitting the gas, oil, and salt water occurring in all porous sedimentary rocks to separate themselves in the order of their specific gravities, the water occupying the synclines and lower slopes of the strata, the oil coming next above the water and extending upward until it is in turn succeeded by natural gas higher up the slope and across the crowns of the anticlinals, if the rocks are continuously porous. (See diagram.) Hence when



Ideal diagram of strata to illustrate the natural relations of brine, petroleum, and gas in a porous bed (Y) contained between impervious beds (X, Z). A well at A yields only brine. A well at B yields first petroleum and afterward brine. A well at C yields first gas and afterward petroleum and brine.

the rocks are nearly horizontal over a wide area, structure would condemn such a region as not likely to furnish large supplies of either gas or oil. Structure also teaches that it would be useless to bore for gas in a syncline, unless it should be a subordinate feature of an anticline.

Structure would also condemn all regions for gas or oil where the rocks are highly contorted and the folds of great height, since these fissure the strata deeply, bring the reservoirs themselves to the surface, and permit the escape of the oil and gas they may once have contained.

Reservoir.—When petroleum was first discovered in large quantity, many people imagined that it existed in underground lakes, filling large caverns in the strata, and it was so represented even in leading text-books on geology. Petroleum does not occur in caverns, as thus depicted, but in the rocks themselves, disseminated through the minute cavities and spaces between the sand-grains and pebbles of fragmental deposits, while in limestones it occurs in the crystalline cavities formed by the partial replacement of pure limestone by dolomite. In slates it probably exists mostly in fissures. All sedimentary beds are porous to some extent, but the finer elastic materials, like slate, shales, and ordinary limestone, are so slightly permeable to liquids that unless much fissured they make poor reservoirs for either oil or gas, and hence the geological structure may be favorable, but if porous rock reservoirs be absent from the underground strata we can not expect to find any large supplies of oil or gas. The rate of production of any oil-well appears to depend largely upon the porosity of its rock reservoir. When this is a mere bed of gravel, like the famous fifth sand at McDonald, Pa., we may have a well like the Matthews or Mevey, putting out 15,000 barrels daily, and when the pebbles are not consolidated, as in the Baku district of Russia, the wells may flow even 50,000 to 60,000 barrels daily, while if the reservoir is compact and close-grained, wells penetrating it are non-productive. If the reservoir rock changes its character suddenly a well practically dry may exist close beside one that is highly productive. A non-productive well was drilled within 300 feet of the Mevey well at McDonald, Pa., at the time the latter was yielding 15,000 barrels daily. The porosity or quantity of reservoir space in good oil or gas rock in the Pennsylvania fields varies between one-fifth and one-tenth of the volume of the rock.

Cover.—However coarse or open the rock reservoir may prove, it must be roofed over with an impermeable cover, else the oil and gas will escape to the air, and the drill will find the original reservoir practically empty, or filled with fresh water. Soft shales or slate make such an excellent cover that even where the rocks are bent at an angle of 30° to 60°, as along the Volcano, W. Va., anticlinal, they have still retained a considerable quantity of petroleum in its subterranean reservoirs, though from the sands which lie nearest the surface much of the oil and nearly all of the natural gas has escaped. In any region, then, where unaltered sedimentary rocks have been gently tilted, and contain coarse or porous beds overlain with a considerable thickness of shale, clay, or other impermeable rock, we may expect to find deposits of petroleum and natural gas.

Dr. Orton believes that the terrace, or monoclinal structure, which is really a suppressed or arrested anticlinal, is the most favorable for accumulation of petroleum, since this peculiar arrangement of the rocks, as first noted by Minshall, is so common in the oil-fields of Ohio. It is also prevalent in most of the oil-fields of Pennsylvania and West Virginia.

The pressure under which oil and gas are found in porous rocks is hydrostatic, and identical with that of artesian wells. In any field newly opened, or in a field the wells of which are kept closed until a condition of static equilibrium

is restored, it is approximately measured by the pressure of a column of water rising from the same reservoir at another point. If, in the case illustrated by the diagram, the brine in well A rises half way from the reservoir to the top, the oil in well B, being lighter than water, will rise to a higher level, and the gas in well C will sustain a pressure measured by that part of the column of oil in B which is above the surface of oil in the reservoir, or approximately by that part of the brine in A which is above the oil-surface in the reservoir. This law of pressures has been demonstrated by Dr. Orton for the Trenton limestone reservoirs in Ohio and Indiana, and the same rule holds true for the oil-sands of Pennsylvania and West Virginia. An important corollary is that in the same "oil-pool" the liquid must occupy about the same level in the rock, since it is subjected to practically the same pressure in every portion of the pool. Hence when one good well is found in any field, the proper direction to go in search of others is along the *strike* of the rocks, and as the strike of the oil-sands is nearly the same as that of the surface rocks, the latter may be used in tracing out the probable course of oil-belts in advance of the drill. In this is found the philosophy of the 45°, 35°, or 22½° lines which in different oil-fields have proved so popular with the practical oilmen. These are strike lines in the several regions where used.

Geological and Geographical Distribution.—Petroleum and natural gas are not confined to any particular geological horizon, but occur in rocks of all ages from the Lower Silurian up into the Quaternary, as will be seen by the following remarks on distribution in the U. S.

The Trenton limestone of the Lower Silurian is the lowest and oldest known horizon for productive oil and gas wells. This horizon was first discovered near Findlay, O., and has proved one of the most prolific sources of oil and gas that is yet known in the U. S. Very large areas in Ohio, Indiana, and also in Canada contain petroleum and natural gas. Dr. Orton has shown that the productive areas of the Trenton limestone are confined to domes and terraces in this rock, where it has been rendered porous by the presence of dolomite.

The Hudson river beds seem to have furnished the first flowing well on the continent in the salt-well of Cumberland co., Ky., bored in 1829. This formation is petroliferous at many points in Kentucky and Tennessee, but none of the wells are very productive, as the rocks are close-grained. The Clinton series has proved, according to Orton, a rich repository of gas in the vicinity of Lancaster and Newark, and in other parts of Ohio, having also some oil. It is also, according to the same authority, the probable oil and gas horizon in the Barren County oil-field of Kentucky, where a great many small producing wells have been found. The producing stratum is a sandstone in Ohio, and probably the same in Kentucky.

The Corniferous limestone, Devonian, appears to be the principal oil horizon in the Canada petroleum-fields, and it has also produced oil in several borings of Eastern Kentucky, though always in small amounts. The Marcellus shale is the source of considerable natural gas in New York, and doubtless at many points in Ohio, but the wells are always small. The Chemung series (including the Portage, Chemung, and Catskill formations) has so far proved the most prolific oil and gas horizon in the U. S. The Portage beds are always low in porosity and, so far as known, have yielded gas and oil only sparingly, the localities being at Erie, Pa., and elsewhere near the shore of Lake Erie. In the Chemung and Catskill rocks, however, we find coarse sandstones and conglomerates, which are very porous, and both of these series have proved great reservoirs of oil and gas along the western slope of the Appalachian Mountain system from the southern portion of New York across Pennsylvania, and down into Ohio and West Virginia. The great Bradford oil-field, as well as the Southern New York region, derives its oil and gas from the Chemung beds proper, and that from Kane, Sheffield, Warren, Cherry Grove, Speechly, and adjoining regions, comes from the same source. The Catskill rocks appear to be even more prolific in oil than the Chemung, since the Venango oil-sand group of Pennsylvania, with its first, second, third, fourth, and fifth sands, from Venango County down through Clarion, Butler, Armstrong, Mercer, Lawrence, Beaver, Allegheny, Westmoreland, Washington, and Greene, belongs wholly in the Catskill beds, with the possible exception of its basal members. This Venango group has furnished practically all of the oil and gas of Western Pennsylvania, and has proved prolific at Macksburg, O., and at Eureka, Wellsburg, Mannington, Big Isaac, and many other points in West Virginia. Two of the largest gas-wells ever struck were found in a member of the Venango group at Big Isaac, in Doddridge co., and near Joetown, Marion co., W. Va.

The Cleveland shale, which, according to Orton, is the black shale of Southern Ohio and Eastern Kentucky, is also a member of the Venango or Catskill series, and contains some petroleum and gas wherever its outcrop extends. The gas-wells near Brandenburg, Meade co., Ky., occur in this stratum, and they have proved large enough to pipe to Louisville, 25 miles distant. Dr. Orton reports the shale as shattered and fissured at this locality, and its reservoir capacity has thus been increased to a large extent.

The next higher member of the geologic scale, the Pocono sandstone (Lower Carboniferous), No. X., or Vespertine of Rogers, is also one of the great petroliferous horizons. It is so far the principal oil and gas horizon of West Virginia, the Mt. Morris, Doll's Run, Peddler's Run, Jake's Run, Fairview, Mod's Run, and Mannington oil and gas fields being found at this horizon. The great Sistersville oil-field is found in the same rock, while it was the principal producing horizon at Volcano, White Oak, and Burning Springs. The gas-wells of the Great Kanawha, Guyandotte, and Big Sandy rivers are found in these beds. It is the Slippery Rock oil-sand in Pennsylvania, and the Mecca sand in Ohio, while through Kentucky, Tennessee, and Alabama it carries more or less oil, gas, or asphalt. The Mountain limestone series next above the Pocono is also petroliferous at many points in Kentucky, where the Keokuk and Chester divisions contain some massive sandstones. The tar-springs of Breckinridge and Grayson Counties come at this horizon. The Pottsville conglomerate also holds hydrocarbons, when covered sufficiently to prevent their escape. It holds large quantities of gas in Southwest Pennsylvania and Northern West Virginia, and also considerable oil along the Volcano anticlinal of the latter State. This series also carries oil in Southern Ohio, Eastern Kentucky, and at some localities in Illinois and Indiana.

The sandstones of the lower coal-measures, No. XIII., hold oil and gas in West Virginia, the Freeport sandstone being the one most generally petroliferous. This rock appears to hold gas over a wide area in Central West Virginia.

The Mahoning sandstone, at the base of No. XIV. in the Barren measures, is also widely petroliferous, and at one locality near Dunkard creek, Greene co., Pa., has produced a large quantity of oil. It is also the "Cow Run" sand of Southern Ohio and the Williamstown district of West Virginia, in both of which regions it has produced a considerable quantity of oil.

The highest stratum geologically that has ever produced oil in the Pennsylvania field is the Morgantown sandstone, 200 feet below the great Pittsburg coal-bed. In the Dunkard region of Pennsylvania a large well was struck in this sandstone.

The natural gas at Paola, Kan., and the Kansas City region probably comes from the coal-measures. A small quantity of oil is found in the Triassic beds of North Carolina.

The oil and gas of the Western States and Territories are found in newer rocks than those of the Appalachian region. The Florence oil-field near Cañon City, Col., is in the Cretaceous beds, while the same rocks are petroliferous through Wyoming, Dakota, Montana, and New Mexico. The oil of California, Mexico, the West Indies, and much of that of South America, occurs in the Miocene. That of Trinidad and Peru is reported to occur in the Eocene. The natural gas near Salt Lake City, Utah, is derived from Pleistocene lake-beds; that of La Moile, Ill., from glacial gravels.

In England a small quantity of petroleum has been found in the coal-measures. In the valley of the Rhône and in Savoy it occurs in the Jurassic limestones. That of the Apennines, Dalmatia, Albania, Roumania, Galicia, the Caucasus, and Baku is mostly from rocks of Eocene age, as also that from the Punjaub and Burma. Oil and gas are also found in Persia, Hindustan, China, Japan, Java, Australia, and Africa, and in all these cases the oil zones appear to lie parallel to the principal mountain systems of the several countries, as they do in America, thus indicating the connection of oil deposits with rock structure.

Available Store.—From this review it will be perceived that petroleum and natural gas, like coal, are distributed quite generally over the world and through rocks of all ages, from the Lower Silurian up to the Quaternary. The process of exhaustion is a slow one, many individual wells

in the Pennsylvania field having yielded oil in paying quantities continuously for a period of more than thirty years. New districts and new horizons are constantly being discovered, so that there is no immediate prospect of the exhaustion of petroleum. Not so with natural gas, however, which can be removed from the rocks so much more rapidly and completely than oil. In regions like Pittsburg, where several hundred wells have been drilled to the gas horizons, rapid exhaustion must certainly follow, but in other regions, where only a few wells are drilled, the supply may be counted upon for an indefinite time, since large gas-springs like those in the Caucasus have been burning for centuries. For other information, see the articles PETROLEUM and NATURAL GAS.

REFERENCES.—Orton, *The Origin and Accumulation of Petroleum and Natural Gas* (Geological Survey of Ohio, Economic Geol., vol. vi., Columbus, 1888), and *Origin of the Rock Pressure of Natural Gas* (*Bulletin* of the Geological Society of America, vol. i., 1890); White, *The Mannington Oil-field and the History of its Development* (*Bulletin* of the Geol. Soc. of America, vol. iii., 1892). I. C. WHITE.

Petrol'ogy [from Gr. πέτρα, rock + λόγος, discourse]: the science of the mineralogical composition of rocks. See PETROGRAPHY.

Petromyzon'tidæ [Mod. Lat., named from *Petromy'zon*, the typical genus; Gr. πέτρα, rock, stone + μύζων, sucking in. The name is given in allusion to the manner in which these animals remove small stones from their breeding-grounds]: the single family of the order *Hyperoartii*, comprising the forms known as lampreys and lamprey eels. The form is eel-like; the skin naked; in the adult the head is elongated, with branchial and antebranchial regions nearly equal; eyes well developed, not far in front of the first branchial aperture; mouth with a subcircular suctorial disk armed with teeth which are horny, each resting on a soft papilla, and simple or multicuspid; the branchial apertures are always seven in number and lateral; dorsal, anal, and caudal fins represented to a greater or less extent by a continuous or interrupted membrane; pectorals and ventrals not developed; the intestine has a spiral valve. Such are the characters of the adults, but all the species undergo a metamorphosis, and a very different form is possessed by the young or larvæ. This stage was formerly regarded as representing a peculiar mature form, and described under the name *Ammocœtes*; in this stage the front region of the head is little developed, the eyes are wanting, and the mouth is represented by a longitudinal slit, and is without teeth. The species are, to some extent, parasitic, and fasten themselves by their suckers to fish, whose flesh they consume by abrasion. Revised by D. S. JORDAN.

Petro'nius Ar'biter: the author of a Latin romance, *Satiræ*, also called *Satiricon*, which in a half-comical manner gives a description of the vices and debauchery of Roman society under the first emperors, now in prose, now in verse, sometimes witty, occasionally obscene. Of the work, which seems to have been very large, only fragments are extant, from the fifteenth and sixteenth books. One of these, the *Supper of Trimalchio* (*Cena Trimalchionis*), was first discovered in the middle of the seventeenth century, and published at Paris in 1664. Several attempts have been made to deceive the public by spurious manuscripts of the lacking portions of the book; thus, in 1693, Francis Nodot published a complete *Satiricon* from a manuscript which he pretended to have found in Belgrade. The best editions of the true fragments are that by Burmann (Amsterdam, 1743) and that by Bücheler (Berlin, 1862, and in a third smaller edition 1882). A minute and thorough collation of the MSS. was made by Charles Beck (Cambridge, 1863). Of the author of this book nothing is known, but there are strong reasons for identifying him with the Petronius of whose character and life Tacitus (*Annales* 16. 18) gives an amusing sketch, the *maître de plaisir*, *elegantiæ arbiter*, at the court of Nero, the authority and model in matters of taste and fashion in dress, manners, and sensual enjoyment. The scene of the *Supper of Trimalchio* is laid in a town of Campania, probably Cumæ or Puteoli, and under Nero, although other scholars put it under Augustus or in the last years of Tiberius. There is an excellent edition of the *Cena* with German notes and translation by Friedlaender (Leipzig, 1891). See also C. Beck, *The Age of Petronius* (Cambridge, Mass., 1856); Haley, *Quæst. Petron* (Harvard Studies, ii.); A. Collignon, *Étude sur Petrone* (Paris, 1892). Revised by M. WARREN.

Petropaulov'ski [Harbor of Peter and Paul]: a strong Russian naval station on the east coast of Kamchatka, commanding the Northern Pacific (see map of Asia, ref. 2–J). Pop. about 500, besides the garrison. It is the chief town of the peninsula.

Petrop'olis: capital of the state of Rio de Janeiro, Brazil; in a valley of the Organ Mountains, 2,300 feet above the sea; 35 miles N. of Rio de Janeiro and connected with it by a mixed railway and steamboat route (see map of South America, ref. 7–G). Originally a German colony, it became a favorite summer residence of wealthy residents of Rio, and the Emperor Pedro II. had a summer palace here. During the naval rebellion of 1893–94 the state government removed from Nictheroy to Petropolis, which was made the permanent capital in Oct., 1894. The climate is delightful and the scenery is magnificent. Pop. 8,500. H. H. S.

Petrosilex: See FELSITE.

Petrozavodsk': capital of the government of Olonets, European Russia; on the Onega Lake (see map of Russia, ref. 5–D). It was founded in 1703 by Peter the Great, who discovered the rich iron ore which the neighborhood contains. It is the see of an archbishop, and has many educational institutions, a good harbor, and a large cannon-foundry. Pop. 11,500.

Petrus de Apono: See ABANO, PIETRO, d'.

Petrus Lombardus: See LOMBARD, PETER.

Pettenkofen, AUGUST, von: genre and military painter; b. in Vienna, Austria, in 1821; member of the Vienna Academy 1866; member of Munich Academy 1867; knighted 1876. D. in Vienna, Mar. 20, 1889. His pictures, which are generally of small size and depict episodes in the soldier and peasant life of Hungary, are painted with marvelous exactness of detail, and at the same time are broad and complete in general effect. *A Rendezvous* is in the Vienna Museum, and *Hungarian Peasants' Halt in the Puszta* and *After the Duel* are in the Fedor Museum, Amsterdam. *The Ambulance Wagon* and *Hungarian Volunteers* are in the collection of Mrs. W. H. Vanderbilt, New York, and *Hungarian Artillery on the March* is owned by Henry G. Marquand, New York. WILLIAM A. COFFIN.

Pettenkofer, MAX, von, M. D.: chemist and sanitarian; b. at Lichtenheim, Bavaria, Dec. 3, 1818; graduated from the University of Munich in 1843; became a professor of chemistry in Munich in 1847. In 1866 he initiated the first practical instruction in hygiene in Germany, and has been intimately associated with the advance in hygiene since that date. As a chemist his researches in the affinities of gold, the preparation of platinum and of hydraulic lime, the process of obtaining illuminating gases from wood, and of the characteristics of oil-colors, were of signal commercial advantage. His announcement made in 1855 that the ætiology of cholera was an equation with three unknown quantities—x, a specific germ disseminated by human intercourse; y, a factor dependent on place and time, that might be called local disposition; and z, the individual predisposition—has been substantiated by the facts discovered in later years. He was coeditor of the *Zeitschrift für Biologie* from 1865–82. Among his important works are *Untersuchungen und Beobachtungen über die Verbreitungsart der Cholera, nebst Betrachtungen über Massregeln, derselben Einhalt zu thun* (Munich, 1855); *Ueber die Verlegung der Gottesäcker in Basel* (Basel, 1864); *Ueber die Kanalisirung der Stadt Basel* (Basel, 1866); *Boden und Grundwasser in ihren Beziehungen zu Cholera und Typhus* (Munich, 1869); *Zum gegenwärtigen Stand der Cholerafrage* (Leipzig, 1877). S. T. ARMSTRONG.

Pettigrew, CHARLES, D. D.: bishop; b. probably in Pennsylvania about 1750; removed with his family to North Carolina; became a teacher at Edenton 1773; was ordained in the Protestant Episcopal Church in London 1775; was chosen first Bishop of North Carolina 1794, but was prevented by accident from receiving consecration. He took a leading part in establishing the University of North Carolina. D. at Bonarva, near Lake Scuppernong, N. C., in 1807. Revised by W. S. PERRY.

Petty, Sir WILLIAM: political economist; b. at Romsey, Hampshire, England, May 26, 1623; was the son of a clothier; educated in the school of his native town and at Caen in France; was for a time an officer in the English navy; afterward studied medicine at Paris; obtained from Parliament in 1647 a patent for his invention of a "penta-

graph " or copying-machine; practiced medicine at Oxford, where he became assistant to the professor of anatomy; obtained a fellowship at Brasenose College 1648; chosen Professor of Anatomy in the University of Oxford 1651; Professor of Music in Gresham College 1651; became physician to the army in Ireland and secretary to Henry Cromwell 1652; was made surveyor of forfeited lands in Ireland; entered Parliament 1658, and at the Restoration was knighted and made surveyor-general of Ireland. He was one of the founders of the Royal Society; made several curious inventions and discoveries in physics; lost much by the fire of London, but afterward acquired a large fortune by successful speculations, and was author, among other works, of *The Political Anatomy of Ireland* (1691), *Treatise on Taxes and Contributions* (1662), *Political Arithmetic* (1691), a treatise on money entitled *Quantulumcunque* (1682), which have procured him the reputation of being the principal founder in England of the science of political economy. D. at Westminster, Dec. 16, 1687.

Petunia [Mod. Lat., from Braz. *petun*, tobacco]: a genus of annual, biennial, or perennial plants of the family *Solanaceæ*, natives of the hot regions of America. The *Petunia nyctaginiflora* and *P. violacea* are cultivated in European and North American gardens, and have afforded numerous hybrid and other varieties, some of which are very beautiful.

Peutinger, poi'ting-*er*, Konrad: antiquarian; b. at Augsburg, Oct. 14, 1465; d. Dec. 24, 1547; wrote several works on antiquities, and was the possessor of the so-called *Tabula Peutingeriana*, a map of the military roads of the West Roman empire from the fourth century. It was first discovered in a Benedictine monastery at Tegernsee, and remained there for nearly two centuries in the family of Peutinger, but in 1814 was bought by Prince Eugene, who presented it to the imperial library of Vienna, where it is now preserved. Published by Scheyb (Vienna, 1753); by Mannert (Leipzig, 1824), who also gives an interesting account of the vicissitudes which this unique monument of ancient literature has gone through from the fourth to the nineteenth century; and in *Recueil d'Itinéraires anciens*, by Fortia d'Urban (Paris, 1845). Cf. Paulus, *Erklärung der Peutinger Tafel* (1867). Revised by A. Gudeman.

Pew [from O. Fr. *pui*, *poi*, rising ground, hill, high place < Lat. *po'dium*, height, elevated place, emperor's gallery in the circus, appar. liter., foot-rest. Cf. Gr. *πόδιον*, dimin. of *πούς*, *ποδός*, foot]: an inclosed seat in a church. In England the exclusive and perpetual right to a particular pew in the parish church may be held as a kind of Heirloom (*q. v.*) by a parishioner as an appurtenant to his messuage (dwelling-house), such ownership arising either from prescription—that is, long-continued use—or from a grant by the ordinary or bishop. All the other pews not so claimed, except that appropriated to the minister's family, are under the control of the churchwardens, acting on behalf of the ordinary—i. e. the bishop of the diocese. Every parishioner is entitled to a sitting, and may enforce his right by suit in the proper court. This is the law applicable to churches built before 1818; with regard to those built thereafter acts of Parliament provided for the existence of some free seats and the manner of letting the rest. Pews in the Established Church in Scotland are held under a similar system. In the U. S., where the Church and state are separate, the method of holding church seats is regulated by the rules of the various churches. Occasionally the trustees or vestry, or other officers of the corporation or society, retain the entire custody of the church edifice, and the seats are free to all comers during divine service. Sometimes the pews are leased for a year only at a specified rent; on the other hand, they are often conveyed by an instrument in the form of a perpetual lease, reserving an annual rent. In the latter case the right of the pew-holder is peculiar; it is property, and may be transferred, but is generally exempt from sale on execution; in some States it descends to the heirs as real estate, and in others it passes to the administrator as personal estate. It is, however, limited, and subject to the ultimate control of the trustees or vestry, who may, under restrictions not affecting the pewholder, convey the church edifice, rebuild, repair, or remodel it at their discretion. Revised by F. S. Allen.

Pewee: See Phœbe-bird.

Peyer's Glands: small sacculi peculiar to the mucous membrane of the small intestine, termed *glandulæ solitariæ* when scattered singly, and *glandulæ agminatæ* when collected in groups. Also called *Peyer's patches*, from Peyer (1653–1712), who first described them. See Histology.

Peyron, pā'rōn', Vittorio Amadeo: philologist; b. at Turin in 1785; d. 1870. He was a pupil of Tommaso Valperga di Caluso, and succeeded him in the chair of Oriental languages. He was a member of the Turin Academy of Sciences and foreign member of the French Institute. He rendered important services to the study of Greek and of Coptic; translated Thucydides anew into Italian; published a critical essay upon the Hellenic constitution, prefixed to the *Scene Elleniche* of Brofferio; some Greek texts, partly inedita, of Empedocles, Parmenides, Theodosianus; and fragments of the *Orations* of Cicero for Scaurus and Tullius and against Clodius. He has also the merit of having founded the study of Coptic by his *Lexicon Linguæ Copticæ* and his *Grammatica Linguæ Copticæ*.

Revised by A. Gudeman.

Peyronnet, pā'rō'nā', Charles Ignace, Comte de: statesman; b. at Bordeaux, France, Oct. 9, 1778; studied law, and practiced as an advocate in his native city; became very conspicuous during the first and second Restorations as an ultra-royalist and stanch adherent of the Bourbons, and was Minister of Justice 1821–28. In 1822 he carried a law by which all press cases were deprived of trial by jury and referred immediately to the royal courts, which were empowered to suspend and suppress any publication which seemed hostile to the public peace, the established Church, and the royal authority. In 1825 he carried another law by which profanation of any object consecrated to the public worship was punished by forced labor for life. In 1822 he was created a count; on May 16, 1830, he again entered the Government as Minister of the Interior in the cabinet of Polignac, and as such he signed the notorious ordinances of July 25, 1830, which occasioned the Revolution of 1830 and the fall of the elder line of the house of Bourbon. Arraigned before the House of Peers for high treason, he was sentenced to imprisonment for life and confined in the fortress of Ham, but Oct. 17, 1836, he was pardoned. D. Jan. 2, 1854, on his estates in the Gironde. He wrote a *Histoire des Francs* (2d ed. 1846) and *Satires* (2d ed. 1854). F. M. Colby.

Pfleiderer, Otto: German Protestant theologian; b. at Stetten, near Cannstatt, Würtemberg, Sept. 1, 1839; studied under Baur at Tübingen 1857–61; became pastor at Heilbronn 1868; superintendent and Ordinary Professor of Theology at Jena 1870; Professor of Theology in Berlin 1875. He belongs avowedly to the school of Baur, and defends his views with logical power and eloquence. He has twice appeared as a lecturer on English foundations—once as Hibbert lecturer in London (1885) and once as Gifford lecturer in Edinburgh (1894), and both courses were published in English—*Lectures on the Influence of the Apostle Paul on the Development of Christianity* (London, 1885) and *The Philosophy and Development of Religion* (2 vols., 1894). Besides these there are in English, *Paulinism: a Contribution to the History of Primitive Christian Theology* (2 vols., 1877); *The Philosophy of Religion on the Basis of its History* (4 vols., 1886–88); *The Development of Theology in Germany since Kant and its Progress in Great Britain since 1825* (1890). Samuel Macauley Jackson.

Pflü'ger, Eduard Friedrich Wilhelm, M. D.: physiologist; b. at Hanau-on-the-Main, June 7, 1829; studied medicine first in Marburg, then in Berlin, where he was a pupil of John Mueller and of Du Bois-Reymond; graduated M. D., University of Berlin, in 1855; elected Professor of Physiology at the Bonn University in 1859; established and edited the *Archiv für die gesammte Physiologie des Menschen und der Thiere* in 1868. Among his important works are *Die sensorischen Functionen des Rückenmarks der Wirbelthiere*, etc. (Berlin, 1853); *Untersuchungen über die Physiologie des Electrotonus* (Berlin, 1859); *Wesen und Aufgaben der Physiologie* (Bonn, 1878). S. T. Armstrong.

Pforz'heim: town: in the grand duchy of Baden, Germany; at the confluence of the Nagold, Enz, and Würm; 20 miles by rail S. E. of Carlsruhe (see map of German Empire, ref. 6–D). It has large manufactures of jewelry, chemicals, and linens, iron-works, tanneries, and oil-mills, and an active trade in timber, which is cut in the neighboring Black Forest. Pop. (1895) 33,345.

Phacochœ'ridæ [Mod. Lat., named from *Phacochœ'rus*, the typical genus; *φακός*, lentil seed, wart + *χοῖρος*, pig]: a family of even-toed ungulates comprising the wart-hogs, and closely related to the true hogs, with which they are

combined by some zoölogists. The milk dentition is I. $\frac{1}{3}$, C. $\frac{1}{1}$, P. M. $\frac{3}{2}$, M. $\frac{3}{3}$; but many of the teeth are lost as growth proceeds, and in the adults frequently none are present but the canines and last molars. The structure of the molars is peculiar, as they consist of about twenty upright columns of dentine coated with enamel and united by cement, each column having its own pulp-cavity. See WART-HOG.

F. A. LUCAS.

Phædra (in Gr. *Φαίδρα*): in Greek legend, the wife of Theseus and the stepmother of Hippolytus, with whom she fell desperately in love. When he refused to comply with her wishes, she accused him to his father of an attempt upon her honor, but when she heard that he had perished in consequence of his father's wrath, she confessed her guilt and committed suicide. The tragedies on this subject by Sophocles and Euripides are lost, but there is a celebrated one by Racine. Revised by J. R. S. STERRETT.

Phæ'drus: author; b. in Thracia; was taken to Rome as a slave, but was made free by Augustus, and was the first to raise the fable to the dignity of a special branch of Roman poetry. He wrote five books of fables, now extant but incomplete, containing ninety-three fables in all, many of which, however, are only versifications of the fables of Æsop. The style is easy and fluent, and the book often very pleasant to read. There are editions by Orelli (Zurich, 1831), L. Müller (Leipzig, 1868), and a larger critical edition, containing appendix of additional fables, 1877. See L. Hervieux, *Les fabulistes latins* (Paris, 1884), and Hartman, *De Phædri fabulis* (Leyden, 1890). Revised by M. WARREN.

Pha'ëthon [= Lat. = Gr. *Φαέθων*. Cf. *φαέθων*, shining]: in Grecian mythology, the son of Helios. He obtained one day permission of his father to drive the chariot of the sun across the heavens, but the horses ran off, and the chariot was just about setting heaven and earth on fire when Zeus struck down the unfortunate driver with a thunderbolt. He fell into the Eridanus, and his sisters, the Heliades, who stood mourning by his corpse, were transformed into poplars and their tears into amber. Revised by J. R. S. STERRETT.

Phaëton'idæ [Mod. Lat., named from *Pha'ethon*, the typical genus, from Gr. *Φαέθων* (see PHAËTHON), in allusion to their tropical habits]: a family of birds belonging to the order *Steganopodes*, and containing the TROPIC BIRD (*q. v.*).

Phagocyto'sis [Mod. Lat., from Gr. *φαγεῖν*, eat + *κύτος*, a hollow vessel]: a word first used by Metschnikoff to express the destruction of bacteria and other injurious substances by means of white blood-corpuscles. In accordance with this view of Metschnikoff, the leucocytes, which in inflammation leave the vessels and enter into the tissue, play an important and useful part, their function being to eat up and destroy bacteria and other injurious solid substances. Metschnikoff found on inoculating an animal with certain organisms that after inflammation was produced the bacteria became included in the leucocytes, and when this was the case they were apparently destroyed or rendered innocuous, and the inflammation subsided.

It was found from the experiments of Nuttall, Buchner, and others that the destruction of the bacteria is not due to this action of the leucocytes, but to destructive effects of substances contained in the blood serum, and the bacteria are already destroyed when they are taken into the cells. These substances in the blood serum, which are destructive to the bacteria, are either present naturally, in which case the animal has an immunity to the disease inoculated, or they arise during the course of the disease, and with their presence in the blood in sufficient amount the disease subsides. There is no doubt, however, that although the process has not the full bearing and importance which was ascribed to it by Metschnikoff, it plays an important *rôle* in disease. Not only are dead bacteria removed by the leucocytes, but foreign particles of all sorts, including necrotic cells and portions of tissue. These substances are taken into the body of the leucocytes, and there undergo a complete or partial digestion, and are rendered soluble and thus absorbed. In other cases they may be carried off while still in the body of the leucocytes. This is the case when particles of pigment are placed in the skin as in tattooing. The presence of the leucocytes in such places is always due to the presence of a chemical substance which has a powerful action in attracting the leucocytes. This substance is known to be of an albuminous character, and it is found in all cases where dead cells of whatever nature, whether bacteria or the tissue cells themselves, are present. W. T. COUNCILMAN.

Phalan'ger: a common name for a marsupial of *Cuscus*, *Phalangista*, or a related genus of the family *Phalangistidæ*, popularly known in Australia as an opossum. The phalangers are about the size of a cat; have a rather small, somewhat pointed head; long, bushy, prehensile tail; and are clad in thick, woolly fur. They are arboreal and nocturnal in their habits, and live on fruit and leaves. They are found in Australia and Tasmania, and are eaten by the natives and to some extent by the settlers. The vulpine phalanger (*P. vulpecula*), which is of fox-like aspect, and gray above, whitish below, with white ears and a black tail, is a well-known species. The flying phalangers, of the genus *Petaurus*, have, like the flying squirrels, a fold of membrane running from the fore to the hind leg, which serves as a parachute and enables them to take long leaps. The genus ranges from New Ireland to New South Wales. F. A. LUCAS.

Phalangida [from Gr. *φαλάγγιον*, spider + *εἶδος*, like]: a group of Arachnida, including those long-legged spider-like forms familiarly known as harvestmen or daddy-long-legs. They have small bodies consisting of an unsegmented anterior portion (cephalothorax) and a six- or eight-jointed abdomen. They have usually a single pair of eyes; they breathe by means of air-tubes (tracheæ), and so-called lungs are absent. The legs are usually extremely long and slender, the distal portion (foot or tarsus) being many-jointed. Some 250 to 300 species have been described, South America being especially rich in species. The harvestmen live in damp places, crawling over leaves, etc., by means of their long legs, and being protected from enemies by a pair of "stink glands," which open on either side of the cephalothorax. They are largely nocturnal, and feed upon small insects, etc. American species have been described by Wood (in *Proceedings Essex Institute*, vol. vi., 1870) and Weed (in *American Naturalist*, 1888–93). J. S. KINGSLEY.

Phalangist'idæ, or **Phalangeridæ** [*Phalangistidæ* is Mod. Lat., named from *Phalangis'ta*, the typical genus, from Gr. *φάλαγξ*, phalanx, bone between joints of the fingers or toes. So called from the peculiar joining of the phalanges]: a family of herbivorous marsupials containing the members of the genera *Cuscus*, *Phalangista*, *Belideus*, and their allies. The dentition is somewhat variable, I. $\frac{3}{1}$, C. $\frac{1}{1}-\frac{1}{0}$, P. M. $\frac{2}{1}-\frac{3}{3}$, M. $\frac{4}{4}=\frac{3}{3}$. The fore and hind limbs are of nearly equal size, all with five toes. The first toe of the hind foot is opposable to the others, the second and third are slender and united by skin as far as the claws. The stomach is simple; a cæcum present and usually large. See CUSCUS, KOALA, and PHALANGER. F. A. LUCAS.

Pha'lanx [= Lat. = Gr. *φάλαγξ*]: in the military organization of ancient Greece, the tactical unit of the heavy-armed troops, a body of foot-soldiers armed with spears and shields. The number of men was various. They were arranged from four to sixteen men deep. In later times the great phalanx under the Macedonians comprised 16,384 men, and was composed of four minor phalanges, each of which had two *merarchies*, or halves. Each merarchy was composed of two *chiliarchies*, each of these of four *syntagmata*, and each syntagma of 256 men. The phalanx was, as compared with the Roman legion, a cumbrous arrangement of men.

Revised by J. R. S. STERRETT.

Phal'aris: proverbially the most cruel tyrant known to antiquity; the ruler of Agrigentum in Sicily for about sixteen years, in the middle of the sixth century B. C. Of his history hardly anything is known with certainty, most of it being enveloped in fables. A prominent feature in these fables is the brazen bull, invented by one Perillus, in which Phalaris roasted his enemies, inaugurating the ingenious instrument of torture by the roasting of its inventor. This story perhaps originated in the worship of the Phœnician Baal with human sacrifices, and after the abolishment of this cult its practice would seem to have been associated with the memory of the odious tyrant. The famous *Epistles of Phalaris*, 148 in number, first printed at Venice in 1498, and afterward often reprinted and translated, give quite another picture of the man's character, and were read through many centuries with great edification, until Bentley proved that they were spurious, a product of a much later time. Revised by G. L. HENDRICKSON.

Phalarope, făl'a-rōp: any one of three species of small wading birds resembling sandpipers, but having the toes lobed, or furnished with scallop-like margins, which enables these birds to swim and dive with great ease. They are found in the northern hemisphere and breed far north. On

their breeding-grounds they are usually found in couples about some body of fresh water, but during their migrations they often occur at sea in considerable flocks. They feed on seeds, insects, and minute crustacea. Wilson's phalarope (*Phalaropus tricolor*) is peculiar to North America. *P. lobatus* and *Crymophilus fulicarius* are found in Europe and Asia as well. F. A. Lucas.

Phalaropod'idæ [Mod. Lat., named from *Phala'ropus*, the typical genus; Gr. φαλαρίς, coot + πούς, ποδός, foot]: a family of aquatic birds of the order *Limicolæ*, containing the phalaropes. The bill is slender, straight, about as long as the head, and with the sides of the upper mandible grooved for nearly the whole length; nostrils near the base, linear, and in the lateral groove of the mandible; wings long and pointed; tail short and rounded; legs rather posterior, with the tarsi moderate, the anterior toes united at the base and with lobate sides, and the hind toe elevated and with a narrow membrane. F. A. Lucas.

Phallic Worship [*phallic* is from Gr. φαλλικός, deriv. of φαλλός, penis; probably cognate with Germ. (dial.) *bulle*]: originally the adoration of the reproductive and regenerative powers of nature, represented after a time by a figure of the phallus, or male generative organ, or in some instances by a straight column or by the pistil of a flower, as in India at the present day. This worship, whatever of symbolism it may have had at first, rapidly became a most corrupt practice. It prevailed in India (as at present), in Chaldæa, Egypt, Syria, Phrygia, Greece, and Rome, as in later days among some of the American savages, notably the Seminoles of Florida. The forms which this abomination assumed were innumerable. Dionysus, Hermes, Venus, Priapus, Pan, Isis, and other gods were worshiped at Rome by phallic symbolism.

Phana'riots, or **Fana'riots** [from *Fanar*, one of the quarters of Constantinople where they dwell; from Gr. φανάριον, the "beacon" there situated]: a body of Constantinopolitan Greeks who claim a noble Byzantine descent. Spared by the Turkish conquerors, they artfully insinuated themselves into public affairs, and until 1822 held many important civil, military, and naval positions, in which they displayed, as a rule, selfish and ungenerous qualities. Their power as a class is now completely broken.

Phaneroga'mia, Phan'erogams [*phanerogamia* is Mod. Lat., from Gr. φανερός, apparent, visible (deriv. of φαίνειν, φανῆναι, show) + γάμος, marriage]: the highest branch of the vegetable kingdom, the flowering plants. The less objectionable terms Anthophytes (*q. v.*) and Spermaphyta are displacing the older ones in recent botanical works. See Vegetable Kingdom. Charles E. Bessey.

Phanocles: Greek elegiac poet of the Alexandrian period who wrote a cycle of elegies on the boy-favorites of the gods and heroes (Ἔρωτες ἢ καλοί). The fragment preserved by Stobæus, *Floril.*, 64, tells of the love of Orpheus for Calaïs, son of Boreas, and the death of the singer at the hands of jealous women. Ed. by Schneidewin in his *Delectus* and Bergk in his *Anthologia Lyrica*. B. L. G.

Pha'raoh [Egypt. *Per-āa*, great house; Heb. *Phar'ōh*, Gr. Φαραώ]: the royal title of the Egyptian kings, used generally alone in the Bible, rendering it impossible to distinguish between successive sovereigns. Only in the later periods were other names added, as Pharaoh-Necho and Pharaoh-Hophra. The etymology given above is the one usually accepted, though several others have been proposed. It is often compared to the Turkish Sublime Porte. For contrary views, see Renouf, *Proceedings of the Society of Biblical Archæology*, vol. xv., p. 421 f. C. R. G.

Pharaoh's Hen: See Egyptian Vulture.

Pharisees [from Lat. *Pharisæ'us* = Gr. Φαρισαῖος, from Heb. *pᵉrūshīm* (plur.), deriv. of *pārash*, to separate]: a political and religious party among the Jews, originated during the time of the Maccabees in opposition to the invasion of Greek ideas and Greek customs which took place especially during the reign of Antiochus Epiphanes. While the Sadducees and the ruling aristocracy had yielded to the idea of a distinction between religion and politics, between Church and state, the Pharisees still maintained the old and genuinely Jewish view of a theocracy; and while the Sadducees adhered rigorously to the literal conception of the words of the sacred books, the Pharisees adopted the tradition as a means by which to interpret Scripture. Thus the Pharisees stood at the time of Christ at once as the national party in politics and as the progressive school in theology, and their influence with the mass of the people seems to have been very great. The sources of our knowledge of them are the New Testament, Josephus, and the Mishna. Modern scholars seem inclined, however, to look at them under a milder view than that in which they appear in the New Testament, though it is only natural when the importance which they ascribed to the observation of all minutiæ of the law led to hypocrisy and falsity.

Pharmacopœ'ia [Mod. Lat., from Gr. φαρμακοποιΐα, preparation of medicines; φάρμακον, drug, medicine + ποιεῖν, make]: a book containing formulas and directions for preparing and compounding drugs for use in the treatment of disease. Such a book may be the outcome of individual enterprise or the execution of an order of the government. In many European states the *Pharmacopœia* is issued by the authority of the Government, and penalties are attached to failure on the part of the pharmacist to observe its directions. In the U. S. the *Pharmacopœia* is not prepared under authority of the general Government, but observance of its provision is, in certain States, required by special law. The first pharmacopœia published in the U. S. was issued at Philadelphia in 1778 for the use of the hospital of the U. S. army, at Lititz, in Pennsylvania. This was published in Latin. In the second edition, Dr. William Brown was named as its author. In 1805 a pharmacopœia was issued for the use of New England. Another pharmacopœia was issued in 1815 for the use of the New York Hospital. In 1817 Dr. Lyman Spalding, of New York, proposed a plan for the formation of a *National Pharmacopœia*, and circulars being issued to a large number of medical societies, these sent delegates to Washington in 1820 to prepare the first *National Pharmacopœia*, which was issued Dec. 15, 1820, in Latin and English. Since that time at certain intervals conventions have been held by representatives of the medical profession and pharmacists, which have revised and altered the *Pharmacopœia*, so as to incorporate in it new drugs or new formulas which had come to be recognized as useful, and to exclude others which had fallen into disuse or been found unworthy of a place in such a work. The issue of the *Pharmacopœia of the United States of America* called the seventh decennial revision was prepared by a convention which met at Washington in 1890. It was printed at Philadelphia, and became official on Jan. 1, 1894. It contains descriptions of drugs and the mode of preparing them for use, and a great variety of information on subjects collateral with these. The following is an example of the description of a drug: "Acidum Carbolicum. Carbolic Acid. C_6H_5OH–93·78. (Phenol.) A constituent of coal-tar, obtained by fractional distillation, and subsequently purified. Carbolic acid should be kept in dark amber-colored, well-stoppered vials." After this follows a full description of the chemical and physical characteristics and properties of carbolic acid. In the preparation of compound remedies the *Pharmacopœia* gives the name in Latin, then in English, then a description of the preparation, then its constituents with their proportions, followed by a description of the method of compounding them. Works of this kind are of the greatest value in producing uniformity in the preparation of drugs, and in securing reliability as to strength and genuineness of their ingredients. In the U. S. there is no general law compelling physicians or pharmacists to follow the directions of the *Pharmacopœia*, but it is recognized as the best guide in regard to the preparation and compounding of drugs, and is the basis of all intelligent teaching on pharmacy. Charles W. Dulles.

Pharmacy [from Gr. φαρμακεία, use of medicines, pharmacy, deriv. of φαρμακεύειν, administer medicines, deriv. of φάρμακον, drug, medicine]: the art of preparing, preserving, compounding, and dispensing remedies for disease. The modern idea of pharmacy includes only the art of one who acts as an agent for the physician, and in so far differs from the theory and practice of the ancients. This definition corresponds fairly to the present actual relation of the dispensers of drugs to practitioners of medicine, although many who claim the name of pharmacists prepare remedies according to formulas which they make public or conceal, and sell these with indications for their use and directions how to employ them. This practice is not regarded as commendable by physicians, on the ground that, while sometimes useful, it may at times be damaging to those who avail themselves of it.

The origin of pharmacy is very ancient. In the earliest medical times it was carried on by physicians who prepared

their own remedies and directed their administration. The earliest history of medicine, which is that of the Egyptians, contains records in the Leipzig and Berlin papyri of the preparations of remedies by the priestly class, who were the physicians. The earliest Greek physicians (the Asclepiadæ) prepared their own remedies, and were in the original sense of the word pharmacists. About the time of the Christian era there was a class of persons called rhizotomes (root-cutters), who collected drugs and sold them to physicians. In a rude way these were the first pharmacists in the modern sense of the word. After this, with the increase of medical practice, there arose a class of persons who made it a business to collect drugs and prepare them for the use of physicians, and accordingly this work became more specialized. There were certainly drug-shops among the Romans, for one has been unearthed at Pompeii; but it was not until the end of the Middle Ages that pharmacy became much of an art, receiving a distinct recognition from the great Emperor Frederick II., who was the patron of the University of Salerno in the thirteenth century. At present it is made an object of study in institutions devoted to it alone, and is regulated by law in most civilized lands. Some of the most celebrated schools of pharmacy are found in the U. S., where men of great learning have contributed to elevate the standard of education of pharmacists, until the art is now sometimes erroneously spoken of as a profession. The intending pharmacist is instructed in chemistry, botany, physics, animal physiology, materia medica, toxicology, and pharmacology. The result of education and of cultivating the niceties of the art of pharmacy has been the preparation of many remedies, beautiful in appearance and pleasant to take, and at the same time of proper efficiency. The French pharmacists have unusual skill in the manufacture of what are known as elegant preparations. The U. S. is especially distinguished for what may be called neat pharmaceutical preparations.

The shop of the modern pharmacist is supplied with many things besides drugs, such as various surgical appliances, plasters, bandages, and even instruments, with many articles of convenience or of cosmetic usefulness. The enterprise of modern pharmacy secures, in the large cities, everything, no matter how rare, that is of approved value in the treatment of disease, and has led to the actual discovery of useful remedies. See APOTHECARY. CHARLES W. DULLES.

Pha'ros (in Gr. *Φάρος*): an island off Alexandria, in Egypt, celebrated for its lighthouse. Alexander the Great connected the island with Alexandria (a distance of 7 stadia) by a dike.

Pharyngobran'chii [Mod. Lat.; Gr. *φάρυγξ*, throat + *βράγχια*, gills]: a group of fish-like vertebrates, so named from the perforation of the pharynx for the gill-slits. It is equivalent to the class LEPTOCARDII (*q. v.*), which is the generally used term.

Pharyngog'nathi [Mod. Lat.: Gr. *φάρυγξ*, throat + *γνάθος*, jaw]: name applied to an artificial combination of fishes originally established by Johannes Müller for the reception of those teleosts in which the two lower pharyngeal bones form a single solid piece. The group thus distinguished was recognized as an order by Müller, and to it were referred some of the spiny-rayed fishes (*Labridæ*, *Cichlidæ*, *Embiotocidæ*), as well as some with soft rays (*Scomberesocidæ*). These forms have, however, on the one side no close affinity with each other, and on the other side they are severally related to other types in which the lower pharyngeals are separated; again, there are fishes of other families, as the drumfishes (*Aplodinotus* and *Pogonias*) among the *Sciænidæ*, which have the lower pharyngeals as much united as in the typical *Pharyngognathi* of Müller. On account of these inconsistencies the order, though formerly generally adopted, is now discarded by the best ichthyologists.

Revised by D. S. JORDAN.

Phar'ynx [Mod. Lat., from Gr. *φάρυγξ*, throat, pharynx]: a musculo-membranous sac situated at the base of the skull, immediately behind the mouth, nose, and larynx, and in front of the cervical vertebræ, extending as far down as the fifth, where it is continuous with the œsophagus. It has the following openings into it: Two from the nose, the posterior nares; two Eustachian tubes, which communicate with the middle ear; the mouth, larynx, and œsophagus. It is lined by mucous membrane, which is continuous with that lining the various cavities opening into it. Beneath this mucous coat is a fibrous layer known as the pharyngeal aponeurosis; and beneath this, again, is a muscular layer, composed of the superior, middle, and inferior constrictor muscles; they diminish the capacity of the pharynx, and by their successive contraction from above downward the food is carried along into the œsophagus. The pharynx is freely supplied with glands, which are situated in the mucous membrane, and there is considerable lymphoid tissue in various parts. This is similar in structure to the tonsil gland. The function of the pharynx is to give passage to the food in deglutition and to the air in respiration. The pharynx is a common seat of catarrhal inflammations, occurring acutely as "colds" or as more chronic affections. Those who smoke tobacco or drink strong alcoholic beverages, as well as those whose occupation requires public speaking and especially that in the open air, are liable to a peculiarly obstinate form of inflammation of the pharynx.

Revised by W. PEPPER.

Phascolomy'idæ [Mod. Lat., named from *Phasco'lomys*, the typical genus; Gr. *φάσκωλος*, pouch + *μῦς*, mouse]: a family of marsupial mammals containing the wombats (see WOMBAT), and distinguished by their rodent-like dentition. The body is stout and large; the head large; nostrils widely separated behind, but converging forward; upper lip cleft; dentition, I. $\frac{1}{1}$, P. M. $\frac{1}{1}$, M. $\frac{4}{4}$, all of which are rootless, more or less incurved, and grow upward, like the incisors of the placental rodents; the limbs are nearly equal, short and stout, and with five toes to a foot; anterior toes, with broad and little-curved nails; the innermost toe of hind foot small, at nearly right angles with the rest, and destitute of a nail; the second, third, and fourth toes are connected, and they, as well as the fifth, have long curved nails; tail rudimentary; stomach simple, with a special gland situated to the left of the cardiac orifice; cæcum short and wide, with a vermiform appendage. Revised by F. A. LUCAS.

Phasian'idæ [Mod. Lat., named from *Phasia'nus*, the typical genus, from Lat. *phasia'nus*, pheasant; cf. *Pha'sis*, name of a river in Colchis. See PHASIS]: a family of birds including most of the gallinaceous fowls. They all have the bill moderate, with the sides compressed, and with the culmen arched toward the tip, which is curved over the lower mandible; the wings are moderate and more or less rounded; the tail variable in development; the tarsi are robust, and covered with transverse scales in front, smaller ones behind, and still smaller ones on the sides, and in the cock generally armed with one or more spurs; the toes are moderate, three in front united at base by a slight membrane, and a hinder one short and elevated. The family has been made the subject of a beautiful monograph by D. G. Elliot. Revised by F. A. LUCAS.

Pha'sis [= Lat. = Gr. *Φᾶσις*]: the ancient name of the *Rion* or Faz river; in the Russian province of Transcaucasia; considered by the classical geographers as the boundary between Europe and Asia. The Argonauts were fabled to have landed at its mouth.

Pheasant [from Lat. *Phasianus* (sc. *avis*), the Phasian bird]: a name said to have been given by the ancients to the best-known species of pheasant (*Phasianus colchicus*), from the fact that it was brought from the vicinity of the river Phasis, in Colchis. It is now used as a general name for the long-tailed gallinaceous birds related to the common pheasant, and forming the sub-family *Phasianinæ*, and is extended to a number of other game-birds. In the U. S. it is applied to the ruffed grouse (*Bonasa umbellus*), in those sections of country where the quail (*Colinus*) is termed partridge. *Phasianus colchicus* originally inhabited Western Asia about the Caspian Sea, and Southeastern Europe, but it has been introduced in other localities, especially in England, and in the U. S. is very commonly known as the *English* pheasant. It is nearly 3 feet long, half of this being due to the tail. The plumage is rich and variegated. The head and neck are glossy green, the lower neck, breast, and sides reddish brown with a purple luster, the feathers being edged with black. The rump is coppery red, wings striped with brown and red, tail gray with black bands and brown edges. The female is smaller, of a general grayish brown, and she is shorter and without the long central tail feathers. These long feathers, so characteristic of the males of the true pheasants, reach their maximum in Reeve's pheasant (*P. reevesii*), in which they attain a length of over 5 feet. Two species of pheasants closely related to the common pheasant, the Mongolian pheasant (*P. torquatus*) and the green pheasant (*P. versicolor*), have been introduced into Oregon, as has also the beautiful golden pheasant (*Chrysolophus pictus*). The fire-back pheasants (*Euplocamus*) are so called on ac-

count of the glowing red upon the rump of the males of some species. To this genus belongs the Macartney pheasant, *E. ignitus*, of Siam. The impeyan pheasants (*Lophophorus*) are large birds of rich metallic colors, distinguished by their tails being flat and rounded instead of compressed and pointed. They inhabit the slopes of the Himalayas. The horned pheasants, or tragopans (*Ceriornis*), are distinguished by a little pointed wattle on either side of the head. Their general color is dull red with white spots, and they too dwell on the slopes of the Himalayas. Pheasants are ground-frequenting birds, and feed on grubs, insects, seeds, and grain. They are mostly polygamous, and the numerous eggs are deposited in a very rude nest. With the exception of *Phasianus colchicus* they are confined to Asia and some of the large adjacent islands, and Japan. A beautiful monograph of the group has been issued by D. G. Elliot, under the title *A Monograph of the Phasianidæ, or Family of Pheasants.* A more accessible work is Tegetmeier's *Pheasants: their Natural History and Practical Management.*

F. A. Lucas.

Phelps, Austin, D. D.: clergyman and author; b. at West Brookfield, Mass., Jan. 7, 1820; graduated at the University of Pennsylvania 1837; studied divinity at Andover and New Haven; was pastor of the Pine Street Congregational church, Boston, Mass., 1842–48, and was Bartlett Professor of Sacred Rhetoric in the Andover Theological Seminary 1848–79. He published *The Stilt Hour* (1859); *The New Birth* (1867); *The Theory of Preaching* (1881); *Men and Books* (1882); *My Portfolio* (1882); *Engtish Style in Public Discourse* (1883); *My Study* (1885); *My Note-book* (1890); and numerous articles in the religious journals. With Prof. Park and Dr. Lowell Mason he edited the *Sabbath Hymn-book* (1858). D. at Bar Harbor, Me., Oct. 13, 1890. See his *Life* by his daughter, Mrs. Ward (1891).

Revised by G. P. Fisher.

Phelps, Edward John: lawyer; b. in Vermont, July 11, 1822; graduated at Middlebury College in 1840; was at Yale Law School 1842–43; a lawyer in Vermont from 1844; second comptroller of the treasury 1851–53; member of Vermont constitutional convention 1870; Democratic candidate for Governor of Vermont 1880; became Kent Professor of Law in Yale College in 1881, and lecturer on constitutional law in Boston University in 1882. He was a Webster Whig till that party broke up, and then became an independent Democrat. He was U. S. minister to Great Britain 1885–89, and one of the counsel for the U. S. in the Bering Sea tribunal of arbitration in 1893. D. March 9, 1900.

Phelps, Elizabeth S.: See Ward, Elizabeth Stuart.

Phelps, Thomas Stowell: See the Appendix.

Phelps, William Walter, LL. D.: statesman; b. in New York city, Aug. 24, 1839; graduated at Yale College 1860 and at Columbia Law School 1863: member of Congress 1873–75; U. S. minister at Vienna 1881–82; again in Congress 1883–89; one of the U. S. commissioners to negotiate the Samoan treaty with Germany 1889; U. S. minister at Berlin 1889–93; appointed a judge of the New Jersey Court of Errors and Appeals 1893. D. at Teaneck, N. J., June 16, 1894.

Phenacetin: a drug which occurs in colorless needles, slightly soluble in water. Its general action on the system is almost identical with that of antipyrin and antifebrin, but it is thought by many physicians to be safer than those remedies. In nervous headaches and other nerve pains, in doses of 10 grains, it frequently affords great relief.

Phenakis'toscope: See Stroboscope.

Phenic Acid: See Phenol and Carbolic Acid.

Phenicin, or **Phenyl Brown**: a coloring-matter first prepared by Roth in 1865 by the action of nitrosulphuric acid on phenol (carbolic acid). It is a brown amorphous powder, slightly soluble in water, very soluble in alcohol, ether, and acetic acid. With alkalies it forms a fine violet-blue solution, which is changed to brown by the slightest excess of acid. It dissolves also in lime-water. It consists of two coloring-matters—one yellow dinitro-phenol, the other a black, humus-like body, both possessing the same tinctorial properties. Phenicin was at one time used for coloring leather, but it has given way to other dyes.

Revised by Ira Remsen.

Phe'nol ($C_6H_6O = C_6H_5OH$), **Phenic Acid**, **Carbolic Acid**, **Phenyl Hydrate**, **Phenylic Alcohol**, or **Coal-tar Creosote** [*phenol* is from Gr. *φαίνειν*, show, named from its yielding derivative colors]: a substance discovered in coal-tar by Runge, produced by the dry distillation of salicylic acid and a number of other substances. The urine of the cow, horse, and man yields it in small quantities. Commercial creosote often consists entirely of phenol, but the true creosote from wood is a totally different substance.

Preparation.—Phenol is prepared from coal-tar. The tar is separated by fractional distillation into (1) light oil of coal-tar, crude coal-tar naphtha; (2) heavy oil of coal-tar, "dead oil"; (3) anthracene oil; (4) pitch which remains in the still. From the light oil the phenol is most easily prepared. The oil is rectified by distilling with a current of steam, and leaves behind a portion known as naphtha tailings, which contain about 15 per cent. of phenol. From dead oil it is more difficult to obtain pure phenol, owing to the presence of much cresol. But the mixture of the two, which is better than pure phenol for disinfecting purposes, is readily obtained. Dead oil contains from a trace to perhaps 12 per cent. of the tar acids, phenol, cresol, etc., according to the part of the distillate it represents, the entire product of dead oil averaging about 5 per cent.

Properties.—Phenol occurs in long colorless needles or in white crystalline masses, sp. gr. 1·065, melts at 93°–95° F., and boils at 368°–370° F. The crystals deliquesce on exposure to the air by absorbing a trace of water. Phenol smells like wood-tar creosote, and attacks the skin like that substance. It dissolves in about 20 parts of water, and mixes in all proportions with alcohol, ether, and strong acetic acid. The aqueous solution of phenol coagulates albumen and preserves animal substances from decomposition. It even removes the fetid odor from meat which is already in a state of decomposition. Fish and leeches die when immersed in the aqueous solution, and their bodies subsequently dry up on exposure to air, without putrefying. These properties have led to the extensive use of phenol as an antiseptic and disinfectant. It is used in all grades of purities—dead oil for privy vaults, sewers, cattle-yards, and cars, and purer forms for street-gutters, cellars, water-closets, dwellings, clothing, etc. All grades except dead oil should be mixed with 20 to 50 parts of water before they are applied, or they may be mixed with dry slaked lime, sawdust, clay, etc., and applied in powder; the first-mentioned mixture is sold under the name of carbolate of lime. Many mixtures of carbolic acid are advertised as disinfectants which are practically worthless. A mere odor of phenol is not sufficient to prevent putrefaction. (See Disinfection and Fermentation.) Phenol is highly poisonous, except in an extremely dilute solution. The best antidote is olive oil, administered in large quantities. Sulphuric acid converts phenol into phenyl-sulphuric acid. Strong nitric acid converts it into trinitro-phenic acid, Picric Acid (*q. v.*), an important dye, $C_6H_3(NO_2)_3O$. On heating the soda compound of phenol in carbonic acid half the phenol distills off, leaving a sodic salicylate, which is now the source of the valuable salicylic acid. For phenol in its relations to medicine, see Carbolic Acid.

Revised by Ira Remsen.

Phenol Colors: an important class of artificial dyes derived from coal-tar. The most important are (1) Picric Acid (*q. v.*); (2) *dinitro-cresot*, known as *Victoria yettow*, *aniline yettow*, etc.; (3) *aurin*; (4) *rosotic acid* (the last two are described in the article Rosolic Acid); (5) *azutine*; (6) *phenicin*; (7) *pæonine*. The phenols combine with phthalic acid to form another class of colors, known as the phthalic-acid colors; and they also combine with azo-compounds. See Azo-colors.

Revised by Ira Remsen.

Phenology: See Climate.

Phenols: a class of compounds of which ordinary phenol is the best-known example. They are closely related to the alcohols. The latter are derived from the paraffins by the substitution of hydroxyl (OH) for hydrogen, while the phenols are derived from the aromatic hydrocarbons (see Hydrocarbons) in the same way. As benzene is the simplest of the aromatic hydrocarbons, so the substance called phenol is the simplest representative of the class to which it belongs. Its relation to benzene is shown by the formulas:

C_6H_6	$C_6H_5(OH)$
Benzene.	Phenol.

Cresol is derived from toluene in the same way that phenol is derived from benzene:

$C_6H_5.CH_3$	$C_6H_4<\begin{matrix}CH_3\\OH\end{matrix}$
Toluene.	Cresol.

There are phenols derived from the hydrocarbons by the substitution of two hydroxyl groups for two atoms of hydrogen. These are called di-acid phenols. Of these, hydroquinone, resorcin, and orcin are examples. Tri-acid phenols are derived from the aromatic hydrocarbons by the substitution of three hydroxyl groups for hydrogen. Pyrogallic acid is the best-known example of the tri-acid phenols. The phenols have a somewhat more acid character than the alcohols. This is shown by the ease with which they form salts when treated with strong bases such as sodium hydroxide, NaOH, potassium hydroxide, KOH, calcium hydroxide, $Ca(OH)_2$, etc. They readily undergo decomposition when treated with oxidizing agents, and, unless pure, they are slowly decomposed by contact with the air, the change being shown by change in color. IRA REMSEN.

Phenyl (C_6H_5): a univalent radical which exists in aniline, phenol, etc.

Phenylic Acid: See PHENOL.

Phe'ræ (in Gr. Φεραί): an ancient city of Thessaly; in a fertile plain near Mt. Pelion; 10 miles W. of its port; on the Pagasæan Gulf; on the site of the modern *Velestino*. Jason, son of Polyphron, succeeded to the throne of Pheræ in 378 B. C., and subdued the greater part of Thessaly up to Pharsalus. Pheræ now became a splendid and prosperous town, and under the government of the nephew of Jason, Alexander, who was notorious for his cruelty, it became the controlling power of the whole of Thessaly and played a conspicuous part in Greek politics. The treachery of Alexander induced the Thebans (see PELOPIDAS and EPAMINONDAS) to aid the oppressed Thessalians, and after the battle of Cynoscephalæ his dominion was again confined to the city and district of Pheræ. He was, nevertheless, still strong enough to land troops in Attica and plunder Piræus. In 358 B. C. Alexander was murdered, and in 352 B. C. Pheræ passed with the rest of Thessaly into the hands of Philip of Macedon. Revised by J. R. S. STERRETT.

Pherec'rates (in Gr. Φερεκράτης): poet of the Old Attic comedy, whose strength lay in his invention. A few fragments—one of considerable length—may be found in Meineke's and Kock's collections. B. L. G.

Pherecy'des (in Gr. Φερεκύδης) OF LEROS: a Greek logographer of the fifth century B. C. who lived in Athens. Of his great work on Greek mythology, often quoted by ancient writers, though under different titles, the existing fragments have been collected and edited by Müller, *Fragmenta Histor. Græcorum*, vol. i., 70–99, and vol. iv., 637–639. B. L. G.

Pherecydes OF SYROS: Greek philosopher of the sixth century B. C. He was considered by some the earliest Greek prose writer; was a rival of Thales and the teacher of Pythagoras. Of his work, which bears the mystic title Ἑπτάμυχος, and seems to have been a product of poetical intuition rather than of philosophical reasoning, some fragments are extant, and have been edited by Sturz (2d ed. 1824). See Ueberweg-Heintze, *Grundriss der Geschichte der Philosophie des Alterthums*, p. 31. B. L. G.

Phid'ias (in Gr. Φειδίας): the greatest sculptor of Greece; b. at Athens 500 B. C.; was taught by Hegias and Ageladas. His career as a sculptor (he gave but brief attention to painting) began under Cimon, but reached its glory under Pericles, with whose splendid epoch his name is indissolubly associated. He was a man of lofty soul, majestic intellect, consummate knowledge of the principles of his art, and wonderful skill in design. The buildings that crowned the Acropolis at Athens are believed to have been erected under his direction, and much of the work—how much can not be known—may be ascribed to his hand. The great statue of Athene in the Parthenon, of gold, ivory, and precious stones, was, there is little room for doubt, executed by him. It was finished 437 B. C. Later, he completed the colossal statue in gold and ivory of Zeus in the temple of Olympia at Elis. It sat enthroned in the temple for 800 years, and was finally destroyed by fire about 475 A. D. Of these works, which commanded the admiration of all Greece, and have given the master an immortal renown, nothing but the fame remains. The traditions concerning the life of Phidias are conflicting. That he met great changes of fortune from the fickleness of his countrymen, that he shared the popularity and the unpopularity of his patron, Pericles, was accused of crimes against the state, embezzlement, and even impiety, and imprisoned, may be believed. He is supposed to have had a long life, and to have died from poison about 432 B. C. See de Rouchand, *Phidias, sa vie et ses ouvrages* (Paris, 1861); Petersen, *Die Kunst des Pheidias*, etc. (Berlin, 1873); Waldstein, *Essays on the Art of Pheïdias* (Cambridge, 1885); Collignon, *Phidias* (Paris, 1886); Brunn, *Geschichte der Griechischen Künstler* (Brunswick, 1853; 2d ed. 1889), i., pp. 157–210; Overbeck, *Geschichte der Griechischen Plastik* (Leipzig, 1893), i., pp. 344–385; Mitchell, *History of Ancient Sculpture* (New York, 1888), i., pp. 299–364; Collignon, *Histoire de la Sculpture Grecque* (Paris, 1892), i., p. 517 ff.—vol. ii., which has not appeared in 1894, will continue the subject. Revised by J. R. S. STERRETT.

Phigali'a (in Gr. Φιγαλία): a city in the southwestern corner of Arcadia, near the frontier of Messenia, now Pavlitza. It was celebrated chiefly for the temple of Apollo Epicurius at Bassæ, on the top of Mt. Cotylium, some miles from Phigalia. The temple was built by Ictinus, one of the architects of the Parthenon, at Athens. Thirty-six columns and their architraves are still standing The frieze, made up of sculptures now called the Phigalian marbles, is in the British Museum. One half of it represents a battle of the Greeks and Amazons, the other half the struggle of the Centaurs and Lapiths. The sculptures are of almost the best style of early Greek art. See Stackelberg, *Der Apollotempel zu Bassæ* (1826); Donaldson, *Antiquities of Athens and other Places in Greece* (London, 1830), vo.. iv.; Cockerell, *The Temple of Jupiter Panhellenius and Apollo Epicurius at Bassæ* (London, 1860). See the histories of Greek art cited under PHIDIAS. Revised by J. R. S. STERRETT.

Philadelphia: See ALA SHEHR and AMMAN.

Philadelphia [from Gr. φιλαδελφία, brotherly love, deriv. of φιλάδελφος, loving one's brother; φίλος, friendly, loving (but for meaning, cf. φιλεῖν, to love) + ἀδελφός, brother]: city; coextensive with Philadelphia co., Pa.; on the west bank of the Delaware river, 103 miles from its mouth, on both banks of the Schuylkill river, which joins the Delaware near the city's southern boundary, and on the Penn., the Phila. and Reading, the Lehigh Valley, and the Balto. and Ohio railway systems; area, 129⅛ sq. miles: extreme length, 20 miles; extreme width, 10 miles; water frontage, 38 miles (for location, see map of Pennsylvania, ref. 6–J). It is the most important city in Pennsylvania, and the third city in population in the U. S.

Plan of the City.—The streets running N. and S. are numbered (as First, Second, Third, etc.) from the Delaware westward; these are crossed at right angles by streets running E. and W. that are named from trees and the counties and Governors of Pennsylvania, and a few main thoroughfares cross diagonally the square blocks thus formed. The principal streets are from 50 to 120 feet wide. The houses are numbered N. and S. from Market Street, and W. from the Delaware, 100 to the block or square, though the block or square may not contain 100 buildings. Numerous streams formerly flowed through the comparatively level land on which the older parts of the city stand. Dock Street shows the winding course of Dock creek. Others have been converted into sewers. The Poquessing, Pennypack, Wissinoming, Frankford, Gunner's, Cohocksink, Hollanders, and Bow creek empty into the Delaware, the Wissahickon and Mill creek into the Schuylkill.

On Dec. 31, 1900, there were 1,510 miles of streets, of which 1,090·62 miles were paved. The streets are lighted every night in the year by 8,569 arc lights, 20,174 gas lamps, and 13,966 gasoline lamps. Between 1855 and 1900 141·22 miles of main sewers and 670·24 miles of branches were constructed. Most of the main streets are traversed by trolley cars. The Schuylkill is spanned by bridges at Penrose and Gray's ferries, at South, Walnut, Chestnut, Market, and Callowhill Streets, and at Girard Avenue and the Falls of Schuylkill, and by seven railway bridges. The most beautiful bridge in the city limits is the stone one of the Reading Railroad over Wissahickon creek. Ninety-four per cent. of the water-supply is drawn from the Schuylkill, the rest from the Delaware. There are 6 pumping-stations and supplementary high service at Roxborough, Mt. Airy, Belmont, Chestnut Hill, and Wentzfarm, and 11 reservoirs and 2 tanks, also four stand pipes, with a total capacity of 1,417,966,400 gals. The police force numbers 2,779 men and 18 matrons. There are 34 station-houses, 10 sub-stations, 3 police tug-boats, and 31 patrol stations.

Public Buildings and Places of Interest.—Among the buildings of historic importance Independence Hall stands first. The Old Swede's church, Christ Episcopal church, where Bishop White preached, Washington worshiped, and Franklin and Robert Morris are buried; Carpenters' Hall,

PHILADELPHIA
SCALE
0 ¼ ½ ¾ 1 Mile
Railroads
Street Car Lines
VICINITY OF PHILADELPHIA
SCALE OF MILES
0 1 2 3 4 5
C
D
E
1
2
3
3
GERMANTOWN
NICETOWN
TIOGA
KENSINGTON
RICHMOND
FAIRMOUNT PARK
PENNSYLVANIA
NEW JERSEY
West Philadelphia
Camden
Hunting Park
Greenmount Cemetery
Cambria Reservoir
East Park Reservoir
Delaware R.
Schuylkill R.


Depots.
A. Balt. & Ohio R. R., C 5
B. Camden & Atl. R. R., Vine St. Fy., D 5
C. Cooper's Pt. (Camden) E 5
D. Market St., D 5
E. Federal St. (Camden) E 5
F. Penn. R. R., Broad St. Sta., C 5
G. Kensington Depot, D 4
D. Amboy Div., D 5
H. Phil. & Read. R.R., 9th & Green Sts., D 4
N. 12th and Market Streets, D 5
J. Broad and Callowhill Streets, C 5
K. Atlantic City Division, D 6
L. " " " E 6
M. Phil. Newtown & N. Y. R. R., D 3
E. West Jersey R. R. Sta., E 5
Hotels.
1. Aldine, C 5
5. Colonnade, C 5
6. Continental, D 5
8. Girard House, D 5
9. Lafayette Hotel, C 5
Prominent Institutions and Buildings.
13. Academy of Fine Arts, C 5
14. Academy of Natural Sciences, C 5
17. New Site for U. S. Mint, C 5
20. Blockley Almshouse, B 6
21. Carpenters' Hall, D 5
24. City Hall, C 5
25. Custom House, D 5
26. The Bourse, D 5
27. Drexel Building, D 5
28. Drexel Institute, B 5
29. Eastern Penitentiary, C 4
30. Fairmount Water Works, B 5
33. Girard College, C 4
35. Hahnemann Medical College, C 5
36. Independence Hall, D 5
37. Jefferson Medical College, D 5
41. Masonic Temple, C 5
43. Mercantile Library, D 5
44. Merchants' Exchange D 5
45. Moyamensing Prison, D 6
47. Naval Asylum, C 6
48. Pennsylvania Hospital, D 5
55. Philadelphia Library, C 5
58. Post-office, D 5
65. United States Mint, C 5
66. University of Pennsylvania, B 5
69. Young Men's Christian Ass'n, C 5
70. Zoological Garden, B 4
Prominent Churches.
71. Arch St. M. E., C 5
73. Bethany Presbyterian, C 6
74. Cathedral of St. Peter and St. Paul (R. C.), C 5
75. Christ Memorial, A 5
77. Christ Protestant Episcopal, D 5
85. Church of the Messiah, (Univ.), C 4
86. First Baptist, C 5
88. First Presbyterian, D 5
89. Grace Baptist, C 4
92. Old Swedes', D 6
99. St. James (Prot. Epis.), C 5
109. Tabernacle Presbyterian, B 5
WEST PHILADELPHIA
CAMDEN
HESTONVILLE
Woodland Cemetery
Penna. Hospital for the Insane
MARKET
A
B
C
D
5
6
7

in which the first continental congress met; the old building on South Street which was the first American theater; William Penn's house, which stood in Letitia Street and has been removed to Fairmount Park; St. Joseph's, Willing's Alley below Fourth, the scene of the pathetic meeting of Evangeline and Gabriel; Mt. Pleasant, the home of Benedict Arnold, in East Fairmount Park; the modest house at No. 239 Arch Street, where Betsy Ross made the first American flag for Washington; and the site of the house at Seventh and Market, where Jefferson wrote the Declaration of Independence, are a few of the city's possessions rich in historical associations. The principal Government buildings are the U. S. mint, the post-office, and the custom-house, Naval Asylum and Hospital, and two arsenals. Among the parks are Stenton, once the property of James Logan, and Bartram's Garden, the first botanical garden in America. The Schuylkill and the romantic Wissahickon, along the latter of which dwelt Kelpius, the mystic, and Henry Bernhard Koster, the Chiliast of the seventeenth century, flow through Fairmount Park. Included in Fairmount Park are the residence of John Penn, the last colonial governor; the estate of the witty Judge Peters, the Revolutionary Secretary of War, and the country-seat of Robert Morris. The Zoölogical Garden, of 33 acres, is on the west bank. In the lower Schuylkill section of the park are 500,000 trees and shrubs, including 3,400 forest trees, some of them 27 feet in circumference. Of flowering shrubs and flowers there are 500 genera and 700 varieties. The park contains one-sixth of all the known minerals of the U. S. Fifteen species of fish inhabit its waters, and 77 species of birds its woods and valleys. There are 50 miles of carriage drives, and 100 miles of byways and bridle-paths. Steamboats ply for 6 miles through the park on the Schuylkill, and the course for row-boats on the Wissahickon is 2 miles in length.

Among the more notable works of art are the equestrian statue of Washington, made for the Pennsylvania Society of the Cincinnati by Rudolph Siemering, costing $225,000; the Reynolds and McClellan statues in front of the city-hall; the statues of Gen. Meade, Lincoln, Grant, Garfield, and Jeanne d'Arc in Fairmount Park; and that of Benjamin Franklin at the post-office building. The Smith Memorial entrance, in memory of officers of the civil war, is now being erected in Fairmount Park at a cost of $500,000. The city-hall, at Broad and Market Streets, has cost $24,000,000. The tower, completed in 1894, is surmounted with a bronze statue of William Penn, 37 feet in height and 547 feet above the pavement. The length of the north and south front of the city-hall is 470 feet, and of the east and west front 486½ feet. The Masonic Temple is on North Broad Street, opposite the city-hall.

There are some fifty prominent clubs, among them the Philadelphia, founded in 1834, the Manufacturers', the Rittenhouse, the Union League, the Penn, the Art, the Sketch, the University, the Pen and Pencil (of newspaper-workers), the New Century (for women, whose drawing-room seats 600), and the United Service. The State in Schuylkill, founded in 1732, is said to be the oldest club in the world. There are over 50 hotels, and 18 theaters.

At the State penitentiary, on Fairmount Avenue, opened in 1829, the separate system of confinement was first introduced. Each prisoner works in his own room. The system has been adopted in several European countries. The Philadelphia Bourse, erected in 1894, at a cost of $2,000,000, is primarily intended as a place for the display and sale of everything made in Philadelphia's widely scattered mills and factories. The great hall is 250 feet by 125 feet. There are 400 offices, and a room 130 feet square for the exhibition of machinery with or without power. It has also all the conveniences of a great club-house.

The site of the navy-yard at League island, including nearly 1,000 acres, was presented to the U. S. Government by the city in 1862. There are many cemeteries, of which the best known is Laurel Hill, where many famous men are buried, including Dr. Kane, the Arctic explorer, Gen. Meade, and Gen. John C. Pemberton.

Educational Institutions.—Penn's plan of government provided for the erection of public schools and the encouragement of useful sciences and laudable inventions. In 1689 the William Penn Charter School, still one of the most flourishing in the city, was formally opened. The Assembly charter, granted in 1711, provided for the instruction of poor children in "reading, work, languages, arts, and sciences." In 1740 subscriptions were raised for a charity school, and the site was purchased in that year. On Feb. 1, 1749, the lot and buildings were conveyed to James Logan and twenty-three other trustees, the plan having been enlarged to include a college. This movement of 1740 was the beginning of the University of Pennsylvania. See PENNSYLVANIA, UNIVERSITY OF.

The medical colleges comprise the University, Jefferson, the Woman's, the Hahnemann, the Medico-Chirurgical, and the Philadelphia Polyclinic and College for Graduates. There are 3 colleges of dentistry, 1 of pharmacy, and one of veterinary surgery.

Philadelphia has over $16,000,000 invested in public-school property, and in 1901 the 428 public schools, taught by 3,700 teachers and maintained at an expense of $3,426,416, exclusive of $593,912 for permanent improvement, were attended by 155,000 pupils. At the head of the public-school system are the Boys' High School, the School of Commerce for Boys, the Girls' High School, the Girls' Normal School, the Commercial High School for Girls, and a School of Pedagogy. There are 2 manual-training schools, 2 schools of practice, an industrial art school, 13 cooking-schools, 13 grammar schools, 64 combined grammar and primary schools, 32 consolidated, 142 kindergartens, 147 primary, 84 night schools, 2 special schools for truant children, 5 vacation schools, and 70 summer playgrounds. One hundred and seventy-five prize scholarships are open to public-school students in the University of Pennsylvania, Bryn Mawr College, and other higher institutions. The Pennsylvania Institution for the Deaf and Dumb at Mt. Airy, the Asylum for the Blind, and the Pennsylvania Working Home for Blind Men are prominent local charities. The Academy of the Fine Arts, founded in 1805, is the oldest art institution in the country. The School of Design for women was founded in 1853. The Drexel Institute, founded by A. J. Drexel, imparts industrial education to both men and women. It was opened in 1891. The Pennsylvania Museum and School of Industrial Art was incorporated in 1876. Its valuable collection of fabrics, metals, curios, etc., has been maintained in Memorial Hall, the permanent building erected by Pennsylvania at the Centennial Exhibition of 1876. The Spring Garden Institute aims to cultivate the industrial side of art education. The Williamson Free School of Mechanical Trades, founded by I. V. Williamson, is near Media. Girard College, to found which Stephen Girard left about $7,000,000, in 1900 contained 1,510 orphan pupils, 114 officers and pupils, and 268 employees. The Temple College, with a faculty of 40 members and 3,000 students, has an evening department for the instruction of working-people at a nominal charge, and a day and afternoon department for all grades of scholars. The Wagner Free Institute of Science, begun in 1847 by Prof. William Wagner, has a lecture-room seating 640 people, a library of 7,500 volumes, a natural history museum, and provides free lectures on scientific subjects. The Franklin Institute was founded in 1824 for the promotion of the mechanic arts and manufactures. Its library contains 40,000 volumes, 25,000 pamphlets, 20,000 maps and charts, and 1,000 classified and catalogued photographs. The library is strictly scientific and technical in character. The institute maintains a drawing-school, publishes a monthly journal, and awards each year medals for meritorious discoveries and inventions. The American Philosophical Society, which was made famous in the eighteenth century among scientists by the attainments of Rittenhouse, the great astronomer, and with the general public by the more popular experiments of Franklin, and which included among its members Godfrey, the inventor of the mariner's quadrant, Mason and Dixon, who ran the boundary-line between Pennsylvania and Maryland, and many other celebrated men, was founded in 1743. Its reference library contains 50,000 volumes. There are over 100 libraries open to the public, the oldest being the Philadelphia Library, founded in 1731; its Ridgway branch, under the will of Dr. James Rush, received a legacy of $1,000,000. With the Philadelphia Library is the Loganian Library, begun in 1699, founded by James Logan, the secretary of Pennsylvania, who provided that the librarian should always be one of his male descendants, thus creating what is said to be the only hereditary office in the U. S. The Mercantile Library was founded in 1821. The library of the Carpenters Company was established in 1736, the Friends' Library in 1742. The city is rich in special and reference libraries, among the most important being those of the Pennsylvania Historical Society (30,000 volumes), the College of Physicians, the Law Library, the Hurst Free Law

Library, and the library of the Academy of Natural Sciences. The Apprentices' Library and that of the City Institute, the latter being the first free library in the city, are free. The Free Library of Philadelphia, founded in 1891, consists of a main library, which includes a department for children and a department for the blind, and fifteen branches which have been established in different parts of the city. It contains over 230,000 volumes, and its circulation during the year 1900 reached a total of 1,826,637 volumes, the largest attained by any library in the U. S., if not in the world. The Academy of Natural Sciences, founded in 1812, has the largest collection of shells in existence. Its ornithological cabinet holds 27,000 mounted specimens and 5,000 unmounted skins. Here are the Gould collection of Australian birds, the Bonaparte collection of European birds, and the Verreaux collection of African and Asiatic birds. In fossils, especially in invertebrates, the collections are particularly rich. The academy gives a scientific education to a number of young persons without charge. At the Historical Society are the most complete collection of colonial laws in the U. S., the Dreer collection of autograph letters, and a wealth of historical material.

The churches number 773; the Sunday-schools 682, with 18,376 teachers and 204,046 scholars. The first Sunday-school in the world, of which there is now a record, was conducted at Germantown. There are 72 hospitals and dispensaries. The oldest hospital in America is the Pennsylvania, founded in 1751. The Philadelphia City Hospital is the largest in the U. S. in capacity. Each of the great medical schools maintains a hospital, and most of the hospitals have training-schools for nurses. The Nurses' School of the Lying-in Charity, founded in 1828, is the oldest in America and the second oldest in the world. The Wills Eye Hospital was founded in 1832 for the relief of the poor. The Young Men's Christian Association is the third in the world in size and equipment.

The Municipal Government.—The municipal life of Philadelphia begins with the charter to William Penn of Mar. 4, 1681, and the government of the provincial council, the county court, and the grand jury. Under the proprietary charter of 1691, Humfrey Morrey became the first mayor. Penn in 1701, before his departure to England, granted a second proprietary charter to Philadelphia, and this lasted until the Revolution. From 1776 to 1789 the government of the city rested in the justices of the peace and the legislative commissions. In 1789 an act of the Legislature incorporated the city, which remained under this charter until 1854. During the greater part of this period the government was administered practically by the different committees of the city council, although at first an effort was made to concentrate power and responsibility in the executive. In 1854 the many outlying districts which previously had their separate governments were consolidated with the city, which became coterminous with the county. The old city had extended from Vine to South Streets, and from the Delaware to the Schuylkill. The charter created by the Bullitt Act of 1885 concentrates executive power in the mayor, elected for four years. He appoints a director of public safety, whose department includes the police, fire, electrical, health, building inspection, city property, and boiler inspection bureaus; a director of public works, whose department includes the bureaus of gas, highways, street-cleaning, lighting, surveys, and water; and a president and four directors of the department of charities and correction. The receiver of taxes and city solicitor are city officers elected in the spring for terms of three years. The city treasurer and city comptroller are county officers elected for three years in November, the city and the county of Philadelphia being identical geographically, but having a separate political existence. There are a central board of education, consisting of a representative from each ward, and local boards in the different wards. The sinking fund commission is composed of the mayor, city comptroller, and one member elected by the city councils. The park commission is composed of the mayor, the presidents of select and common councils, chiefs of the bureaus of surveys, water, and city property, and ten citizens appointed for five years by the judges of the common pleas courts. The public buildings commission, created by the Legislature in 1870, had charge of the erection of the new city-hall until 1901, when it was abolished, and the building placed in charge of the bureau of city property. The park commissioners have charge of Fairmount Park and Hunting Park. The other forty small parks of the city, of which twenty-five, with a total area of 86 acres, are improved, while the rest are used as children's play-grounds, are under the control of the bureau of city property of the department of public safety. The legislative branch of the city government is composed of the select and common councils. Each of the forty-one wards is represented by one select councilman elected for three years, and by common councilmen, the number varying in the different wards, elected for two years. There is one common councilman for every 2,000 names on the completed canvassers' list of the year in which the election is held. The judiciary consists of fifteen judges af the court of common pleas, four judges of the orphans court, and, in 1901, twenty-eight magistrates. The Supreme Court of the State sits for a large part of the year in the city-hall. The U. S. circuit and district courts sit in the post-office building. The city is represented in the Legislature by eight members of the State Senate and thirty-nine members of the House of Representatives. Philadelphia had in 1901 five representatives in Congress.

The assessed value of real estate, about two-thirds of the actual value, is $880,935,265. The tax-rate is $1.85 on every $100 of assessed valuation. The total city debt on Jan. 1, 1901, was $56,503,333, an increase during the year of $3,024,253; amount in the sinking fund, $17,708,125; cash in the treasury, $11,389,783; and taxes due and collectable, $2,601,264. These assets amounted to $28,527,055, leaving the total debt above cash assets, $27,976,278. The real estate owned by the city is appraised by the board of revision of taxes at $58,413,394. The total receipts for the year ending Dec. 31, 1900, were $32,972,187.51; expenditures, $30,628,246.25—excess of receipts, $2,343,941.26.

Banking and Insurance.—In 1900 there were 40 trust companies with a combined capital of $28,600,000, and deposits of $135,500,000. These companies afford facilities that in most cities are furnished by banks, and, with a capital larger than that of the banks, control most of the market for collateral loans. There are 35 national and 3 State banks with an aggregate capital of $20,131,000 and deposits of $125,349,000. There are 8 savings-banks with deposits of $77,566,286. The field for these institutions is limited on account of the great number of building and loan associations, 600 of which have offices in this city, have investments of $50,000,000, and receive annually $10,000,000.

There are 20 joint-stock fire and marine insurance companies, with a capital of $8,652,875, a surplus of $9,133,007, and total assets of $35,902,673. There are 3 life-insurance companies of more than local standing.

Manufactures.—The census returns of 1890 showed that 18,166 manufacturing establishments (representing 330 industries) reported. These had a combined capital of $375,249,715, employed 260,264 persons, paid $135,917,021 for wages and $311,645,804 for materials, and had products valued at $577,234,446. The minimum yearly products of all Philadelphia's manufactures have been estimated at $763,820,400, the number of distinct establishments at 22,500, and the number of employees at 350,000.

Ship-building.—In ship-building from 1710 to 1894 Philadelphia led all American cities. From 1781 to 1790 162 vessels aggregating 18,000 tons register were constructed in Philadelphia. From 1790 to 1812 New Bedford and Nantucket whalemen frequently had their vessels built at the Philadelphia yards. In 1790 John Fitch made regular trips between Philadelphia and Trenton with the first American steamboat. In 1794 Joshua Humphreys, a Philadelphia ship-builder, designed the Constellation, President, Constitution, and the Congress, and himself superintended the building of the United States at Philadelphia. The purchase by the East India Company in 1830 of two Philadelphia ships built for the China trade resulted in the closing of the British market to American-built ships. Cramp's ship-yard was founded in 1830, and there were then fourteen ship-building firms along the Delaware front of the city. Two of these are still in existence. In seventy-one years the Cramps built 282 ships for the public service. The new Atlantic liners and the Newark, New York, Columbia, Indiana, and Philadelphia, among other vessels of the new navy, were built at this yard. The company recently completed a cruiser for the Japanese navy, another for the Russian navy, and has made a contract to build still another for Turkey. The Russian battleship Retvizan is now in course of construction, as is also the battleship Maine and the cruisers Pennsylvania and Colorado for the U. S. navy. The Neafie and Levy yard has three destroyers

and two cruisers under construction for the U. S. navy. The New York Ship-Building Company in 1900 completed a large, modern yard at Camden, N. J., opposite Philadelphia, and has a number of important contracts for merchant ships. The application of electrical labor-saving devices has in this yard reached its highest development.

Commerce.—There are 7 steamship lines from Philadelphia to European ports, 5 to Jamaica and the West Indies, and 6 coastwise. The International Navigation Company, owner of the New York, the Paris, the Berlin, the Chester, the St. Louis, and the St. Paul, is capitalized and controlled in Philadelphia.

In 1753 Philadelphia exported 125,000 barrels of flour and 175,000 bush. of wheat. In 1793 its domestic exports were $7,000,000; in 1796, $17,500,000; in 1806, $31,000,000. In 1843 the exports had fallen to $2,300,000; in 1880 they reached $56,500,000. In 1900 the imports were $49,186,877; exports, $81,145,966. The immigrants arriving at the port were in the same year 16,516.

Railways.—The railway systems entering the city are the Pennsylvania, controlling 13,136 miles of road, of which 2,279 is Baltimore and Ohio, and 921 B. and O. Southwestern; the Philadelphia and Reading, 2,302 miles; the Lehigh Valley, 1,398 miles. The terminals of the Pennsylvania and the Reading railways, in the heart of the city and reached by elevated viaducts of brick, stone, and iron extending to the outskirts, are among the finest in the world. At the Broad Street and Camden stations of the Pennsylvania line an average of 631 trains and 54,111 passengers arrive and depart daily, and 230,391 trains and 19,750,508 passengers yearly. The terminal of the Pennsylvania Railroad extends on Broad Street from Market 306 feet to Filbert Street, and with the train-shed along Market and Filbert Streets westwardly for 812 feet. The train-shed has an arch of iron and glass with a clear span of 304 feet. The Reading terminal, at Market and Twelfth Streets, is of pink granite to the second floor, with pink-tinted brick and white terra-cotta above. It cost $10,000,000. Here and at the other Reading stations in the city 433 trains and 38,000 passengers arrive and depart daily. The Pennsylvania Railroad has stations in Philadelphia at which freight is received and distributed. Two grain elevators at Girard Point have a total capacity of 1,900,000 bush. The Philadelphia and Reading Railroad has 53 freight-stations in the city. The Port Richmond grain-elevator has a capacity of 1,500,000 bush.; another elevator at Washington Avenue has a capacity of 400,000 bush. At Port Richmond are the great coal-wharves of the Reading Company, and the great modern freight terminus. The coal-wharves of the Pennsylvania Company are at Greenwich Point. A short distance above the mouth of the Schuylkill, at Point Breeze, is the terminus of the pipe-lines of the Standard Oil Company, where tank steamers receive about 35 per cent. of all the oil exported from the U. S. The Schuylkill Canal, 108 miles, is controlled by the Reading Railroad. In 1894 city councils appropriated $10,000 for a preliminary survey of a ship-canal across New Jersey to the ocean.

Delaware River Improvements.—From 1836 to 1900 inclusive the Government appropriated $3,542,500 for the improvement of the channel of the Delaware river, and $3,935,000 for the harbor between Fisher's Point and Kaighn's Point, a distance of 5 miles. In 1894 Smith and Windmill islands were removed, as part of a plan to contract the Delaware river immediately in front of the city from a width of 2,400 feet to one of 1,900 feet by an extension of the wharves on the Philadelphia side to a length of from 500 to 600 feet, which would permit the widening of Delaware Avenue from 50 to 150 feet. To obtain the desired depth of 26 feet at mean low water and 32 feet at high water for a width of 1,000 feet from the harbor line, the excavation of 25,000,000 cubic yards of material and the expenditure of $3,500,000 were required. Councils have appropriated $685,000 for improving the river-channel below the harbor, and $1,500,000 for the widening of Delaware Avenue. The Girard estate also has a fund of about $1,000,000 available for the latter purpose.

History.—Queen Christina of Sweden in 1636 sent a little band of Swedish colonists to the village of Wiccaco, now a part of the city. An Indian town previously stood within the present city limits. In 1677 the Swedes erected a log church, which also served as a fort. In 1700 this was torn down and a brick structure erected on the site, known as the Old Swedes' church, which still stands in the southern part of the city on the banks of the Delaware. Services in the Swedish language were continued until 1818. The Dutch vessel Onrust, Capt. Hendrickson, explored the Delaware in 1623, and near New Castle the Dutch in 1651 built Fort Casimir, which was captured by the Swedes in 1654, retaken by the Dutch the same year, captured by the English in 1664, surrendered to the Dutch in 1673, and given over to the English by the treaty of 1674. William Penn's deputy governor and cousin, Capt. William Markham, arrived at Philadelphia in Oct., 1681, and Penn's commissioners in the early summer of 1682. Penn himself, with a large company of Friends or Quakers, reached New Castle on the Delaware on Oct. 27, 1682. The city of Philadelphia had been named, surveyed, platted, and the lots occupied by some settlers in July, 1682. The Dutch and German pioneers, who had been invited by Penn to remove to Pennsylvania, arrived at Philadelphia Oct. 6, 1683, and settled Germantown, now a ward of the city. This immigration is notable because four of the immigrants, Gerhard Hendricks, Dirk Op den Graeff, Francis Daniel Pastorius, and Abraham Op den Graeff, on Apr. 18, 1688, sent to the Friends' meeting the first public protest ever made in America against the holding of slaves; because in 1690 the first paper-mill in America was erected by William Rittinghuysen, a Dutch immigrant, where was made the paper used by William Bradford, the earliest printer in the middle colonies; and because Sower, the German printer of Germantown, printed in German three quarto editions of the Bible before an edition in English had been printed in America.

The principal political events of the colonial period were the attempts, extending over many years, to wrest the political control of the colony from the Quakers and Germans, and the contests between the Assembly and the proprietary interests. Benjamin Franklin was active in the efforts to alienate the Germans from the Quakers, but was himself defeated when a candidate for the Assembly. These political struggles had an important influence upon the attitude of the colony in the contest with Great Britain. The religious and civil liberty encouraged by Penn's government caused the Quakers and the Germans to feel a strong attachment to the proprietors, whose rights they saw would be imperiled by revolution. The leaders of society in Philadelphia were not clergymen, as in Massachusetts, but lawyers, like John Dickinson, who had received a thorough legal training at the Inns of Court in London, who had great respect for law, and who thought that the legal methods for settling the difficulties should be exhausted before force was resorted to. Opposition to the Stamp Act took form in 1765. The act of Parliament imposing duties upon paper and tea was resisted in 1768, and when in 1773 the news reached Philadelphia that the tea-ships were on their way, the people met in the State-house on Oct. 17, and adopted resolutions which were unanimously readopted by the Boston meeting on Nov. 5. The tea-ship Polly, Capt. Ayres, from London, anchored near Philadelphia two days after Christmas, but was not allowed to discharge her cargo. Carpenters' Hall was the meeting-place of the first Continental Congress of 1774, and the State-house that of the second Congress, which met May 2, 1775, and which, on July 2, 1776, agreed to the resolution declaring that the united colonies "are, and of right ought to be, free and independent States." On July 8 the Declaration of Independence was first publicly read by John Nixon from the platform of the observatory, which then stood in the square back of the hall, and the bell, now called the Liberty bell, in the State-house steeple fulfilled the prophecy of its inscription—"Proclaim liberty throughout the land unto all the inhabitants thereof."

The city was soon to become the center of stirring events. The battle-fields of Trenton, Brandywine, where more troops were engaged than on any other battle-field of the war, the scene of the attack upon and escape of Wayne at Paoli, where he occupied a perilous position by Washington's orders, and Valley Forge, are only an hour's ride from the city; while Germantown, where the losses were heavier than in any other battle of the war, is now a ward of Philadelphia. Lord Howe entered the city Sept. 26. The Congress had fled to York. Count Donop, with 2,500 men, was defeated at Red Bank by Col. Christopher Greene with one-sixth of that force Oct. 22, 1777. The British naval attack on the same day also ended in disaster. Fort Mifflin, on Mud island, after a gallant defense of six days, was abandoned on Oct. 16, by which time the earthworks had been leveled by the British fire. On Dec. 8 Howe declined a battle with Washington at Whitemarsh. The British evacuated Phila-

delphia in June, 1778, and Congress returned. The convention which framed the Constitution of the U. S. met at the State-house in May, 1787, and adjourned Sept. 18. Under the Constitution Philadelphia was the capital of the U. S. from 1790 to 1800, and in the building, still standing, at the southeast corner of Sixth and Chestnut Streets George Washington was inaugurated as President for a second term and John Adams and Thomas Jefferson as President and Vice-president.

On the invitation of the Pennsylvania Abolition Society a convention was held in Philadelphia Jan. 1, 1794, of delegates from the different abolition societies of the country. The nineteenth century was marked locally by the opening of the water-works Jan. 1, 1801; the completion of the Schuylkill Canal in 1825; the opening of the Germantown Railway in 1832; the lighting of the streets with gas Feb. 18, 1836; the abolition riots of 1834, 1835, and 1838; the burning of Pennsylvania Hall by a mob on May 17, 1838; the anti-Catholic riots of May and July, 1844; the civil war period; and the Centennial Exhibition from May 10 to Nov. 10, 1876, which was carried through entirely by Philadelphia capital, with the exception of a Government loan that was repaid in full.

Philadelphia's services to the Union cause during the civil war (1861–65) were important. One of her sons, Gen. George B. McClellan, organized the Army of the Potomac, and, with a brief interruption, commanded it from June 22, 1861, until Nov. 7, 1862. Another Philadelphian, Gen. George Gordon Meade, commanded it from June 28, 1863, a few days afterward winning the battle of Gettysburg, until the army was disbanded in 1865. Gen. Andrew A. Humphreys, a descendant of the designer of the famous vessels which won the brilliant naval victories on the sea in the war of 1812, was famous as chief of staff of the same army and as commander of the Second Corps at the time of Lee's surrender. Gen. David Bell Birney, another corps commander, was also a Philadelphian, and Admiral Porter, who at Fort Fisher commanded the largest armada the world had ever seen, was a native of a Philadelphia suburb. The city sent eighty regiments to the field. The Union Volunteer and Cooper Shop refreshment-saloons fed all the Union soldiers from the North and East, passing to the front and returning home, until the end of the war, the total number thus cared for being over 1,000,000. Philadelphia was the headquarters of the U. S. Christian Commission, which expended $2,524,512 in caring for the soldiers, and distributed stores valued at $2,953,767, besides Bibles, hymn-books, etc. The Sanitary Fair held in Logan Square in 1864 netted $1,080,000 for the sick and wounded soldiers. During the war the house of Jay Cooke & Co. placed $3,000,000,000 worth of Government securities without direct profit to the firm. In the Mexican war E. W. Clarke & Co. placed one-third of the war loan, Stephen Girard furnished the funds for the war of 1812, and Robert Morris was the financier of the Revolution. For a number of years the Bank of the United States, of which Nicholas Biddle was the head, was the center of the financial currents of the country, its position being destroyed when President Andrew Jackson vetoed the bill to recharter it, and ordered the removal of the Government deposits.

There are 16 daily newspapers, 99 weekly publications, 114 monthly, 7 fortnightly, 15 quarterly, and 7 bi-monthly periodicals. In the last quarter of the eighteenth century Robert Bell, one of whose clerks was Thomas Paine, introduced English literature to the people of the U. S., publishing *Rasselas*, Goldsmith's *Traveller* (1768), Robertson's *Charles V.* (3 vols., 1771), Blackstone's *Commentaries*; the poems of Milton and Thomson, and other standard works. For sixty years of the nineteenth century the Philadelphia magazines, from *The Portfolio* to *Graham's Magazine*, were the best in the U. S.

Population.—(1800) 65,787; (1820) 114,445; (1850) 360,305; (1870) 674,022; (1880) 847,170; (1890) 1,046,964; (1900) 1,293,697.

Authorities.—Westcott, *History of Philadelphia*; Allison and Penrose, *Philadelphia 1681–1887, a History of Municipal Development.*

Phi'lae [= Lat. = Gr. *αἱ Φίλαι*; Egypt. *P-alek*, the island of the end; Copt. *Pilak*, or *Pelak*; mod. *Jeziret Anas-el-Wojond*]: a sacred island in the Nile, a little S. of the first cataract (about 24° N. lat.), devoted principally to Isis and Osiris, who were worshiped here for seventy years after the edict of Theodosius, in 381 A. D., prohibiting the native cult. It was regarded as one of the graves of Osiris (*q. v.*), and was hence a resort of pious pilgrims. On its west side is located a large and irregular temple of Isis, built by Nectanebo II. and extended by the Ptolemies and the Roman emperors down to Diocletian. A small but exceedingly beautiful temple to Isis is also located on the east of the island. It was built by Nerva Trajanus, and is usually known as Pharaoh's Bed. Charles R. Gillett.

Philaret, Basil Drosdoff (*Vasily Drozdov*): Metropolitan of Moscow; b. at Kolomna, 63 miles S. S. E. of Moscow, Jan. 6, 1783; was educated in the theological seminary in Moscow; became tutor of the Greek and Latin languages; preacher in the Sergian monastery of Troizka 1806; entered the monastic life, and became archimandrite (1811), and later rector (1812) of the St. Petersburg Theological Academy; Bishop of Reval (1817), Archbishop of Tver and Yaroslav (1891), Metropolitan of Moscow 1821. D. in Moscow, Dec. 1, 1867. He was renowned as an orator, a theologian, and a statesman. He was learned and remarkably broad-minded. To him is attributed the emancipation of the serfs. He was the constant adviser of his sovereign, and the most venerated and beloved man in the Russian empire. His writings enjoyed the highest reputation, and one of them, his *Longer Catechism of the Orthodox Catholic Eastern Church* (rep. by Schaff, *Creeds*, ii., 445–542, in Blackmore's translation), was sent to all the Eastern patriarchs and unanimously approved by them, and since 1839 has been generally used in the Russian schools and churches. A selection of his sermons in English translation, with a short biography, appeared in London 1873. His greatest work was his history of the Russian Church (Moscow, 1850–59; German trans., 2 vols., Frankfort, 1872).

Samuel Macauley Jackson.

Philbrick, John Dudley, LL. D., D. C. L.: educator; b. at Deerfield, N. H., May 27, 1818; graduated at Dartmouth 1842; taught the next ten years in Boston; was principal of the State Normal School, and State superintendent of schools in Connecticut four years; superintendent of public schools in Boston 1857–74 and 1876–78; for ten years member of Massachusetts board of education, and its agent in 1875; president of State educational associations of Connecticut and Massachusetts and American Institute of Instruction, and National Teachers' Association; was editor of Connecticut *Common-school Journal* and *Massachusetts Teacher*; educational commissioner of Massachusetts to Vienna Exposition 1873, serving as member of international jury; U. S. commissioner of education and member of international jury at Paris 1878, receiving the decorations of the cross of the Legion of Honor and the gold palm of the University of France. He was the author of nearly fifty public-school reports of great value, and of *City School Systems in the United States* (U. S. Bureau of Education 1885), a comprehensive and valuable study. D. at Danvers, Mass., Feb. 2, 1886. Revised by C. H. Thurber.

Philel'pho, or **Filelfo**, Francesco: humanist; b. at Tolentino, Italy, July 25, 1398. Having studied at Padua, he was appointed professor at the age of eighteen. The next year (1417) he was invited to Venice to teach eloquence and moral philosophy. Here he remained two years, becoming a citizen of Venice and being treated with great respect. In 1419 he was appointed secretary to the Venetian consul-general (bailo) at Constantinople, and in 1420 he arrived there. He at once took up the study of Greek under John Chrysoloras, brother of the more famous Manuel (*q. v.*), and became a favorite at the imperial court. In 1427 he returned to accept the chair of Eloquence at Venice; but in 1428 we find him in Bologna, and in 1429 in Florence. In 1434, however, as a result of a bitter quarrel with the scholars of Florence and of rash participation in the intrigues against Cosimo de' Medici, he had to remove to Siena. After four years' residence here he was invited by Filippo Maria Visconti to Milan, where he was treated with great respect, and enabled to live in the luxurious and vainglorious fashion he loved. After the death of Filippo Maria (1447), however, and the seizure of Milan by Francesco Sforza, he found his position an uneasy one. At last, in 1474, he was tempted to accept a professorial chair at Rome. Things went badly here, and in 1476 he posted back to Milan. In 1481 he was called to the chair of Greek Literature in Florence, and died two weeks after his arrival there, July 31, 1481. He was conceited, jealous, passionate, and absolutely without principle. Yet he extorted from his contemporaries almost unbounded respect and admiration. He was perhaps the first modern to know Greek and Latin

equally well, and this knowledge seemed at the time almost a miracle. The works he has left, apart from his translations, have almost no interest beyond that attaching to the ingenuity of their scurrility. See *Francesci Philelfi Epistolarum Familiarum libri xxxvi.* (Venice, 1502); *Satyrarum Hecatosticha* (Venice, 1502); *Orationes Franc. Phil. cum quibusdam aliis eiusdem operibus* (Paris, 1515); É. Legrand, *Cent-dix lettres grecques de François Filelfe . . . d'après le Cod. Trivul. 873* (Paris, 1892); *Convivia Mediolanensia* (Spires, 1508); C. de Rosmini, *Vita di Franc. Filelfo* (3 vols., Milan, 1808); G. Voigt, *Die Wiederbelebung des klassischen Alterthums* (2d ed. 2 vols., Berlin, 1881).

A. R. Marsh.

Phile'mon (in Gr. Φιλήμων): Greek comic poet; b. at Syracuse, or at Soli, in Cilicia, about 361 B. C.; lived mostly in Athens, where he was a successful rival of Menander, but spent some time in Alexandria. D. at Athens in 262 B. C. The *Mercator* and *Trinummus* of Plautus are adapted from Philemon, and fragments of his plays are to be found in Meineke's and Kock's collections. B. L. G.

Philemon, Epistle of St. Paul to: a letter written at the same time as the Epistles to the Ephesians and Colossians. It is a private letter, begging forgiveness and acceptance as a brother beloved for a runaway servant, Onesimus, who had been converted through the apostle's teachings. It is stated by tradition that the letter was written from Rome. Others suppose Cæsarea was the place. One tradition makes St. Philemon a Bishop of Colossæ, and in the Roman missal he is commemorated on Nov. 22. See Pauline Epistles.

Phile'tas (in Gr. Φιλήτας): Greek grammarian and poet of the island of Cos; tutor of Ptolemy Philadelphus; master of Theocritus, teacher of Zenodotus. A great light in his day, and much admired by his imitator, Propertius. Scant fragments are given in Schneidewin's *Delectus* and Bergk's *Anthologia Lyrica*. See Couat, *La Poésie Alexandrine*, pp. 68–80. B. L. G.

Phil'idor, François André Danigan: composer and chess-player; b. at Dreux, Eure-et-Loire, France, Sept. 7, 1726; received his musical education in the royal chapel, afterward in Holland and Germany, where he resided from 1745 to 1754; composed between 1754 and 1774 a number of operas, comic and serious, which were well received; but became most famous as an unrivaled master of chess-playing. His book, *L'Analyse du Jeu des Échecs* (London, 1777), was for many years considered the code of the game. D. in London, Aug. 24, 1795. See Allen's *Life of Philidor* (Philadelphia, 1864).

Philip: the fourth called to the apostleship by Christ; b. at Bethsaida. He is often mentioned in the Gospels, especially by John (vi.; xii. 20–22; xiv. 8), but must not be confounded with Philip the Evangelist, mentioned in Acts vi., who had four virgin daughters who prophesied (Acts xxi. 8, 9). By the Fathers they are so confounded that it is impossible to separate them. Thus Theodoret reports (*Com. on Ps.* cxvi.) that he preached in Phrygia, which is likely; Clement of Alexandria (*Stromata*, iii., 6 [*Ante-Nicene Fathers*, ii., 390]) that he was married and had married daughters, which again is likely, but the statement may come from the confusion noted above; Eusebius (*Ch. His.*, iii., 31; Eng. trans., pp. 162–163) states that he died at Hierapolis, in Syria, but, as the context shows, he confounds him with the evangelist. His festival is celebrated by the Latin Church on May 1, by the Greek on Nov. 14. The *Acta Philippi* are apocryphal.—Philip the Evangelist was one of the seven deacons (Acts vi. 5); persecution drove him to Samaria, where he confounded Simon Magus (Acts viii. 5). He was instrumental in the conversion of the Ethiopian eunuch (viii. 2 *seq.*); afterward preached in Cæsarea (viii. 40), where Paul met him (Acts xxi. 8), and Greek Church legends make him Bishop of Tralles, in Lydia. Revised by S. M. Jackson.

Philip (in Gr. Φίλιππος): the name of five Macedonian kings, of whom two became very celebrated. Philip II. (359–336), b. at Pella in 382, a son of Amyntas II.; spent while a youth three years as a hostage at Thebes, in the house of Epaminondas, where he became familiar with Greek tactics and politics. When he ascended the throne Macedonia was attacked from two sides by external enemies, the Illyrians and the Athenians, and in the interior it was torn by four pretenders and their factions; but in less than two years the young king repelled the Illyrians, bought off the Athenians, defeated and killed the pretenders, and established himself firmly in the kingdom. He immediately began to work at the realization of his much-cherished plan, the acquisition of the supremacy over all Greece, and by his energy and shrewdness, his talents and unscrupulousness, he succeeded at last. He conquered Pydna and Methone, two Athenian possessions on the coast of Macedonia, the peninsula of Chalcidice, with the prosperous cities of Olynthus, Potidæa, Amphipolis, etc., all Athenian colonies or allies; and a part of Thrace, with the rich gold mines, and the town of Crenides, which soon became a flourishing city under the name of Philippi. In spite of Demosthenes's thundering against him, he achieved these conquests without occasioning any serious breach with Athens, for he understood how to bribe and how to deceive. Meanwhile he had also defeated the tyrant of Pheræ and reduced the whole of Thessaly, and during the two sacred wars in 346 and 339 he acquired a foothold in Greece proper, called in by the Greeks themselves—in the first case, by the Thebans against the Phocians; in the second, by the Amphictyonic Council against the Locrians. Alarmed at his successes, Athens made a coalition with Thebes and other Greek states against him, but he routed the allied army at Chæronea in 338, and after this victory became the master of Greece. By his admission as a member of the Amphictyonic Council shortly after the First Sacred war he and the Macedonians were recognized as belonging to the Greek nation, and by the congress at Corinth (in 337) he was chosen commander-in-chief of all the Greeks under a projected invasion of Persia; but the realization of this vast plan he had to leave to his son Alexander; during his preparations he was assassinated at Ægæ by Pausanias.—Under Philip V. (220–179), b. in 237, Macedonia relapsed into insignificance. He dreamt, like his subjects, only of the re-establishment of the empire of Alexander. His whole attention was taken up by the East, by Pergamus, Bithynia, Syria, etc., and meanwhile the danger arose from the West, from Rome, which already held possessions in Illyria. The offers of alliance which Hannibal made he treated slightingly, and the war with Rome, which began incidentally, the first Macedonian war (210–205), he carried on without energy, though generally successfully. In 200 the war began again, the second Macedonian war, in consequence of Philip's aggressive policy toward Pergamus and the Achæan association, now allies of Rome. The Macedonian army was completely routed by Titus Quintius Flamininus at Cynoscephalæ in 197, and the country reduced to a submissive ally of Rome, relinquishing all its conquests in Europe and Asia, surrendering its fleet, and paying a tribute. Revised by J. R. S. Sterrett.

Philip: the name of six kings of France. Philip I., b. 1052, son of Henry I. and a Russian princess, Anna, came to the throne in 1059, ruling at first jointly with his father, after whose death in 1060 Philip possessed the undivided sovereignty. In 1071 he married Bertha of Holland, by whom he had three children; but in 1091, having fallen in love with Bertrade of Montfort, the wife of the Count of Anjou, he repudiated the queen and married Bertrade, in spite of the vehement opposition of the Church. The Archbishop of Lyons, who was papal legate for France, excommunicated Philip and Bertrade at the Council of Autun, 1094, and in the following year, 1095, at the Council of Clermont, Pope Urban II. in person renewed the excommunication. Philip, however, continued to live with Bertrade, and after the death of Bertha the Church lost its principal argument against him. Nevertheless in 1100 the legates of Paschal II. compelled him to acknowledge his eldest son, Louis, as coregent, and from that time begins really the reign of Louis VI. D. July 29, 1108.—Philip II., Augustus, b. in Aug., 1165, son of Louis VII. and Alice of Champagne, ascended the throne Sept. 18, 1180, after the death of his father. His reign was eminently successful. In the controversies which took place between Henry II. of England and his sons Philip invariably took the part of the latter, and not without profit, though he afterward found among them his bitterest and most formidable enemy, Richard Cœur de Lion. Richard ascended the throne of England in 1189, and in the following year he and Philip joined in their famous crusade. They quarreled in the Holy Land, and Philip returned to France, stopping at Rome on his way to ask the pope to release him from the oath that he had taken not to attack Richard's possessions in his absence. The pope denied his request. Nevertheless, as soon as he heard of the imprisonment of Richard by the Emperor Henry VI., Philip made an alliance with John,

began the attack, and seized a portion of the English king's territories in France. After the liberation of Richard and his reconciliation with John, war broke out in which fortune decided now on this side and now on that; but at the death of Richard in 1199, Philip was the gainer, and, under John, England lost most of its remaining possessions in France. He was equally successful in his many controversies with Flanders, Brittany, etc., with the feudal lords of the realm, and with the clergy. He sent his ambassadors to the great Council of the Lateran in 1215, and he promised to give one-fourth of his revenues to a new crusade, but he absolutely refused to take any part in the war against the Albigenses. When Amaury of Montfort proposed to cede to him those domains in Languedoc which the Council of the Lateran had given to his father, he declined the offer, well knowing that by keeping aloof from this whole business, with its horrible crimes, the French crown could not fail finally to harvest the fruits. The general character of his government was decidedly aristocratic. The tribunal of the barons, which afterward played a conspicuous part in the history of France, was his creation, and, though he was very careful to make conspicuous distinctions between the king and the feudal lords, he sought and found his principal support among the latter. Nevertheless, few kings have done so much for the security and prosperity of the cities as he. A great number of places in France were provided with walls and other kinds of fortifications during his reign, and those works were generally executed at his expense. Paris especially owes much to his munificence. He gave its university—which already attracted not only the nobility of France, but also that of England and Germany—many privileges and a more independent position beside the Church. He continued the Cathedral of Notre Dame, which had been begun under Louis VII., and he built the churches of St. Sulpice, Ste. Geneviève, etc. He also laid the first foundation for the palace of the Louvre. D. July 14, 1223.—Philip III., b. Apr. 3, 1245, was second son of Louis IX. and Margaret of Provence, and became heir-apparent to the crown after the death of his older brother, Louis. He embarked on a crusade with his father, and followed him to Tunis, but he was stricken by the plague. Upon the death of his father he was immediately recognized as king, and after some minor battles he made peace with Tunis and returned to France. An armistice of ten years was established, all Christian slaves were liberated without ransom, freedom of worship was granted to the Christians, and 210,000 gold pieces were paid to France. The rest of his reign was quiet and peaceful. D. Oct. 5, 1285.—Philip IV., The Fair (1285–1314), b. in 1268, a son of Philip III., was an avaricious, haughty, and even cruel man, but courageous and eminently successful in extending the boundaries of France and consolidating the power of the crown. In order to procure money the king taxed the clergy. The pope, Boniface VIII., forbade the clergy to pay the tax, and the king answered by forbidding the exportation from France of money or other valuables, thereby cutting off one of the richest sources of the papal revenue. The pope sent a legate, who remonstrated in an insolent manner with the king, and the king threw the legate into prison. Philip now convoked the States-General, and having ascertained that the French people would stand by him even if he were excommunicated, he pursued his own course and confiscated the property of those prelates who sided with the pope. Meanwhile Boniface assembled a council at Rome and excommunicated the king, but a French army under William de Nogaret captured Rome and imprisoned the pope. In 1304, at the election of Clement V., the papal residence was transferred to Avignon, and for a long time the papal authority was merely a weapon in the hands of the French king. Clement V. also sold the Knights Templar to Philip IV., who treated them in a cruel and unjust manner, in order to get possession of their wealth. (See Templars.)—Philip V. (1316–22), the second son of Philip IV., based his claims to the throne on the Salic law. His brief reign was uneventful.—Philip VI. (1328–50), the founder of the house of Valois, b. in 1293, a son of Charles of Valois, brother to Philip the Fair; was first proclaimed regent of France on the death of Charles IV. in 1328, but when the queen-dowager, who was pregnant at the death of her husband, shortly after gave birth to a daughter, who, according to the Salic law, was excluded from the French throne, Philip assumed the royal dignity and was crowned at Rheims. Edward III. of England, a grandson of Philip the Fair, laid claim to the French throne, and when Philip undertook to support David Bruce of Scotland, the English king made an alliance with Flanders and declared war in 1337, thus opening that terrible contest between the French and English dynasties which lasted for 100 years, exhausted England, and devastated France. The two prominent events of the war during the reign of Philip VI. were the battle of Cressy (1346), in which the French army was totally routed, and the capture of Calais by the English (1347). In the following year the plague, the so-called Black Death, entered France and made fearful ravages: but in spite of all these calamities the king, who was bigoted and debauched, went on with his carousals, squandering the money which was extorted from the people by heavy taxes and ruinous government monopolies.

Revised by F. M. Colby.

Philip: the name of five kings of Spain, of whom two deserve a special notice.—Philip II., b. at Valladolid, May 21, 1527; succeeded his father, Charles V., in the Netherlands in 1555, and in the other possessions of the Spanish crown Jan. 16, 1556. Charles's attempts to procure for his son the imperial crown of Germany and the Austrian possessions had failed, and Philip's marriage with Queen Mary did not have the anticipated effect of making England the ally of Spain, but Philip II. was nevertheless, on his accession to the throne, the most powerful monarch of Europe. He ruled over Spain, its vast dominions in America, the East Indies and Africa, the two Sicilies, and Milan, Burgundy, and the Netherlands, to which in 1581 he added Portugal; and these countries were at that time the principal centers of European civilization and wealth. From his father's reign he inherited a war with France, the pope, and the Turkish sultan, who had made an alliance for the purpose of depriving the Spanish crown of its Italian possessions; but the Duke of Alva, Viceroy of Naples, drove the French out of Italy and compelled the pope to sue for peace under the walls of Rome, while the brilliant victories of St. Quentin and Gravelines, won by Egmont, enabled Philip to conclude an advantageous peace with France at Câteau-Cambrésis, Apr. 2, 1559. Nevertheless the forty years' reign which now followed was a period of decline. The countries under his scepter sank into degradation or rose in rebellion. On leaving the Netherlands he confirmed the political privileges of the provinces, but he refused to repeal his father's ordinances against heresies. On the contrary, he would enforce them, and immediately set to work to extirpate heresy in the Netherlands by means of the Inquisition. He met with energetic resistance, and the Duke of Alva was sent as governor to the country, with an army of Spanish veterans. Egmont, Horn, and other prominent men were executed and horrible cruelties perpetrated; but the result was just the opposite of that which had been expected. The resistance, instead of dying out, grew into a revolution, and under the organization and leadership of William of Orange the union of the seven provinces was formed at Utrecht in 1579, and a protracted war was carried on against Spain by land and sea. When Philip died Spain was exhausted, but the provinces were not reduced to obedience. In his wars against the Turks or the Mohammedans in general he gained a brilliant success by the battle of Lepanto, Oct. 7, 1571. After this victory it would have been possible to incorporate the northern coast of Africa into the political systems of the civilized world, and Don John of Austria entertained some such idea; but Philip felt a jealous distrust of his illustrious half-brother, and the situation of the Mediterranean pirates remained the same after the battle as it had been before. The destruction of the Invincible Armada was a mortification which he bore with dignity, but the unfortunate war against Henry IV. of France and the disadvantageous Peace of Vervins (May 2, 1598) he felt as a deep humiliation. After a lingering and painful disease he died in his palace of the Escorial in Sept., 1598, leaving Spain exhausted almost to prostration, with its industry, commerce, and other material resources greatly impaired and disturbed, and the proud, adventurous spirit of its people curbed by despotism and influenced by fanaticism. He was four times married—with Maria of Portugal, Mary of England, Elizabeth of France, and Anne of Austria. By his first wife he had a son, the unfortunate Don Carlos; by his fourth wife he had another, Philip, who succeeded him. (See Prescott, *History of Philip II.* (3 vols., 1856–59), and Motley, *Rise of the Dutch Republic* (3 vols., 1856).)—Philip V. (1701–46), the founder of the house of Bourbon in Spain, b. at Versailles, Dec. 19, 1683, the second son of the dauphin Louis, son of Louis XIV. by the Spanish princess

Maria Theresa; was declared heir to the Spanish throne by the will of Charles II., who died childless Nov. 1, 1700. There was, however, another claimant to the throne—Archduke Charles of Austria—and war began almost immediately. (See Succession Wars, Spanish.) By the Peace of Utrecht (1713) Philip retained the Spanish crown, but he was compelled to surrender his possessions in Italy and the Netherlands to Austria, and Gibraltar to England. He was indolent, weak-minded, and always controlled by his advisers. Under his first marriage, with Louisa Maria of Savoy, the Princess Orsini had the predominant influence; after his second marriage, in 1714, with Elizabeth Farnes of Parma, the queen, Cardinal Alberoni, the adventurer Ripperda, and others held the reins. The policy of the queen was concentrated on the acquisition of the former possessions of Spain in Italy for her sons, for which purpose Spain waged several wars. (See Succession Wars, Austrian.) Meanwhile the king became weaker and weaker. Jan. 10, 1724, he abdicated in favor of his eldest son, but as the young king died Sept. 6, 1724, Philip was persuaded to assume the government once more, though he had become almost idiotic. At last he would not leave his bed, and nothing would arouse him from his mental stupor but the songs of Farinelli. D. in Madrid, July 9, 1746.

Revised by F. M. Colby.

Philip, or **Metacom**, usually called **King Philip**: youngest son of Massasoit, sachem of the Pokanoket Indians of Massachusetts. Philip succeeded to the chieftainship on the death of his brother Alexander 1662, when he visited Plymouth and promised friendship to the colonists; but in 1675 he headed the war that is known by his name, and in which thirteen towns were destroyed and 600 colonists killed. Philip was killed at Mt. Hope Aug. 12, 1676, by a party under Capt. Benjamin Church, after his tribe had been nearly annihilated.

Philip, John W.: See the Appendix.

Philippeville: town (founded in 1838); in the province of Constantine, Algeria, on the Gulf of Stora (see map of Africa, ref. 1–D). It forms the port of Constantine, is well built, and has a fine harbor and large fishing, manufacturing, and trading interests. It is the seat of a bishopric. Pop. (1891) 21,962.

Philip'pi [Lat.; in Gr. *οἱ Φίλιπποι*; mod. *Filibi*]: an ancient town of Macedonia; built, or at least enlarged, by Philip, from whom it received its name. It became very famous as the place where the battle was fought in 42 B. C. between Brutus and Cassius on the one side, and Antony and Octavius on the other. Brutus and Cassius were totally routed. The apostle Paul founded a Christian church here (Epistle to the Philippians). J. R. S. Sterrett.

Philippians: See Pauline Epistles.

Philip'pics [from Gr. *Φιλιππικός*, pertaining to Philip, deriv. of *Φίλιππος*, Philip]: a name properly belonging to three splendid and spirited orations of Demosthenes against King Philip of Macedon. The first was delivered in 351 B. C., the second in 344, the third in 341. There is a fourth philippic, which is assigned by some to the year 340, and which is generally pronounced either a forgery or a patchwork. The fourteen orations of Cicero against Mark Antony are also called philippics. They were delivered in 44 and 43 B. C., mostly in the senate, but the second and severest and most famous was written and not delivered. The name is applied to any severe personal attack in speech or print.

Revised by B. L. Gildersleeve.

Phil'ippine Islands: See the Appendix.

Phil'ippins [from Philip Pustoswiät, one of their former leaders], or **Staroverski** (old-faith men): name of a sect of Russian origin settled since 1700 in East Prussia and Lithuania. They reject oaths and the priesthood, refuse to do military service, rebaptize all converts from other sects, and have a celibate eldership. They are peaceable and industrious citizens, but have at times fallen into wild, fanatical excesses. They cling persistently to the ancient liturgy of the Russian Church, which has been officially discountenanced for more than 200 years. The Philippins are a branch of the Raskolniks (*q. v.*).

Philippop'olis (Bulg. *Plovdiv*): chief city of Eastern Roumelia (South Bulgaria); picturesquely situated on five granite hills close to the Maritza in the middle of the great Roumelian plain (see map of Turkey, ref. 3–C). It is a center of trade in attar of roses, grain, tobacco, wool, and wine, and does an extensive banking business. The inhabitants are enterprising. Pop. (1890) 33,442. E. A. G.

Philippoteaux, fĕĕ'lĕĕ'pō'tō', Henri Emmanuel Félix: painter; b. in Paris, France, in 1815. He was a pupil of Léon Cogniet, and worked with him on the painting of the *Battle of Mount Tabor* for the Museum of Versailles. He adopted the historical and descriptive manner of painting, and his work, though not of very high rank as fine art, is of great interest as illustration. Late in life he painted several remarkable panoramas. D. Nov. 9, 1884. Of his important pictures there are in the South Kensington Museum *Before the Battle of Fontenoy* and the *English Squares at Waterloo*; at Versailles, *The Chevalier Bayard defending the Bridge at Garigliano. The Siege of Antwerp in 1832*, and the *Battle of Montebello, 1859*; at the Luxembourg, *Louis XV. on the Field of Fontenoy*; and in the Gallery of Marseilles, *The Last Banquet of the Girondins.* R. S.

Philips, Ambrose: poet; b. in Leicestershire, England, about 1671; educated at St. John's College, Cambridge, and graduated 1696; settled in London as a writer; was an associate of Steele, Addison, and their circle; wrote six *Pastorals*, which appeared in Tonson's *Poetical Miscellany* (1709) along with others by Pope—a circumstance which led to a bitter rivalry between the two poets; produced on the stage three tragedies, *The Distressed Mother* (1712), *The Briton*, and *Humphrey, Duke of Gloucester* (1721); began in 1718 the publication of a serial paper, *The Free-thinker*, which attained great popularity; became secretary to the primate and to the chancellor of Ireland 1726; was chosen a member of the Irish Parliament; became registrar to the prerogative court 1734; returned to London, where he published a collection of his poems, 1748. D. there June 8, 1749. Revised by H. A. Beers.

Philipsburg: borough; Centre co., Pa.; on the Moshannon river, and the Penn., the Beech Creek, and the Altoona and Philipsb. Connecting railways; 20 miles N. of Tyrone, 38 miles N. by E. of Altoona (for location, see map of Pennsylvania, ref. 4–E). It is the center of the bituminous coal region, has a large lumber trade, and contains a national bank with a capital of $50,000, a private bank, and a daily, a semi-weekly, and two weekly newspapers. Pop. (1880) 1,779; (1890) 3,245; (1900) 3,266.

Philip the Bold: Duke of Burgundy; b. Jan. 15, 1342, a son of John, King of France. He distinguished himself in the battle of Poitiers (1356), where he saved his father's life and received the surname of *Le Hardi*. Sept. 6, 1363, King John gave him, as a fief of the French crown, the duchy of Burgundy, which had become vacant by the extinction of the elder ducal line in 1361. Philip married Margaret of Flanders, heiress of Flanders, Artois, Rethel, and Nevers, and founded the younger ducal line, under which Burgundy became one of the most prominent powers of Western Europe. During the minority and subsequent insanity of Charles VI., Philip the Bold assumed the regency of France, which involved him in many feuds with his brother, the Duke of Anjou, and his nephew, the Duke of Orleans, but which he held to his death, Apr. 27, 1404.

Philip the Good: Duke of Burgundy; b. at Dijon, June 13, 1396, a grandson of Philip the Bold. He succeeded his father, John the Fearless, after his assassination on the bridge of Montereau in 1419, and married in 1424 Jacobæa of Holland, heiress of Holland, Brabant, Zealand, and the rest of the Low Countries. In order to avenge the murder of his father, which had been perpetrated at the instigation of the dauphin, afterward Charles VII., Philip allied himself closely with England, and acknowledged by the Treaty of Troyes (1420) the English king as the legitimate heir of the French crown after the death of Charles VI. The arrogance of the English, however, provoked him afterward to break the alliance, and in 1435 he concluded a separate peace with Charles VII. and aided him in expelling the English from France. He governed his extensive possessions with great wisdom, and, in spite of several risings in Ghent and Bruges, occasioned by heavy taxation, he was much loved by his subjects. D. at Bruges, June 15, 1467.

Philip the Magnanimous: landgrave of Hesse; b. in Marburg, Nov. 13, 1504; succeeded his father, William II., with his mother as regent, in 1509; married in 1523 a daughter of George the Bearded, Duke of Saxony. In 1531 he participated in the formation of the Smalcald League, and was subsequently one of its two leaders, the other being the elector John Frederick. In the battle of Mühlberg,

Apr. 24, 1547, the league was defeated by the Emperor Charles V., and Philip was retained as a captive until the treaty of peace was signed at Passau, Aug. 2, 1552, when he was released on payment of a large indemnity. He was secretly married in 1540 to Margaret von der Saale, his wife being alive at the time, and the assent of Luther and Melanchthon to the act caused great scandal. D. in Cassel, Mar. 31, 1567.

Philis'tines [from Lat. *Philisti'ni*, from Heb. *Pᵉlishthīm*, Philistines. See PALESTINE]: a people who occupied the southern seacoast of Palestine during most of the period of biblical history, and were almost constantly at war with the Israelites. The Old Testament speaks of them as immigrants into Palestine from the Egyptian region known later as Caphtor (Gen. x. 14; 1 Chron. i. 12; Amos ix. 7; Jer. xlvii. 4). Once, apparently, they are called Caphtorim (Deut. ii. 23). The immigration occurred early, as they were in or near the region in the time of Isaac (Gen. xxvi. 1, 8, 14, 15, 18), and probably earlier, in the time of Abraham (xxi. 32, 34). The accounts of the conquest under Joshua seem to imply that the region was then occupied partly by Philistine and partly by Canaanite communities (Josh. x. 29–34, 40, 41; xi. 16; xii. 11–15; xv. 11, 38–47, etc., compared with xi. 22; xiii. 2, 3).

In the phrase "whence the Philistines came out" (Gen. x. 14), the adverb denotes the region whence they came, not the race. The passage gives no indication as to whether the Philistines were Hamitic by race. Perhaps the evidence indicates that they were either Semites or Aryans who became thoroughly Semiticized in language. Some have tried to connect the twelve to fifteen names and titles we know as Philistine with Sanskrit and Greek, but a Semitic derivation fits better in every case. The ending *ath*, which is found in many names (Goliath, Achusath), is Egyptian, and indicates an emigration from Egypt. The land of the Philistines was the low plain called the *Shefelah*, and their superiority in the arts of war and in the possession of weapons several times enabled them to conquer the Israelites. The five chief cities of the Philistines, Gaza, Ashdod, Ashkelon, Gath, and Ekron, had their several princes, who were united in a confederacy. The chief divinities of the Philistines noticed in the Bible are Dagon, Ashtaroth, and Baal-Zebub. The Philistines shared the fate of the Israelites in successive subjection to Assyria, Babylon, and Egypt, and disappeared altogether from history previous to the Christian era. Revised by WILLIS J. BEECHER.

Phili'stus (in Gr. Φίλιστος): Greek historian; b. about 435 B. C.; was a general in the service of Dionysius the Elder and Dionysius the Younger, and wrote a history of Sicily from the beginning to 362 B. C., in which he showed practical sense and insight as well as groveling servility toward his masters. Thucydides was his model, and he imitated him in condensation of style, in the strictly chronological order of his narrative, and in the use of speeches; hence he was called by Cicero *pusillus Thucydides*. The fragments are to be found in Müller's *Fragmenta Historicorum Græcorum*, vol. i., pp. 185–192; iv., p. 639 foll.
B. L. GILDERSLEEVE.

Phillimore, JOHN GEORGE, LL. D.: b. in Oxfordshire, England, in 1809; educated at Westminster School and at Christ Church College, Oxford; called to the bar at Lincoln's Inn 1832; became an eminent jurist and (1851) queen's counsel and professor at the Middle Temple; M. P. 1852. Besides a number of pamphlets on legal topics, he wrote an *Introduction to the Study and History of the Roman Law* (London, 1848); *Private Law among the Romans*; *Principles and Maxims of Jurisprudence*; and began the publication of a history of England during the reign of George III. (vol. i., 1863). D. at Shiplake House, Oxfordshire, Apr. 27, 1865.—His brother, Sir ROBERT JOSEPH PHILLIMORE, D. C. L., b. in London, Nov. 5, 1810, graduated at Oxford in 1831. He also was a distinguished lawyer and writer; sat in Parliament 1853–57; and held the offices of judge-advocate-general (1871), judge of the arches court 1867–75, judge of the high court of admiralty 1867–83. He was made a baron in 1881. D. Feb. 4, 1885. His most important works are *Commentaries on International Law* (3d ed. 1879–89); *The Ecclesiastical Law of the Church of England* (1873; largely taken from Burn's *Ecclesiastical Law*); also, besides other works, the *Memoirs and Correspondence of George Lord Lyttelton from 1734–73* (1845). Most of his works were published under the name of Robert, or Sir Robert, Phillimore. Revised by F. STURGES ALLEN.

Phillips, ADELAIDE: singer; b. in Stratford-on-Avon, England, Oct. 26, 1833, and went with her parents to the U. S. in 1840. On Sept. 25, 1843, she made her first appearance in public in the Boston Museum in a part in *The Spoiled Child*, in which she sang and danced. In 1850 she was advised by Jenny Lind to cultivate her voice under Manuel Garcia, and the great singer herself headed the subscription list with her check for $1,000. On Dec. 17, 1854, Miss Phillips made her first appearance in opera in Milan as Rosina in *The Barber of Seville*. She returned to Boston in Aug., 1855, and sang in several English ballad-operas in that city. She made her *début* in Italian opera in New York, Mar. 17, 1856, as Azucena in *Il Trovatore*, and was successively re-engaged for five seasons in the Academy of Music. Then she went to Havana, Paris, Madrid, Barcelona, Hungary, and Holland, with success everywhere. From 1865 to 1868 she sang in California, New York, and Philadelphia. She was also a very much admired oratorio singer. She sang many times with the Boston Handel and Haydn Society, and also with other choral societies. Her last public appearance was in Cincinnati in Dec., 1881. Her health began to fail, and the next summer she went to Carlsbad, where she died, Oct. 3, 1882. Her remains were sent to Boston and interred at Marshfield. Her voice was a contralto of great compass (two and a half octaves) and remarkable quality. She left a sister, Mathilda, also a contralto singer, who had been educated by her. See *Adelaide Phillips, a Record*, by Mrs. Robert C. Waterson (Boston, 1883). D. E. HERVEY.

Phillips, CLAUDE: See the Appendix.

Phillips, GEORG: historian; b. in Königsberg, Germany, in 1804, of English Protestant parents; studied law at Berlin and Göttingen under Savigny and Eichhorn; was successively professor at Berlin, Innsbruck, and Vienna; became a Roman Catholic with his wife in 1828, and retired from teaching to live at Salzburg. The great epochs of the Middle Ages, the times of Charlemagne, Innocent III., and St. Louis, exercised a powerful charm over the mind of Phillips, who saw in them the highest flowering of Catholicism. He wrote much on the imperial and constitutional history of Germany, but he will be best remembered by his monumental work on canon law entitled *Das Kirchenrecht*, of which seven volumes (Manz, Regensburg) appeared from 1845 to 1872, in which year he died. The work has been taken up by Prof. Vering, of Prague, who printed in 1889 the first part of the eighth volume; a compendium of it exists in German and Latin for the use of seminaries. He was a man of very great erudition in mediæval matters, possessed a sure and sober judgment, and rigorously adhered to the historico-critical method in his great canonical work. See Adolph Tardif's *Histoire des sources du droit canonique* (Paris, 1887), p. 370. He co-operated with Görres and others in founding the *Historisch-politische Blätter*, a Roman Catholic monthly review of history and politics.
J. J. KEANE.

Phillips, HENRY: author; b. in Philadelphia, Pa., Sept. 6, 1838; educated at home and abroad, and admitted to the bar in Philadelphia, but did not practice law actively, because of delicate health. He became widely known, both in the U. S. and in Europe, as an authority on archæology, philology, and numismatics. He was a member of many scientific societies. He published *History of American Colonial Paper Currency* (Albany, 1865) and *History of American Continental Paper Money* (1866), the first works published on their subjects; *Pleasures of Numismatic Science* (Philadelphia, 1867); *Poems from the Spanish and German* (1878); *Faust*, from the German of Chamisso (1881); and four volumes of translations from Spanish, Hungarian, and German (1884–87). D. in Philadelphia, June 6, 1895.

Phillips, JOHN, LL. D.: benefactor; b. in Andover, Mass., Dec. 6, 1719; graduated at Harvard 1735; was for a time a preacher, but became a successful merchant of Exeter, N. H., where in 1781 he founded Phillips Exeter Academy at a cost of $134,000; gave $31,000 to Phillips Academy, Andover, besides liberal sums to Dartmouth College and Nassau Hall, New Jersey. D. at Exeter, N. H., Apr. 21, 1795.

Phillips, JOHN: geologist; b. in Marden, Wiltshire, England, Dec. 25, 1800; was a nephew and pupil of William Smith, called "the father of English geology"; became Professor of Geology in King's College, London, in the University of Dublin, and finally in the University of Oxford; and made important researches in geology, electricity, mag-

netism, astronomy, and meteorology; author of *Illustrations of the Geology of Yorkshire* (1829–36); *A Treatise on Geology* (2 vols., 1837–38), and other writings on geology. D. at Oxford, Apr. 24, 1874.

Phillips, John Arthur: See the Appendix.

Phillips, Wendell: orator and anti-slavery leader; b. in Boston, Mass., Nov. 29, 1811; the son of John Phillips, the first mayor of Boston; graduated at Harvard College in 1831 and at the Cambridge Law School in 1833, and was admitted to the Suffolk bar in 1834. When he entered upon his professional career the anti-slavery movement was attracting serious attention. In 1835 occurred the attack on William Lloyd Garrison by a Boston mob, and two years later the murder of Lovejoy, the editor of an anti-slavery newspaper in Alton, Ill. His sympathy with the Abolitionists was strengthened by these acts of violence, and at a meeting held in Boston to condemn Lovejoy's murder he delivered a speech of great fire and eloquence, condemning what he characterized as the cowardly spirit of those who would submit without protest to so gross a violation of the liberty of the press. From this time he was the foremost orator of the Abolitionists. He gave up his commission as a lawyer on the ground that he could no longer hold himself bound to obey the Constitution, which recognized the existence of slavery and protected the slaveholder in his rights. Refusing to accept money for his services, he devoted himself with unfailing energy to the advocacy of the anti-slavery cause, for which he maintained that even the disruption of the Union was not too high a price to pay. Believing that the war would lead to emancipation, he supported the North throughout the contest, and when that side triumphed he still continued as president of the Anti-Slavery Society his work on behalf of the Negroes, contending for their possession of equal civil rights with the whites. With the passage of the Fifteenth Amendment the Anti-Slavery Society found its objects attained, and it accordingly dissolved, but by this time Phillips's fame as an orator had won wide recognition, and he made frequent and much-applauded speeches on other topics. In addition to his anti-slavery championship he was an advocate of women's rights and a supporter of the temperance movement, and he occasionally lectured on subjects that had no relation to his aims as a reformer. A well-known lecture of this sort was that *On the Lost Arts*, which was very frequently repeated by him. He also lectured and wrote on financial subjects, and on the relations between capital and labor. He advocated prohibitory legislation in regard to the sale of liquors, maintaining that the attempt to govern great cities on the basis of universal suffrage had been a failure owing to the influence of the dram-shop. He urged that the national banks be deprived of the right to issue bills, and that the Government furnish all the national currency, separating it wholly from any coin basis, and let the currency rest solely on the credit of the Government. D. in Boston, Feb. 2, 1884. Revised by F. M. Colby.

Phillipsburg: city; Warren co., N. J.; on the Delaware river, and the Cent. of N. J., the Del., Lack. and West., the Lehigh Valley, and the Penn. railways; opposite Easton, Pa., 50 miles N. N. W. of Trenton (for location, see map of New Jersey, ref. 2–C). It is in an agricultural, iron-ore, and limestone region, and is noted for its extensive iron-works and their productions. There are six public-school buildings, public-school property (over $60,000), a national bank with capital of $200,000, and a daily and a weekly newspaper. Pop. (1880) 7,181; (1890) 8,644; (1900) 10,052.

Philoch'orus (in Gr. *Φιλόχορος*): the most important of the writers of special histories of Attica (*Ἀτθίδες*); flourished in the first half of the third century B. C. Fragments are in Müller's *Fragmenta Historicorum Græcorum*, vol. i., pp. 384–412, and iv., pp. 646–648. B. L. G.

Philocte'tes (in Gr. *Φιλοκτήτης*): in Grecian mythology, son of Pœas and Demonassa. He was educated in archery by Heracles, whose bow and arrows he inherited from his father, Pœas, who received them from Heracles, because he had set fire to the pyre of that hero. Philoctetes started to Troy with seven ships, but having been bitten on the island of Chryse by a snake sent by Hera because of the service rendered to Heracles, he was abandoned on the island of Lemnos by his fellows, who could not endure the stench of his wound and his agonized wailings. He lay on Lemnos for more than nine years, when he was brought to Troy by Odysseus and Diomedes, or Neoptolemus, because an oracle had declared that Troy could not be taken without the arrows of Heracles. He was healed by Machaon, killed Paris, and Troy was taken. See the tragedy of Sophocles entitled *Philoctetes*. J. R. S. Sterrett.

Philode'mus (in Gr. *Φιλόδημος*) of Gadara: Greek philosopher of the first century B. C., fragments of whose writings have been discovered at Herculaneum, some of them of great importance for our knowledge of the Epicurean school, to which Philodemus belonged. See Ritter and Preller, *Historia Philosophiæ* (1888), p. 447 foll.; Gomperz, *Philodem* (1891), and Sudhaus, *Philodemi volumina rhetorica*. A number of amatory epigrams by Philodemus are contained in the *Anthologia Palatina*.

Phi'lo Judæ'us [= Lat., liter., Philo the Jew]: theologian; b. at Alexandria about 20 B. C.; spent his whole life there, with the exception of two journeys he made—one to Jerusalem and one to Rome. Of his life very little is known. He was of a wealthy family, and occupied a conspicuous position in his native place. In the year 40 A. D. he was chosen a member of the embassy which the Jews sent to Rome to Caius Caligula. The embassy stayed in Rome over half a year without being admitted to the presence of the emperor; but during the reign of Claudius a learned defense of the Jews, written by Philo, was read in the Roman senate. The embassy he has described in his *Legatio ad Cajum*. In Alexandria he devoted all his time to study, and although as a philosopher he is without original genius, the peculiarity of his situation as mediator between Greek and Oriental wisdom, between Platonism and Judaism, between polytheism and monotheism, gave his writings a great influence in his own time, and makes them interesting to ours. He was a very religious man, and believed himself to be an orthodox Jew; but yet is the first representative of those of his countrymen who accommodated the faith of their ancestors to the new circumstances. His writings, which are in the Greek language, may be divided into three classes—those defending his countrymen, *Contra Flaccum*, *Legatio ad Cajum*, *De Nobilitate*; those interpreting and explaining the sacred books of the Jews, *De Opificio Mundi* (ed. L. Cohn, Breslau, 1889), *Legis Allegoriarum Libri III.*, *De Monarchia*, *De Præmiis Sacerdotum*, *De Posteritate Caini*, *De Cherubim*, *De Pœnitentia*; and those treating metaphysical subjects, *De Alternitate Mundi* (ed. F. Cumont, Berlin, 1891), *Quod Omnis Probus Liber*, *De Vita Contemplativa*. Of these three classes, the second and third are the most interesting with respect to his standpoint. His method of interpretation is the allegorical. The texts of the sacred books are not made subjects of positive criticism, but employed as opportunities for the development of theories. With him matter is an eternal principle. His idea of God is thoroughly monotheistic, but between God and matter he finds a convenient place for the ideas of Plato transformed into the angels of the Old Testament. These ideas, or powers, or angels form the medium through which God reveals himself to the world, and they are all gathered together in a divine world-spirit, a divine intellect, the *Logos*, which, however, in the speculation of Philo, remained a cosmic, naturalistic power without any real personality. D. about 50 A. D. The latest complete collection (8 vols.) was published at Leipzig in 1893. There is an English translation by C. D. Yonge in Bohn's Ecclesiastical Library (4 vols.). Cf. J. Drummond, *Philo Judæus, or the Alexandrian Philosophy in its Development and Completion* (2 vols., London, 1888). Revised by S. M. Jackson.

Philola'us (in Gr. *Φιλόλαος*): Pythagorean philosopher; contemporary of Socrates. The genuineness of the extensive fragments written in Doric dialect was maintained by Boeckh in his *Philolaus* (Berlin, 1829). See Ritter and Preller, *Historia Philosophiæ* (1888), p. 57 foll. B. L. G.

Philology: See Language and Comparative Philology.

Philome'le (in Gr. *Φιλομήλη*): in Grecian mythology, daughter of Pandion, King of Athens, and sister of Procne, the wife of the Thracian king Tereus, who lived at Daulis, in Phocis. Tereus loved Philomele, and having concealed Procne in the country that he might lie with Philomele when she came to visit her sister, he accomplished his purpose, and having cut out the tongue of Philomele, that she might not inform against him, he announced to Procne that her sister was dead; but Philomele, having discovered the truth, wove the story of her wrongs into a mantle and sent it to Procne. The two sisters then killed Itys, the son of Tereus by Procne, and served him up to Tereus for dinner. The sisters fled, Tereus pursued, and when he had

overtaken and was about to slay them, the gods, at the prayer of the sisters, turned all three into birds; Procne into the swallow, Philomele into the nightingale, and Tereus into the hoopoe. J. R. S. STERRETT.

Philopœ'men [= Lat. = Gr. *Φιλοποίμην*]: soldier and statesman; b. at Megalopolis, Arcadia, in 252 B. C., of a noble family; was carefully educated; distinguished himself greatly in the battle of Sellasia (221 B. C.) as leader of the horse; lived subsequently for several years in Crete, and was chosen commander-in-chief (*strategos*) of the Achæan League in 208 B. C., a position which he held eight times. It was his policy to put down rigorously all internal dissensions and feuds in order to deprive the Romans of any opportunity of interfering in Greek affairs; and although his plan was finally baffled by the fickleness of his countrymen and the meddlesomeness of the Roman senate, in details he achieved many brilliant successes; thus he compelled the Spartans to join the league, which was an important step toward the establishment of a united Greece. He was in Greek history the last character of an heroic cast. When the Messenians revolted against the league, he was seventy years old and sick in bed, but he rose immediately and put himself at the head of the army of the league. In the ensuing battle he was captured, and the hostile commander sent to him a cup of poisoned wine, which he drank (183 B. C.). J. R. S. STERRETT.

Philosophy [viâ O. Fr. from Lat. *philoso'phia* = Gr. *φιλοσοφία*, liter., love of wisdom; *φίλος*, loving + *σοφία*, wisdom]: a term the introduction of which is currently attributed to Pythagoras on the authority of Cicero (*Tusc.*, v., 3) and Diogenes Laertius (i., 12; viii., 8), but the oldest writer known to use it is Herodotus (i., 30). The Seven Wise Men of Greece were called *σοφισταί*, to denote their practical sagacity rather than their knowledge of science as such. Socrates, however, who left behind him no writings of his own, is said to have called himself a philosopher in order to reprove the Sophists of his time, he being only a seeker of wisdom—they, self-styled possessors of wisdom.

Definition.—Many noteworthy definitions of this science may be culled from its writers. While the Stoics made it include "a striving after virtue in the sciences—physics, ethics, and logic"—Epicurus declared it to be the rational pursuit of happiness. Plato had already designated philosophy as the acquisition of true knowledge (*ἐπιστήμη* = scientific knowledge), and Aristotle had defined it as the science of being as being (*τὸ ὂν ᾗ ὄν*). The relation of cause and effect furnishes the basis of the definitions of the earlier among modern philosophers (Descartes, Bacon, Hobbes, Leibnitz). Wolf returns substantially to the Aristotelian basis by defining it to be the science of possible existence in so far as possible, thus referring to the logical conditions of existence. Fichte makes it the science of sciences (*Wissenschaftslehre*); and this conception is very generally adopted, with slight modifications, by later thinkers. Whenever man attempts to refer all of his cognitions to one he begins to philosophize. Each nation's philosophy is an endeavor to solve the problems of the world, as they appear to it from the standpoint of its national life, by some one principle. This principle may be any cognition selected from the realm of nature or from that of mind. The systems of philosophy of a given nation or time may differ as to the one principle chosen as the explanatory one, but they are certain to agree in the elements of the problem to be solved. For the philosophy of a given epoch endeavors to state in ultimate terms the elements of the problems of its epoch. A philosophic solution of a problem consists in the reduction of the immediate and contradictory elements, as they are given in life, to the ultimate terms or expressions which indicate the universal and necessary conditions out of which those elements have arisen. Hence every philosophy has two factors: (1) The temporal and finite one, which includes the empirical elements to be explained—that is, the then present world of man and nature, which involves problems to be solved; (2) an eternal and infinite element, or the permanent and unchangeable ultimate idea through which the solution is wrought out and by which the temporal and finite is explained: this element is the conception of the absolute as it finds expression in the solution. Thus the different systems of philosophy start from different phases of life (because its phases, from one age to another, are perpetually changing), and yet they arrive at substantially the same result if they are complete systems. The difference, therefore, between the systems of philosophy of different peoples appertains rather to the empirical factor than to the character of the general terms in which the solution is expressed and contained. It has been pointed out (see GENERALIZATION) that in the most rudimentary form of knowing—i. e. in sense-perception—there is a synthesis of the two extremes of cognition: (1) The immediately conditioned content, which is the particular object as here and now perceived; (2) the accompanying perception of the self or Ego which perceives—that is, the activity of self-consciousness, the knowledge that it is I who am subject in this particular act of perception. Thus in sense-perception two objects are necessarily combined: (*a*) The particular object here and now presented; (*b*) the universal subject of all activity of perceiving. This universal subject, which is thus its own object in all forms of knowing, appears in two characters if we reflect upon it: (1) It is absolutely particular—i. e. present in this special moment now and here, and in this special act of perception; and (2) it is absolutely universal, retaining its self-identity under the constant change or flux which essentially belongs to the process of the immediate now and here, or present moment. The present now is a point in time, and thus has no duration except through the synthetical addition of past and future time, which *are* not, but either *were* or else *will be*. Thus such a thing as the perception of a permanent or a *relation of any sort* (for example, the one of identity or of difference, the most elementary and fundamental ones) can not take place without attention on the part of the subject who perceives to the perception of self or to the universal factor which is present in perception. This act of attention to self is reflection, self-perception entering all perceptions. The degree of the power of reflection or of attention to self-consciousness measures the ability to generalize or the ability to think; or, in other words, the strength of thought. For the minimum of this power of reflection admits barely the possibility of combining the perceptions of time-moments that are slightly separated, and hence its results are bare perceptions of identity or difference, without their quantity and quality. Sense-perception increases in richness of knowledge in proportion as the power of synthesis or of combining the successive elements of perception increases. And this power of combining such separate elements is contingent on the power of reflection or of attention to the self-activity in perception. Such reflection has been called "second intention," and is the condition of all generalization. Self-consciousness is therefore the basis of all knowledge; for all predication—from the emptiest assertion, "This is now," up to the richest statement involving the ultimate relation of the world to God as the highest principle—is possible only through a withdrawal of the mind out of the limiting conditions of the particular here and now by means of attention to its own activity, which, as already pointed out, comprehends the two phases of absolute particularity and absolute universal potentiality in one. This is the psychological basis of the general principle laid down regarding the identity of systems of philosophy and their phases of difference. The naïve state of mind of the uncultured human being, alike with the acute philosophical intellect or the intuition of the religious mystic, involves in all its activities and at every moment thereof this phase of attention to the self-activity or to the subject which knows. The naïve or non-philosophical stage of consciousness differs from the philosophical stage in the fact that the latter sets up some one of its cognitions as the highest principle, through which it attempts to explain the totality of said cognitions, while the former makes no such attempt. The philosophical activity of the mind is therefore a *third intention*, or act of attention which has for its object the reference of individual cognitions, whether particular or general, to an assumed supreme principle. This philosophical act, it is evident therefore, is a species of reflection different from that reflection which is implicit in all cognition. It is an act of withdrawal of the mind from immediate cognition, which arises through the first and second intention (or perception and reflection), and a concentration of the attention upon the relation of that immediate cognition (as existing in its separate details) to all cognition as totality. It is therefore systematic knowing. Moreover, as already suggested, it may posit as its supreme principle any one of its cognitions, taking, for example, an empty one lying close to the sensuous pole of cognition, or a concrete one lying close to the pure Ego. Thus it may make matter, or some form of matter, as water, air, fire, or ether, the philosophical principle which is to explain all things, being universal and

particular at the same time; or it may take for this purpose Reason (νοῦς), the Will, the Idea, the Good, *Causa sui*, the self-representing monad, or some form nearly approaching the pure Ego, for its principle; but the psychological presupposition underlying all philosophy, whether materialistic or spiritualistic, is the fact of withdrawal or abstraction of the mind from its first stage of cognition, and the contemplation of the same under the form of relation to a single principle—i. e. to an absolute totality. This contains the remarkable result that in this species of knowing the mind views its first principle, or the primitive existences by which it explains things as self-activities; which means that mind sees under its knowledge its own form as the ultimate truth of all. Take the standpoint of materialistic philosophy, for example: Matter is the ultimate principle, the whence and whither of all. Matter is thus posited as a universal which is the sole origin of all particular existences, and also the final goal of the same. Hence matter is active, giving rise to special existences, and also changing them into others with all the method and arrangement which we can see in natural laws. For matter must contain in it potentially all that comes from it. Hence matter is creative, causing to arise in its own general substance those particular limitations which constitute the differences and individuality of things. It is negative or destroyer in that it annuls the individuality of particular things, causing to vanish those limitations which separate or distinguish this thing from that other. Such a principle as this "matter" is assumed to be, which causes existences to arise from itself by its own activity upon itself and within itself, entirely unconditioned by any other existence or energy, is self-determination, and therefore analogous to that factor in sensuous knowing which was called the Ego or self-consciousness—an activity which is universal and devoid of form, and yet incessantly productive of forms, and destructive of the same. All this is implied in the theory of materialism, and exists there as separate ideas, only needing to be united by inferences; but "matter" as such idea is a cognition which arises only through reflection; it is perceived by "second intention," for first intention only refers or relates to immediate particular objects, and not to general objects like "matter," which is only a term for the persistent activity which recurs in the perception of whatever object it apprehends in time and space. As cognition of the mind, therefore, "matter" is a product of "second intention," but as philosophic principle it is more than this: it is this special cognition of matter posited as the absolute or as the totality and entirety of cognition, and hence not as limited through other particular cognitions, but as containing within itself a limiting power necessary for the particularization of other cognitions. Hence it is a pure Ego in so far as the possibility of all special ideas are concerned, and an active process so far as actual particular existence arises from it. Thus the position even of materialistic philosophy implies the thought of a totality which is purely universal, and a pure activity originating particular existences at the same time. Here we meet the most important distinction which belongs to the definition of philosophy. The degrees of consciousness are various, and differ through the completeness with which they grasp the determinations of the self-activity of the Ego. On the stage of philosophy consciousness grasps determination as a totality, and hence as self-determination; but this may happen in all shapes, from the emptiest up to the fullest and concretest. Even in materialism the attempt to explain the world through an ultimate principle indicates the certitude of the mind of the objectivity of its principle of self-determination, and it therefore implicitly asserts and presupposes that the truth of things is self-determination. Yet it may under this form so far contradict itself as to represent its content, "matter," to be a mere spatial existence, thinking under the term a vague abstraction as the origin of all immediate particularity and as the final cause thereof, without distinctly defining to itself these attributes as belonging to matter as highest principle. There are, then, various forms of philosophy, differing in the degree of completeness in which they consciously define their highest principle as the concrete Universal which originates the particular by its self-activity, and thus realizes itself in its own externality.

The distinction of philosophy from religion (which would be thought at first to be a reduction of all special beings to an absolute principle, God, in the same manner as defined for the province of philosophy) lies in the fact that while philosophy attempts to comprehend the totality of things through its absolute principle, religion *represents* its absolute in the historical relation of Creator of the world, and thus while it does subordinate all knowledge to one of its own principles, the mind in religion is not active in its third intention, but only in its first and second intentions. Religion offers its teaching to the lower and lowest stages, as well as to the highest stages of theoretical consciousness; for its revelation, although of the highest essence, is not immediately addressed to the theoretical reason, but rather to the Will. Hence it presents its absolute, not for assimilation, but for practical reconciliation with the individual. The relation of theosophy or mysticism to philosophy is here to be defined. Setting out from the standpoint of religion, and positing the absolute of religion as not only the principle of human action, but also of theoretical cognition, the religious mystic explains the world of nature and of history through it. This constitutes theosophy. It purports to arise through special illumination of the mind through the Absolute, and may be very profound and complete in its theory of things, but will of necessity use categories borrowed from religion, and consequently tinged with pictured representations, while philosophy uses its thoughts abstractly, and derives them from the activity of reflection.

The province of literature is to be distinguished from philosophy through the fact that its works seek an æsthetic unity of form, rather than a unity in the principle portrayed. It may happen, as in the poem of Lucretius, *De Rerum Natura*, that a philosophical treatise assumes an æsthetic form, but such form does harm to the requirements of scientific method. The essay and the literary criticism may offer profound reflections, but they are necessarily hampered through their form when it is literary rather than scientific.

The sciences, finally, are more difficult to distinguish from philosophy, especially the mental sciences. Indeed, philosophy is sometimes made synonymous with mental science, or with psychology. While religion agrees with philosophy in content (the relation of the Absolute to the world), it differs from it in form (employing the prineiple of faith or authority instead of logical necessity); the sciences, on the contrary, agree in form, but disagree in content. They treat of the systematic arrangement of materials within special provinces, rather than the reduction of the same to the first principle of all. The province of philosophy may include those of all special sciences, and even those of art and religion, jurisprudence and ethics, psychology and ethnology, in so far as those provinces are made elements of the problem of the universe to be solved by a first principle.

Method.—Philosophy alone can cognize methods, whether of other provinces of mental activity or of its own procedure. First and most obvious is the analytic method, which proceeds by resolution of a whole into its parts, and is a method of invention or discovery, inasmuch as it concentrates indefinitely the power of the mind upon a subject by attacking its details singly. This method is in philosophy what the microscope is in anatomy and kindred physical investigations. It proceeds from the vague to the distinct and clear. Then there is the synthetic method, which proceeds by combination or composition, and is a method of generalization or of principles—a method of explanation rather than of discovery. Besides these species of method, their union gives rise to higher species of method: (1) Deductive method, proceeding from the necessity of the whole to the necessity of the parts; (2) inductive method, proceeding from particulars contingently given to their necessary unity; (3) dialectic or genetic method, which by the analysis of its object discovers its essential dependence upon other objects and its unity with them; again, considering the new object, which has arisen synthetically through the discovery of dependence in the first object upon other objects, it discovers by analysis a new form of dependence, which leads to a new synthesis, etc. It is a method of ascent toward a first principle by the discovery of presuppositions, and by their addition to the object considered. It is contrasted by Plato (*Repub.*, bk. vi., ch. xiii.) with the mathematical method (that of simple deduction), as the method which removes its hypothesis (i. e. its first object) and ascends toward a first principle (ἐπ' αὐτὴν τὴν ἀρχήν), while geometry and the kindred sciences use fixed hypotheses (i. e. *assumed* first principles), and are unable to show their necessity as the dialectic method does by the discovery of presuppositions. The method of Aristotle is dialectic in the same sense as that of Plato, differing only in this, that he makes it more exhaust-

ive by laboriously collecting and discussing all the inadequate phrases that fall under each subject, exhibiting at last the true archetype or adequate realization of the species, as though he had empirically discovered it by careful investigation. The dialectic method contains the process of analysis in union with that of synthesis. Its analysis proves to be a synthesis because it reveals dependence, and hence the relation of the part to a whole. It must be present under all forms of necessary thinking, even when the thinker is unconscious of his method; as, in fact, he may be even of all method, and still think philosophically. The inductive and deductive methods, so called, unite analysis and synthesis also, but in the former the side of analysis is partly suppressed, in the latter that of synthesis. Again, the dialectic method is skeptical when it lays chief stress on its negative side, on that of the destruction of its hypothesis through the discovery of dependence, and speculative when it subordinates the negative phase to the total result, which is constructive of a more comprehensive and deeper thought —hence of a truer thought.

Classification.—(A) From the foregoing definition of philosophy it is evident (*a*) that there is one province of thought which belongs partly in the domain of philosophy and partly in that of religion—to wit, theosophy or mysticism. In it the dogma is partially rationalized, and therefore belongs to the realm of cognition instead of faith. Theosophy is the first form of philosophy, therefore, inasmuch as it makes its appearance as an outgrowth from religion, the effort being made to realize the content of religion as truth. (*b*) Thought perfectly independent from religion, and intent on constructing a rational view of the world and on reducing its common notions to consistency, may originate systems of materialism. This happens when it is not yet sufficiently disciplined to seize consciously its higher cognitions (those of the soul, for example) as first principles with which to explain the world; it therefore posits a cognition lying close to its ordinary experience and most familiar to it, as the explanation of all. (*c*) By continued reflection it gradually discovers what it has implied by endowing a principle with the power of originating all things, and comes to adopt, step by step, more spiritual principles until it reaches pure idealism and recognizes the world of sense-perception as phenomenal manifestation of absolute mind. This first series is founded on the "third intention of the mind" and constitutes dogmatic philosophy. (B) Above this standpoint begins the series of systems founded on perception of method (the fourth intention of the mind, making for its object the operations of the mind in its third intention, or ordinary philosophizing). (*a*) The first system founded on perception of method is skepticism, which breaks the link between subject and object, between the mind and the truth, by calling attention to the process or method of the mind in philosophizing, and exhibiting the modifying effect of mind upon truth. It shows that the activity of the mind enters and constitutes an element of truth, and therefore invalidates it. (*b*) The second system founded on the perception of method is the system of critical philosophy, giving to it the name which Kant gave his own system. On it is founded the third phase of philosophy which we may call Absolute Idealism, giving it the name given to its best type, the system of Hegel. (C) As the second phase of philosophy is skeptical when it perceives philosophic method only in glimpses, so when it comes to make an exhaustive study of method and to learn all of its possibilities, as in the critical philosophy of Kant and Fichte, then it arrives at the insight that the object of the third intention—namely, mind as the first principle or absolute, is also the presupposition of all psychological method. After this skepticism becomes impossible. This third phase of philosophy is founded on the fifth intention of the mind and perceives the positive side of method, and its necessary universality as principle of existence or as logical condition of the world. This last system is sometimes called pure science, science of ideas in and for themselves, ontological logic, science of knowledge, absolute idealism, etc. Examples of each of these five systems may be found in the subdivision *History of Philosophy*.

Departments.—The old division of Wolf makes four departments in philosophy: (*a*) Ontology, (*b*) rational psychology, (*c*) cosmology, (*d*) theology. This may be modified to meet the present development of philosophy thus: (*a*) Pure science or logic or methodology—dialectical discussion of general ideas; (*b*) science of nature, corresponding to rational cosmology; (*c*) science of spirit, including numerous subordinate spheres, such as (1) psychology, (2) ethics, (3) politics and history, (4) æsthetics, (5) theology (natural). This corresponds nearly to the division of the ancients into (*a*) dialectics, (*b*) physics, (*c*) ethics.

History of Philosophy.—The history of philosophy, according to the definition discussed in this article, will contain the record of all thinking which refers the manifold of experience to an ultimate principle; this explanatory principle being materialistic on the one hand in the elementary stages of thought, and idealistic in the more advanced stages, while it becomes a principle of method (or a principle at once ontological and psychological) in the highest thinking.

The Orient has generally been excluded from the domain of the history of philosophy, on the ground that its thinking is not emancipated from religious authority. Religion and philosophy are mingled in a species of theosophy in Asia, but are worthy of study as a phase of transition containing the embryonic shapes and metamorphoses that become fully developed and distinct in the literature, religion, and philosophy of the Western peoples. The Chinese systems of Lao Tsŭ (604 B. C.) and Confucius (550 B. C.) posit a first principle (called *Tao* by the former, and *Tai-ki* by the latter), an abstract indeterminate substance, whence arise masculine and feminine principles that beget all things.—The Indian caste system gives rise to limitations so irksome and galling that the great problem in Indian thought is emancipation; it seeks relief from the rigid particularity of the distinctions (tedious ceremonial observances) which it encounters in life, by flight to the indefinite, vague, and empty ground of substance of all things, and finds solid satisfaction in contemplating Brahm—i. e. the pure identity wherein neither caste-differences, nor the bewildering luxuriance of tropical nature, nor even the prolific creations of its own active fancy and teeming intellect, any longer find subsistence to vex and weary it. Besides the Saukhya or rational system, there are reckoned the Nyaya, or logical system of Gautama, and its modification in the atomic system of Kanada, called the Vaiseshika Philosophy: the Vedic system, full of mysticism, including the elder school of commentary called *Purva Mimansa*, founded by Jaimini, and a later one, called *Uttara Mimansa*, founded by Krishna Dwaipayana; but the philosophic principle is the same in all these, namely, the doctrine that the absolute is Pure Being devoid of all attributes, and that all phases of mind and matter are only illusion (Maya).—The philosophic standpoint of the Persian consciousness is considered to be an advance upon those just considered, in that it gives greater validity to the negative element—that of limitation or finitude, the principle of individuality or particularity. It posits a process, the conflict of light and darkness or of good and evil, the positive and negative, as the explanatory principle of the universe.—The worship of Hercules and of Adonis in Syria and of Osiris in Egypt indicates a progress over the standpoint of Zoroaster, in that the principle of particularity is still more highly prized. Purification through pain reconciles the finite and infinite, and it is not necessary to annihilate the former. Immortality of the individual becomes explicable, and the Egyptian mind is mostly occupied with this thought.—Western Asia (including Egypt) occupies itself with the problem of individuality and its essential inherence in the absolute. Its influence appears in the Ionic philosophy, particularly in the teachings of Anaximander and Heraclitus; in the Pythagorean philosophy; in Neoplatonism; in gnosticism; in the mysticism founded on the *Cabbala*; in the early Christological speculations of the Church; in Arabian mysticism.—The history of philosophy in the Occident, beginning with Greece, has to do with independent thinking, and is no longer obliged to seek its material in systems that are partly religious, partly ethical, and partly speculative. Greek philosophy begins with the Ionic school in Asia Minor, Thales, Anaximander, Anaximenes, and Heraclitus being its chief names. They set up material principles—(*a*) water, (*b*) the indefinite (matter), (*c*) air, and (*d*) fire—as the origin of things. Pythagoras, born in Ionia and taught in its school of philosophy, founded a society in Lower Italy, and proclaimed numerical harmony as his principle. The Eleatic school (also of Lower Italy) set up the principle of pure being, thus arriving for the first time at a principle entirely above and beyond experience, a principle seen only by pure thought acting *a priori*; it included Xenophanes, Parmenides, and Zeno. Empedocles of Sicily taught that love and hate are the ultimate principles, while Anaxagoras at Athens announced the important doctrine that Reason

(*νοῦς*) arranges and orders all things. Leucippus and Democritus of Thrace founded the atomic philosophy. The Sophists, of whom the most important were Protagoras, Gorgias, and Prodicus, discovered and applied the principles of ratiocination, or the dependence of conviction upon grounds or reasons. Socrates investigated universals, seeking ultimate grounds for conviction in order to establish moral principles on a firm basis. The *νοῦς* of Anaxagoras becomes with the Sophists individual reasoning—with Socrates, universal reason as conscience. Plato, continuing the investigation, finds the theoretical universals, the ideas or archetypes, antecedent to and dominant over the world of experience. Aristotle, finally, takes an empirical inventory of the world, and completes the demonstration that *νοῦς* is the principle of things in detail, being their final cause. He finds that all universals are phases of one universal Reason (*νοῦς ποιητικός*), which is the highest principle. His doctrine of first and second entelechies defines the relation of individuals to this absolute Reason and the grounds of the immortality of man. He maps out the paths of the several particular sciences, and makes important investigations in many of them. His pupils, Eudemus and Theophrastus, and his commentators, Alexander of Aphrodisias, Porphyry, Themistius, Simplicius, and, later, Avicenna and Averroës, deserve mention in any notice of Greek philosophy, however brief. The Stoic school of Zeno of Citium, whose system is ethical in its tendency, the school of Epicurus, whose system is an atomic materialism, belong to the decline of Greek philosophy. (This brief summary of the first phase of Greek philosophy may be supplemented by reference to special articles in this cyclopædia, such as Thales, Parmenides, Zeno of Elea, Heraclitus, Pythagoras, Sophists, Socrates, Plato, Aristotle, Stoics, Zeno the Stoic, Teleology, Form, Matter, Substance, Idea, Simplicius, Sextus Empiricus, and Lucretius.) The revival of Greek philosophy at Alexandria after the Christian era was occasioned by the contact of Greek thought with Orientalism. Alexandria was the focus or center for the East and the West. Neoplatonism, accordingly, is the struggle to define the relation of Greek thought to spiritual religion. Its distinguished names are Ammonius Saccas, Plotinus, the two Origens, Porphyry, Iamblichus, and Proclus. Its principle is the transcendence of the Deity, and it labors to explain how the world emanates from a primal One which is in nowise related to it, and is devoid of all antithesis, and therefore unthinkable. Boëthius, through his *Consolatio* and his translation of a portion of the *Organon*, and by his commentary on the *Isagoge* of Porphyry, transmitted almost all that was known of Greek philosophy by the Christians in the West for several centuries. (See articles on Plotinus, Porphyrius, Iamblichus, Proclus, Gnostics, Mysticism, and Philo Judæus.)—Within Christianity, Gnosticism arose in the second century as an attempt to construct a philosophy on a Christian basis. Philo had already speculated on the Logos. Valentinus made the *νοῦς* the "only-begotten" and the source of the Logos. Origen and Clement endeavored to assimilate some of the Gnostic doctrines. After the Council of Nice had given definition to the orthodox faith, more attention was given to the philosophic justification of its dogmas. Athanasius, Gregory of Nyssa, St. Augustine, Synesius, Æneas of Gaza, Philoponus, and the pseudo-Dionysius the Areopagite contributed to this work. In the ninth century it was the translation of the writings of the pseudo-Dionysius, evidently a Neoplatonist, by Scotus Erigena that gave rise to scholasticism. The controversy of nominalism and realism, in which Roscellinus, Anselm, Abelard, and William of Champeaux were the chief disputants, occupied the first period of scholasticism. The mastery of Aristotle and the refutation of the pantheistic commentary of Averroës were the chief business of the second period, in which appeared the great theologians Alexander of Hales, Bonaventura, Albertus Magnus, Thomas Aquinas, and Duns Scotus. Aristotle became the "*precursor Christi in naturalibus*," as John the Baptist "*in gratuitis*." Besides Averroës should be named Avicenna, Alfarabi, Alkendi, and Algazel among the Arabians, and Avicembron, Ben David, and Moses Maimonides among the Jewish philosophers. Roger Bacon and William of Occam did not follow the prevailing tendencies, the former being an experimenting physicist born before his time, and the latter an invincible opponent of the logical realism current. Nominalism under Occam destroyed the tendency to rationalize the dogma, and scholasticism went down altogether. (See articles on Scholasticism, Nominalists, Realism, Idealism, Immortality, Necessity, Occam, Duns Scotus, and Aquinas.) The fall of the Eastern empire brought many learned Greeks into the West, and kindled at Florence and elsewhere the direct study of Plato and Aristotle in the original Greek, whereas hitherto the interpretation of commentators had been generally accepted. Distinguished translators and new commentators, such as Ficino, Pomponatius, Scaliger, appeared. (See Ficino.) The naturalistic opponents of the traditional philosophy of the schools at this period, Nicolaus Cusanus, Jerome Cardan, Telesius, Patritius, and Ramus, prepared the way for an epoch of emancipation from authority, in which the leading spirits were Giordano Bruno, Francis Bacon, and René Descartes. The first of these attacked the ecclesiastical authority in matters of science; the second founded the empirical method of philosophizing; the third completed the emancipation from scholasticism by bringing the principles of philosophy to the test of consciousness and by discarding the authority of tradition. Thomas Hobbes applied Bacon's principle to politics; Geulincx and Malebranche explained the relation of mind and matter in the Cartesian dualism; Spinoza avoided the Cartesian dualism altogether by adopting the principle of One Substance with the two attributes, thought and extension. Locke attempted a critical survey of the powers of the mind to cognize truth, and found sense-perception and reflection to be the sources of all ideas. Berkeley drew from Locke's doctrine the inference that we know only ideas and not the external world. Cudworth, author of the *Intellectual System*, and Henry More the Platonist, Gassendi the atomist, Grotius and Puffendorf, writers on international law, Bayle the pantheist, are among the foremost thinkers of that time. Meister Eckhart, probably a pupil of Albertus Magnus, founded in the fourteenth century along the Rhine the most noteworthy school of theosophy yet known, and with his followers, Tauler, Heinrich Suso, John Ruysbroeck, and the author of *Theologia Germanica*, and Thomas à Kempis, exercised a most potent influence on the growth of thought in Germany and the rise of the spirit that produced the Protestant Reformation. Jacob Böhme, contemporary of Descartes and Lord Bacon, developed another system of theosophy nearly as remarkable as that of Eckhart, and in substantial agreement with it. With Leibnitz, theosophy becomes philosophy. His doctrines were systematized by Wolf, and held sway down to the time of Kant. In his *Monadology* he sets up in opposition to the mechanical system of Deseartes the doctrine of monads, which have no mechanical relation to each other, but only the ideal or psychological one of representing each other. David Hume is the point of departure for the chief systems of philosophy which have appeared during the past hundred years. His criticism on the idea of causality, reducing it to the mere "habit of surveying things constantly conjoined with each other," sapped the foundations of all dogmatic philosophy current at his time. La Mettrie, Voltaire, Rousseau, Condillac, Diderot, d'Alembert, Robinet (who anticipated Darwinism and the Spencerian "evolution"), and Von Holbach are noted thinkers in the same movement in France. Lessing began the struggle for literary independence in Germany, and Kant completed the reaction in philosophy and freed his country from its subservience to French ideas. The *Critique of Pure Reason* established on the ground of their universality and necessity the *a priori* character of causality and other categories, and demonstrated the self-activity of the mind in sense-perception. The *Critique of Practical Reason* showed that God, free will, and immortality are necessarily postulated by all acts of the individual as "regulative ideas"; hence these are the logical conditions of human action. These two *Critiques* rescued religion and morality, and the institutions founded on them, from the attacks of skepticism, but they denied the possibility of theoretical cognition in the realm of objective existence. This inability the later schools of German philosophy labored to remove. Fichte's *Science of Knowledge* showed in a systematic form the origin of the categories in the self-activity of the mind, and proved that the will is therefore presupposed everywhere as a conditioning factor in cognition. The sensuous factor of knowledge is accordingly subordinated, and the moral world is almost the only world that exists for Fichte. Schelling, however, reacts to the opposite extreme, and lays great stress on the evolution of unconscious organism in nature and human history. The central object of his system is therefore æsthetic art, wherein the unconscious reason reaches its completest expression. Schelling's school in-

cludes the distinguished theosophist Baader and the naturalists Oken, Carus, Oersted, Esenbeck, Steffens; the theologians Schleiermacher, Eschenmayer, Blasche, Görres; Schubert the cosmologist, Stahl the jurist, Solger and Ast, æsthetic writers; besides Krause, Troxler, Jacob Wagner, and others. Hegel, in opposition to Schelling's tendency to emphasize unconscious evolution, endeavored to grasp the content of nature and mind with self-conscious method. His "unity of thought and being" means that universal and necessary ideas, being the logical conditions of the world of experience, are as objective as they are subjective, any denial of this principle being self-contradictory, inasmuch as it assumes to pronounce *a priori* upon the objective possibility of existence—the very thing it repudiates. Hegel's philosophy, like that of Aristotle, takes an encyclopædic inventory of the world of nature and man, reconciling and interpreting all phases. The most eminent of the direct expounders of Hegel are Marheineke, J. Schulze, Gans, Von Henning, Hotho, Förster, Michelet, Rosenkranz, Weisse, Göschel, Erdmann, M. Carrière, K. Ph. Fischer, R. Eucken, and Kuno Fischer. All these expound with originality, and sometimes with important deviations.

According to the popular distinction of Strauss, there is a left wing which expounds the Hegelian system as a logical pantheism (panlogism); a right wing which expounds it in conformity with orthodoxy; a center which agrees substantially with the right wing, but introduces many modifications in technique and interpretation. The study of Hegel and of the Kantian movement in his direction has made its way into Great Britain through the original writings and translations of J. H. Stirling (*The Secret of Hegel*), J. Caird, of Glasgow, T. H. Green, E. Caird, and W. Wallace, of Oxford; and further by A. Seth, D. G. Ritchie, B. Bosanquet, E. S. Haldane, E. Wallace, R. Adamson, F. H. Bradley; into France especially through A. Vera, Ch. Benard; into Italy through A. Vera, B. Spaventa, R. Mariano; into the U. S. through the *Journal of Speculative Philosophy*, and the expositions and translations of J. Watson, C. C. Everett, E. Mulford, G. S. Morris, G. H. Howison, H. C. Brockmeyer, D. J. Snider, J. Royce, J. S. Kedney, J. Dewey, W. S. Hough, W. M. Bryant, J. M. Sterrett, R. A. Holland, N. M. Butler, J. G. Schurman, A. T. Ormond. A school has arisen in Germany which, starting from Hegel or Kant, approximates somewhat in methods the English and Scotch schools of empirical psychology. Its most eminent names are J. H. Fichte, Wirth, Zeller, Ulrici, Fr. Harms, Bona Meyer, Liebmann, Volkelt, J. Bergmann, J. Rehmke, W. Schuppe. A materialistic tendency appears in the writings of the "left" Hegelian wing, and becomes pronounced in Strauss, Feuerbach, and some others. Experimental psychology has recently taken new life from researches in anthropology, ethnology, folklore, child-study, hypnotism, spiritism, mind-reading, and other phases of "psychic research," and more especially through the discoveries in the physiology of the brain and nerves made since the success of Broca in fixing the location of the lesion producing aphasia in 1868. In England the names of Carpenter, Maudsley, D. Ferrier, Galton, Lubbock, Romanes, Sully, Spencer, Tylor, J. Ward, G. C. Robertson, A. Bain, are connected with one or another phase of this movement; in America the names of G. T. Ladd, W. James, G. S. Hall, J. M. Baldwin, J. B. Powell, L. F. Ward, G. Mallery, D. G. Brinton, J. Fiske, G. S. Fullerton, J. M. Cattell, E. B. Titchener, E. Barnes, C. L. Franklin, are most distinguished in the several departments of this study; in Italy the criminologist C. Lombroso is eminent; and in Germany, where the movement borrowed its methods, its literature is due to W. Wundt, Helmholtz, A. Horwics, G. T. Fechner, E. Dubois-Reymond, A. Schleicher, E. Haeckel, F. Brentano, H. Münsterberg, H. Ebbinghaus, C. Stumpf, H. Witte, T. Lipps, G. K. Uphues, M. Dessoir, and their colaborers; in France the hypnotic phenomena have received more attention than elsewhere, and the location of psychical activities in the brain has been investigated with much thoroughness. The writings of Th. Ribot, A. Binet, G. Tarde, Ch. Féré, are studied in both hemispheres. Herbart reproduced Leibnitz modified by ideas derived from Kant and Fichte. His school is prolific in distinguished writers, especially in the department of psychology as applied to philology and education. Prominent are the names of Drobisch, Beneke, Exner, Hartenstein, Lazarus, Steinthal, Waitz, Bonitz, Wittstein, A. Fouillée (in France). H. Lotze's system is almost eclectic, being founded on a criticism of the Herbartian system and the later Kantian systems. It has exercised much influence in the U. S. through the writings of B. P. Bowne, G. T. Ladd, and J. Cook. Trendelenburg's system is based chiefly on Aristotle and Kant, and represents a reaction against the logic of Hegel. Schopenhauer revived the Buddhistic system with great penetration and power of exposition, and with caustic criticism of his contemporaries. E. von Hartmann has added to its popularity by his writings, and Frauenstaedt has connected it with the "left-wing" interpretation of Hegel. Other disciples of Schopenhauer are Julius Bahnsen, K. Peters, P. Deussen, P. Mainlaender, the novelist Spielhagen, and the musician Richard Wagner. Italian philosophy counts Galluppi, Gioberti, Rosmini, Mamiani, and the Hegelians (at Naples), Vera, Spaventa, Mariano, Ragnisco. The writings of Rosmini have been translated into English by his disciples, W. Lockhart and T. Davidson, and expositions made of his ideas in psychology and metaphysics. Besides these, there is an active school of positivists in Italy represented by R. Ardigo, A. Angiulli, G. Cesca, G. Sergi, E. Lombroso, Morelli, and Caporali. In France, Laromiguière, Royer Collard, Maine de Biran, B. Constant, Victor Cousin, T. Jouffroy, P. Janet, C. de Rémusat, Saint-Hilaire, Emil Saisset, J. Simon, Ravaisson, represent the spiritual tendency, partly stimulated by the Scotch philosophy, partly by the scholastic traditions of the universities, and partly by the Kantian movement. Saint-Simon, Fourier, P. Leroux, represent the socialistic direction, and Comte and his disciples positivism. Comte has gained followers in all countries. In France, Blignières, Littré (lexicographer), P. Lafitte, many of the physiological psychologists, Taine, are eminent names in this school. In Great Britain Frederick Harrison is the leader of positivism. A reaction against the materialistic followers of Locke begun with V. de Bonald, Jos. de Maistre, and F. de Lamennais. Writers that should not be omitted in a list of French philosophers are J. Reynard, E. Vacherot, E. Carot, Claude Bernard (physiologist), J. M. Guyau, and especially C. Renouvier, whose writings show the influence of Kant. The Scotch school of Reid, Stewart, Brown, and Sir W. Hamilton begins with a reaction against Hume, and tends toward a modified Kantianism (in the system of Hamilton). Dr. McCosh (see McCosh, James) is a later representative. It has exerted a powerful influence in France and the U. S. The writings of Mansell furnished the foundations of Herbert Spencer's doctrine of the unknowable. The school of Locke and Hume has been represented in the nineteenth century by Stuart Mill, Lewes, and Spencer. All these, and especially Herbert Spencer, have exerted a powerful influence upon thinking minds engaged in natural science. German philosophy was introduced to the English-speaking world by Coleridge and Carlyle and later by J. H. Stirling, Jowett, Flint, T. H. Green, J. F. Ferrier, J. Caird and E. Caird. Shadworth Hodgson has criticised the Kantian doctrines of time and space. Whewell, De Morgan, Boole, Jevons, Venn, Bradley, and Whateley have written on logic, and H. Sidgwick, Leslie Stephen, and James Martineau have written on ethics. In the latest period there has arisen in Germany a movement which takes as its watchword "back to Kant." It counts among its leaders Fr. Paulsen, F. A. Lange, O. Liebmann, A. Krause, A. Classen, J. Folkelt, B. Erdmann, H. Vaihinger, H. Cohen, A. Stadler, P. Natorp, K. Lasswitz, and E. König. The following German writers on philosophy in various departments should be added to those already named: Laas, Riehl, and Avenarius as German positivists; A. Zeising, and K. Groos, writers on æsthetics; C. Sigwart, W. Schuppe, and J. Bergmann as writers on logic. American philosophy counts (*a*) in its theological school the names of Edwards, Dwight, Taylor, Tappan, Finney, W. E. Channing, D. D. Whedon; (*b*) in its transcendentalist school, chiefly founded at first on Platonism and the Coleridge version of Kantianism, and later on influenced by French eclecticism, Fichte, and other Germans, Marsh, Emerson, Margaret Fuller, A. B. Alcott, Theodore Parker, J. F. Clarke, George Ripley, O. A. Brownson (who afterward became a Thomist), F. H. Hedge, and H. D. Thoreau; (*c*) in its psychological school (following the Scotch school or the French eclectics), N. Porter, F. Bowen, A. Mahan; (*d*) in its school based on the study of Kant or his successors, L. P. Hickok, C. C. Everett, J. B. Stallo, and nearly all the present teachers of philosophy in the colleges of the U. S. Most of those who have contributed to philosophy by their writings have been mentioned in other connections. (See articles on Idealism, Identity, Knowledge, Reason, Sensationalism, Transcendentalism, Understanding, Descartes, Spinoza, Malebranche, Bacon (Francis), Locke, Leibnitz, Hobbes, Hume, Kant, Fichte, Schelling,

Hegel, Schleiermacher, Schopenhauer, Herbart, Mill, J. S., and Spencer, Herbert. Consult also, on the general problems recurring in the history of philosophy, Generalization, Infinite, Mind, Moral Philosophy, Psychology, Scepticism, Soul, Thought, and Will.) The chief historians of philosophy are Stanley, Bayle, Brucker, Tiedemann, Buhle, Tennemann, Reinhold, Ritter, Hegel, Schwegler, Erdmann, Ueberweg, Cousin, Lewes, Zeller, K. Fischer, L. Ferri, E. Zeller, R. Falckenberg, W. Windelband, Ludwig Noach (*Philosophisches-Geschichtliches Lexikon*). Recent periodicals devoted to speculative philosophy are *Zeitschrift für Phil. und philosophisch. Kritik* (at Halle); *Phil. Monatshefte* (at Berlin); *Die Neue Zeit* (at Prague); *La Filosofia delle Scuole Italiane* (now *Rivista Italiana di filosofia* (at Rome); *Mind, a Quarterly Review of Psychology and Philosophy* (at London); *Revue philosophique de la France et de l'Étranger* (at Paris); *Journal of Speculative Philosophy* (New York); *The Monist* (Chicago); *International Journal of Ethics* (Philadelphia); *The Philosophical Review* (Ithaca, N. Y.); *American Journal of Psychology* (Worcester); *The American Anthropologist* (Washington); *Journal of American Folk-lore* (Boston); *Philosophisches Jahrbuch* (Fulda); *Vierteljahrsschrift für Wissenschaftliche Philosophie* (Leipzig); *Psychological Review* (New York); *The Platonist* (Osceola, Mo.); *The Journal of the American Akademe* (Jacksonville, Ill.); *Rivista Filosofica Scientifica* and *La Nuova Scienza* (organs respectively of Signor Morelli and Signor Caporali, Italian positivists); *Revue de Hypnotisme* (Paris). W. T. Harris.

Philosophy, Moral: See Moral Philosophy.

Philosophy of the Conditioned: See Conditioned, Philosophy of the.

Philos'tratus (in Gr. Φιλόστρατος): a name borne by four Greek sophists of the same family of Lemnos: 1. The eldest Philostratus, son of Verus, lived under Nero and wrote the dialogue of that name (Νέρων), preserved among the writings of Lucian. 2. The next, Flavius Philostratus the elder, a descendant of Verus, flourished under Alexander Severus (222–235 A. D.), and composed, among other things, the *Lives of the Sophists* (Βίοι Σοφιστῶν) and a remarkable romance, *The Life of Apollonius of Tyana* (see Apollonius of Tyana), much used as an offset to the life of our Saviour. 3. The third Philostratus, son-in-law of Philostratus II., wrote a series of descriptions of paintings; and 4. A fourth Philostratus wrote a second series in imitation of the first. Whether and how far these descriptions deal with real works of art is disputed. The works of these various Philostrati are of great importance for an appreciation of the periods to which they belong. There is a text edition of all the works by Kayser, in the Teubner Library (2 vols., 1849), and a separate edition of the *Vitæ Sophistarum*, with a copious commentary by the same scholar (Heidelberg, 1838). A new edition of the *Imagines* of the elder Philostratus was published by the members of the Vienna Seminary in 1893.

B. L. Gildersleeve.

Philox'enus (in Gr. Φιλόξενος): Greek dithyrambic poet (435–380 B. C.) of Cythera; lived long at the court of Dionysius the Elder, about whose poetical performances he used great plainness of speech. One of his dithyrambs suggested the *Cyclops* of Theocritus. Fragments of another, *The Banquet*, are interesting for their rhythmical form and for the account they give of the luxury of the Sicilian table, and are to be found in Bergk's *Poetæ Lyrici Græci*. B. L. G.

Philter [from Lat. *phil'trum* = Gr. φίλτρον, love-potion, deriv. of φιλεῖν, love]: an aphrodisiac preparation. Philters were much used in ancient Greece and Rome, and the Thessalians had special eminence in their preparation. From the accounts which have come down to us, many of their ingredients were harmless, or at most disgusting, and used on account of some purely fanciful efficacy; while others, it would seem, were violent poisons. Thus a doubtful tradition says that the poet Lucretius died in consequence of a strong philter given by his wife; and some hold that Caligula's madness was caused and maintained by his wife's philters. The use of these potions is prevalent in almost all barbarous and half-civilized lands. As of old, magic arts are employed to add force to the supposed natural powers of the drugs.

Phintias: See Damon and Pythias.

Phips, or **Phipps**, Sir William: Governor of Massachusetts; b. in Pemaquid, now Bristol, Me., Feb. 2, 1651; was a shepherd, but when eighteen was apprenticed to a shipbuilder; removed to Boston, where he worked as a shipcarpenter, and subsequently engaged in commerce; went in 1684 to England, and obtained means to fit out a vessel to recover the silver of one of the Spanish Plate fleet wrecked off the Bahamas, but was not successful until 1687, when he obtained treasure worth $1,500,000 (some accounts say $3,000,000), for which he got about $80,000, besides receiving knighthood and the office of high sheriff of New England; headed, in 1690, an expedition which captured Port Royal, Nova Scotia, and in the same year had command of a fleet which unsuccessfully besieged Quebec; was the first royal Governor of Massachusetts 1692–94; built the fort of Pemaquid, Me., 1692; put an end to the prosecutions for witchcraft by organizing a special court of magistrates for the consideration of the cases; was suddenly called to England 1694 to answer charges against him. D. suddenly, of a malignant fever, in London, Feb. 18, 1695. His enterprise and patriotism were remarkable, and his native abilities fair, but he was ignorant, ill-tempered, credulous, and the tool of abler men. He did not learn to read until he was twenty-two years of age. Cotton Mather wrote an eulogistic *Life* of Phips, who was a member of his church. A trustworthy one by Francis Bowen is given in Sparks's *American Biography* (Boston, 1834–37).

Phlebi'tis [Mod. Lat.; Gr. φλέψ, φλεβός, vein + suff. *-itis*, denoting a disease of]: inflammation of the coats of a vein or veins. Phlebitis may occur in any part of the body from direct injury and accidental or surgical wounds. Idiopathic or primary phlebitis occurs chiefly in the lower extremities, especially in the tortuous expansions and dilated pouches of varicose veins. When a vein is inflamed its contained blood coagulates, adheres to the walls of the vessel; a local fibrinous mass or clot (thrombus) obstructs or wholly suspends the circulation. Exceptionally, this thrombus organizes, connecting with the nutritive capillaries of the venous coats. More often it partly or wholly breaks down, disseminating pus when attached by pyogenic (pus-producing) or putrefactive bacteria, and contaminating the blood, or giving off particles which are carried by the blood to the different parts of the body, and may lodge in the small vessels of large organs, occluding them. Such plugs or emboli deprive a tract of tissue of its nutritive blood-supply, and lead to the condition of fatty degeneration or abscess. Phlebitis, if acute, may be announced by chills and febrile disturbance preceding the local inflammation. The affected vessels are hard, tortuous, prominent, visibly elevated if the surface be viewed in profile. There is a dusky redness over and in the immediate vicinity of the vein, with slight tumefaction and redness of an erysipelatous character, shading off into adjacent tissues. Nodular prominences exist at the site of the valves in the veins. The vein is sensitive to touch, and the entire part tender and painful if moved. Œdema or dropsical swelling, evidenced by pitting upon pressure, may result from the obstructed circulation; in the extremities this swelling may be considerable, with sense of great weight, due to accumulated venous blood and serous transudation. Following childbirth, phlebitis occasionally occurs, usually in the lower extremities, due to local thrombi following the perverted blood of the puerperal state, and probably resulting from absorption of septic matter by the open uterine sinuses. This painful condition is known as *phlegmasia alba dolens* (i. e. painful white swelling), and popularly termed "milk leg." Indeed, at present, the infection of the blood by septic matter and local thrombosis as the causes producing phlebitis are generally conceded. Phlebitis and venous thrombosis are chiefly interesting as engendering embolism and similar putrefactive disturbances in other parts of the body, metastatic abscesses. The "multiple abscesses" of the liver follow inflammation of the venæ portæ. Coexisting abscesses in the brain, lung, liver, spleen, and kidneys may develop from a general poison of the blood. When a vein is enlarged and rigid, as in the sinuses of the cranium, the veins of old hæmorrhoids or stricture of the rectum, or the varicose veins of the leg, its inflammation is very liable to infect the system. The treatment of phlebitis is by local antiphlogistics and internal administration of antiseptics and tonics with absolute rest of the part attacked, and prompt evacuation of collections of pus. Revised by R. Park.

Phlebotomy: See Bleeding.

Phlegma'sia [Mod. Lat., from Gr. φλεγμασία, heat, inflammation, deriv. of φλέγειν, burn]: a term synonymous with *phlegmon*, *phlegmous inflammation*, *pseudo-erysip-*

elas, *diffuse abscess*, and now usually replaced by *cellulitis* or *phlegmonous cellulitis*, denoting an acute inflammation of the subcutaneous cellular tissue, tending to suppuration, in which the pus formed has a tendency to become infiltrated through the tissues, instead of collecting into one place as in ordinary acute abscess. The causes of this variety of inflammation are sometimes very obscure. It is always an expression of an infection by pyogenic or pus-forming bacteria, patients being made more liable thereto by exposure, alcoholic excess, wasting disease, etc. It sometimes results from mortifying shreds of tissue in wounds, and complicating injuries, but in by far the greater number of cases it arises spontaneously in debilitated individuals—persons suffering from mal-assimilation, and consequently having a thin and impoverished blood, i. e. which is incapable of producing a healthy inflammatory action. In such individuals it generally occurs in the extremities, especially in the fingers and hands. The symptoms of phlegmasia are those of ordinary inflammation somewhat aggravated—viz., pain, heat, redness, and swelling; there is always some œdema of the affected part, and, as a consequence of it and the swelling, a tense, shining skin; a throbbing, synchronous with the pulse-beats, is one of the chief symptoms of the disease, and generally immediately precedes the suppurative process. In a few days the skin becomes red at one or more points, and fluctuation appears. Sometimes the œdema and swelling exist to such a marked extent that the skin is deprived of blood, and consequently becomes gangrenous; and as a complication immense sloughs of integument often come away, exposing the uncovered muscles and fasciæ beneath. Accompanying these local symptoms there is always a high fever. In the treatment the first indication should be to remedy as far as possible the condition of the system which has acted as a predisposing cause of the trouble: for this purpose aperients and such tonics as quinine and iron should be given. Locally, suppuration should be hastened by warm applications, and as soon as fluctuation appears at any point an exit should be made for the pus by the lancet; should two or more outlets be found to communicate subcutaneously, the sinus or sinuses should be laid open the entire length, and be allowed to heal from the bottom. Sometimes local depletion, if practiced at the outset of the disease, will cut it short. For *phlegmasia alba dolens*, see PHLEBITIS.

Revised by ROSWELL PARK.

Phlegon (in Gr. *Φλέγων*) OF TRALLES in Caria: Greek historian; freedman of the Emperor Hadrian, and author of a much-read historical compend in sixteen books called *Olympiads*, of which several chapters have been preserved. These and fragments of other works of his are to be found in Müller's *Fragmenta Historicorum Græcorum*, vol. iii., pp. 602–624. B. L. G.

Phlogis'ton: See CHEMISTRY and HYDROGEN.

Phlox [Mod. Lat., from Lat. *phlox* = Gr. *φλόξ*, a flower, so named from its bright color, special use of *φλόξ*, *φλογός*, flame]: a genus of a few annual and nearly thirty perennial herbs of the family *Polemoniaceæ*, all but one Siberian species North American. The phloxes cultivated in flower-gardens are mostly artificial varieties of *Phlox paniculata*, *maculata*, *drummondii*, and *subulata*, all natives of the Atlantic U. S. and Texas. Revised by L. H. BAILEY.

Phlox Family: the *Polemoniaceæ* (from *Polemonium*, one of the genera), a family of gamopetalous dicotyledonous plants, mostly herbs, distinguished from allied families by having regular and symmetrical flowers with the parts five each, except the superior pistil, which is of three carpels, forming a three-celled capsule. The seed-coat when wet usually develops mucilage and spiral threads, especially in the large genus *Gilia*. *Polemonium* (the Greek valerian or Jacob's ladder) is the only European genus, but the single European species is also North American, as are the few others and nearly all the rest of the family, except a few peculiar to South America, and one or two extending into Northeastern Asia. The family is rich in plants for ornamental cultivation, but is otherwise of no economic importance, the plants and their watery juice being bland and inert. PHLOX (*q. v.*) furnishes the gardens with numerous handsome perennials and one or two annuals, running into many varieties; *Gilia* supplies many annuals, chiefly Californian, and one or two showy biennials, such as the "standing cypress." A common cultivated climber, *Cobœa scandens*, with compound leaves and tendrils, is an anomalous member of the family from Mexico and South America.

Revised by CHARLES E. BESSEY.

Phocæ'a: the most northern of the twelve ancient Ionian cities of Asia Minor; founded by the Athenians on the Erythrean Cape, 200 stadia N. W. of Smyrna. Remarkable for maritime enterprise, its inhabitants were first of the Greeks to build fifty-oared galleys and to undertake distant voyages, traversing the Adriatic, Tuscan, and Black Seas. Attacked by Harpagus, general of Darius, the Phocæans abandoned their city rather than submit, and after long wanderings reached Gaul and founded Marseilles. Their abandoned city attracted colonists, again became rich and powerful, and desperately resisted the Romans. In the Middle Ages the Genoese founded a city, Phocæa Nuova, on the same spot, and with their ships aided the Ottomans against the Greeks. The present insignificant village of Phokia occupies the ancient site. E. A. GROSVENOR.

Phocas I.: Byzantine emperor (602–610); originally a groom in Cappadocia, then a common soldier, and finally general; was made emperor by the rebellion which deposed Mauritius. Brave before accession though always sanguinary, on the throne he became tyrannical and timid as if demented; was unsuccessful in war against Persia, whose armies marched to Chrysopolis (Scutari). Abhorred as a monster, he was deposed by the people, and put to death with frightful mutilations.—PHOCAS II., or NICEPHORUS II: Byzantine emperor (963–969); before his accession conquered Crete from the Saracens (962), and was decreed a triumph; was proclaimed emperor by the people shortly after the death of Romanus II.; was successful against the Mussulmans in Asia Minor, captured Aleppo and Antioch, made intimate alliance with Sviatoslav, Prince of Kief, and in subsequent wars was victorious throughout Armenia and Mesopotamia. At the height of his successes he was betrayed by his wife Theophania, and assassinated by John Zimisces, her paramour. E. A. GROSVENOR.

Phocidæ, fos'i-dĕe [Mod. Lat., named from *Pho'ca*, the typical genus, from Lat. *pho'ca* = Gr. *φώκη*, seal]: a family of pinniped mammals belonging to the order *Carnivora*, and containing the earless or hair seals. The nose is blunt, there are no external ears, the flippers are developed as swimming-paddles, the hind limbs, which alone are used in swimming, can not be directed forward, and, as a rule, all the digits bear claws, and are always without the cartilaginous prolongations peculiar to the eared seals (*Otariidæ*). With the exception of one genus (*Monachus*) all are inhabitants of the frigid and colder portions of the temperate zones. See SEAL. F. A. LUCAS.

Pho'cion (in Gr. *Φωκίων*): an Athenian general; b. about 402 B. C., of humble descent, but excellently educated; commanded with great success against Philip II. of Macedon in Eubœa, Megara, Byzantium, and other places. In politics, however, he sided with the Macedonian party, and was an unrelenting adversary of Demosthenes. After the death of Antipater he became implicated in the intrigues between Cassander and Polysperchon, fled to Phocis, was delivered up to the Athenians, and by them condemned to take poison (317 B. C.), and his corpse was hurled unburied across the frontier. One year later the Athenians raised his statue and erected a fine monument in his honor.

Revised by J. R. S. STERRETT.

Pho'cis [= Lat. = Gr. *Φωκίς*]: an ancient division of Greece in Hellas proper; was bounded S. by the Corinthian Gulf, E. by Bœotia, N. by Doris, and W. by Locris. It was very mountainous, being almost entirely covered with the famous mountain range of Parnassus. Its northeastern part was traversed by the river Cephissus, which formed a beautiful and fertile valley. Delphi, Elatea, and Cirrha were its principal towns. It derived its chief historical interest from the circumstance that the famous oracle of Delphi was situated in its territory; but this circumstance became at last the cause of its ruin. A verdict of the Amphictyonic Council ordered the Phocians to pay a fine for having used a tract of land which belonged to the oracle. When the Phocians refused to pay, a ten years' war (generally called the Sacred war), from 355 to 346 B. C., broke out, in which they fought bravely, maintaining themselves by the treasures of the temple; but at last they were conquered, chiefly by the strategy of Philip of Macedon, and then their cities, twenty-two in number, were destroyed, and they were scattered in villages, of which none was allowed to contain more than fifty houses.

Phocyl'ides (in Gr. *Φωκυλίδης*) OF MILETUS: Greek elegiac poet; flourished about the middle of the sixth century B. C.

His poems were of brief compass and conveyed moral lessons in more or less humorous forms. A few of these have been preserved. A transparent forgery called *Phocylidea*, in 230 hexameters, once diligently conned as an authoritative code of morals, is, according to Bernays, the fabrication of an Alexandrian Jew; the time is uncertain, but not later than Nero. Both real Phocylides and false in Bergk's *Poetæ Lyrici Græci* (4th ed. vol. ii., pp. 68–109). On the pseudo-Phocylides see the admirable treatise of Bernays in *Gesammelte Abhandlungen* (vol. i., pp. 192–261). B. L. GILDERSLEEVE.

Phœbe: See DIANA.

Phœ'be-bird, or **Pewee**: a well-known fly-catcher of the U. S., the *Sayornis fuscus*, which often builds under old bridges, mills, and at other points near the water. It is easily recognized by its well-known note, whence its name is derived.

Phœ'bus: See HELIUS.

Phœnicia [Gr. *Φοινίκη*. Etymology uncertain, but plausibly connected with *φοινός*, blood-red, a name applied to the people because of their complexion, analogous to the name *Edom*, which also signifies red]: the name given by the Greeks to the narrow strip of coast-land between the Lebanon Mountains and the Mediterranean. Its northern and southern limits were never accurately fixed, but in a general way Phœnicia may be said to extend from the mouth of the Nahr el-Kebir to Mt. Carmel. The breadth varies from 10 to 12 miles. Its excellent harbors gave it a most favorable situation for commerce, and as early as the fifteenth century B. C. the towns that afterward rose to such importance, as Sidon, Tyre, Byblos, Beirut, Acre, are already in existence. How much earlier the settlement of these places began it is impossible to say. The language of the country known among the natives as Canaan was at the time already Semitic (see PHŒNICIAN LANGUAGE), and the Phœnicians whenever they came either adopted or brought with them this speech. The lack of historical monuments makes it impossible to follow the history of the Phœnicians in unbroken sequence. Inscriptions in large numbers have been found both in Phœnicia itself and in the various settlements made by the Phœnicians, but they are generally of a religious or mortuary character, while the historical annals that appear to have been drawn up by native historiographers are lost, beyond a few fragments preserved in Greek writers. Upon the latter, in combination with the important notices found in the Old Testament and in the annals of Egyptian and Assyrian kings, the history of Phœnicia must largely depend for its reconstruction. The earliest notices that we have show the country to be in a state of dependence upon Egypt. Following the campaigns of Thothmes III. in the seventeenth century B. C., governors were stationed at various points along the coast under Egyptian control, whose duty it was to furnish the tribute imposed upon the country. This control, varying in firmness, continued until the fourteenth century, when the Hittites of Northern Syria appeared as formidable rivals to Egypt, and the latter, agitated by internal disturbances, was unable to retain her hold upon her foreign possessions. The centuries following marked the development of the commercial prosperity of Phœnicia, which gave her such an important place among the nations of antiquity. The native industries of dyes and the manufacture of glass were two of the chief factors that furnished the stimulus to her commercial activity, and about the year 1000 B. C. we find the position of the Phœnicians as the mediators between nations assured. At this time the extension of the Phœnicians beyond the mainland begins. The outlying island of Cyprus may have been settled by them even earlier. After Cyprus, the southern coast of Asia Minor and the islands of the Ægean became additional centers of commercial colonies, and about the ninth century the settlement of Carthage on the African coast took place. Other places followed with the growth of commercial interchange. Sicily, Sardinia, the southern coast of Spain, and, farther to the north, Marseilles, were founded by the Phœnicians. There seems to be no reason to question the tradition that Phœnician ships passed through the Strait of Gibraltar into the open sea and reached the English coast, though whether they actually brought back tin from the mines of Cornwall and amber from the Baltic ocean has not been definitely ascertained. Of the internal history of Phœnicia during all this period few details comparatively are known. The commercial spirit was not conducive to the unfolding of either military force or the creation of a strong national feeling. The cities appear to have been independent of one another for the greater part of their duration and only occasionally did the one or the other endeavor to extend her jurisdiction beyond her limits. In consequence of this lack of unity the Assyrian conquerors, when, in the ninth century, they began the serious conquests of the lands lying to the west of the Euphrates, met with comparatively little resistance; but the tribute imposed upon the cities did not seriously affect the commercial activity, which steadily assumed larger proportions, and it was not until the advent of the Greeks after Alexander's conquests that Phœnicia began to lose her importance. The independent existence of Phœnicia ended with the absorption of all of Syria and Palestine into the Roman empire.

The share taken by the Phœnicians in the propagation of the alphabet, which was probably not their invention (see PHŒNICIAN LANGUAGE), entitles them to an honorable place as potent factors of civilization. Their religion shows an eclectic character, such as we should expect in a nation commingling so largely with others. To the substratum of the primitive Semitic cult, elements taken from the Egyptian and Assyrian religions were added, and at a later period Greek ideas also made themselves felt. The chief god Baal was worshiped in many different manifestations, and the combination of the male and female elements was a distinguishing feature of the religious symbolism that led by a natural degeneration to rites, obscene when viewed from the surface, but redeemed by the mystic sense attached to them.

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Phœnician Language: a language belonging to the Semitic group (see SEMITIC LANGUAGES), spoken by the inhabitants of the ancient district of Phœnicia (native name *Canaan*), on the Mediterranean coast, but with the founding of colonies by the Phœnicians diffused through the islands of the Mediterranean and Ægean—notably Cyprus, Rhodes, Malta, Sicily, and Sardinia—along the southern and in part western coast of Asia Minor, the northern coast of Africa, and the southern coast of France. It is natural that in a language spread over so large a district dialectical variations should arise and become more pronounced with the lapse of time. Phœnician, as spoken and written on the African and Spanish coast and adjacent islands, is thus sufficiently marked off from that current in the mother-land and parts nearer to it to perhaps merit the distinct name of Punic—the term itself being only another form of Phœnician. This distinction extends also to a variation in the script, and it is possible even to differentiate within the Punic dialect between old and new Punic, but the differences touch only minor points, pronunciation and orthography rather than morphology proper and syntactical construction, so that the relation between eastern and western Phœnician may be appropriately compared to the divergences existing between the English of Great Britain and that heard in the U. S. As in the latter instance, the constant communication between Phœnicia and her colonies acted as a check to the accentuation of these differences sufficiently to preserve the unity of Phœnician speech. Our knowledge of the Phœnician language is derived (1) from the large number of inscriptions, mostly of a mortuary or votive character, found in Phœnicia itself, but more copiously in the various settlements, notably Carthage and Citium; also the names and phrases found on coins and seals; (2) the Phœnician phrases transliterated into Latin characters occurring in Plautus's comedy of *Pœnulus*: (3) the proper names and occasional words in the Old Testament, in the Egyptian and Assyrian inscriptions, and in classical writers. Of native Phœnician literature proper, which does not seem to have been very extensive, and so far as we know consisted largely of annals, nothing has been preserved beyond some fragments in Greek translation of Sanchuniathon and Hanno.

The inscriptions form naturally the most important source, but covering as they do the period (roughly speaking) from 600 B. C. to 200 A. D., they are not coextensive with Phœnician history, which approached its climax some centuries earlier, while a corrupt Punic dialect survived in Africa as

late as the fifth century of our era. On the other hand, the Phœnician phrases in Plautus, as well as the transliterated names and words revealed through the other sources mentioned, are of great value in determining the more precise form of the language as well as the pronunciation; for the Phœnician script, like all Semitic alphabets (except the Babylono-Assyrian cuneiform and the Ethiopic), expresses only the consonantal framework of the words, without any vowel signs and only a very sparing use of vowel letters. Even with this help, many features in the morphology of the language remain to be determined, even where the meaning of a text is perfectly clear.

It has been definitely ascertained that Phœnician belongs to the northern division of the Semitic group, and bears the closest resemblance to Hebrew (see HEBREW) and Moabitic. Indeed, the variations are so slight that it is regarded by some scholars as a Hebrew dialect. Hebrew and Phœnician may more appropriately be looked upon as two independent branches of some older form of Semitic speech once current in Palestine, and the peculiarities presented by each are due to the different course taken by the two peoples in their political, social, and religious development, just as the still slighter variations between Hebrew and Moabitic are to be accounted for. The more important points of divergence between the Hebrew and Phœnician are (1) the use of *Kûn* for the predicate verb in the latter (as in Arabic) instead of *hāyā*; (2) the more restricted use of the article; (3) the more frequent recurrence of certain suffixes, as *em*; and (4) lexicographical variations involving the common use of certain stems in Phœnician, as *pa'al*, to do, for which in Hebrew quite different ones are brought into requisition. In general, Phœnician betrays a more archaic stage of language than Hebrew, less indicative of phonetic decay, and simpler in its syntactical constructions. The scantiness of the vocabulary is due to the monotonous character of the epigraphical material, which also is disappointing in affording but little light for the history of Phœnicia and her colonies. See SEMITIC LANGUAGES.

The Phœnician script is an interesting and important study because of its position as the direct prototype of the Greek, Roman, and modern European alphabets on the one hand, and of the square character Hebrew, Palmyrene, Arabic, Nabatæan, Syriac on the other, while less directly the Sanskrit and derivatives and the Ethiopic are to be traced to the same source. The variations in the form of the characters are considerable as we pass from one century to another, while upon approaching the Neo-Punic period, the tendency to cursive script results in distortions which give the writing a confused appearance. The oldest specimen of "Phœnician" script being the Moabite Stone (about 850 B. C.), the origin of the alphabet must be placed at 1000 B. C. at the least. The question, however, as to the time and circumstances of its invention is still involved in obscurity. Recent epigraphical discoveries seem to show that in Southern Arabia and along the Abyssinian coast a more archaic form of the alphabet than even that of the Moabite Stone is to be found, and it is more than doubtful whether the Phœnicians, whose entire culture shows little traces of originality, are to be regarded as the inventors of the alphabet. De Rouge's theory, that the alphabet is a derivative of the hieroglyphic writing of Egypt, requires new investigation in the light of the advanced culture that has been shown to have flourished in Southern Arabia and Abyssinia as early at least as 1000 B. C. The contingency of these districts to Egypt and the commercial intercourse between them makes it probable that we must, after all, look to Egypt as the source of the alphabet, if future investigations should bear out the proposition that it originated among the Semites of Southern Arabia, and was by them transmitted to the Phœnicians. See ALPHABET.

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Phœnicopter'idæ [Mod. Lat., named from *Phœnicopterus*, the typical genus; Gr. φοῖνιξ, purple red, red + πτερόν, feather, wing]: a family of birds of peculiar organization, whose species are known under the English name flamingoes. In their osseous structure, as in their external characters, they are almost intermediate between the duck-like birds (*Anatidæ* and *Palamedeidæ*) and the stork-like birds (*Ciconiidæ*); there has, therefore, been considerable doubt as to their systematic position, some authors having associated them with the wading birds, and others with swimming birds; on the whole, however, they appear to be most closely related to the swimming birds, although forming a peculiar type or "super-family" by themselves, named by Huxley *Amphimorphæ*. See FLAMINGO.

Phœ'nix [= Lat. = Gr. φοῖνιξ; cf. Egypt. *bennu*]: a fabled bird, whose prototype is found in the Egyptian *Bennu*; sacred to Osiris, and also, particularly, as a form of the rising sun, to Ra, the sun-god. In the hieroglyphs the *bennu* is represented as a heron, but in classical myth, following Herodotus (ii., 73), the phœnix was given the form of an eagle. It was reputed to have its origin amid flame in the top of a sacred tree at Heliopolis. Herodotus represents it as an Arabian bird which arises from its own ashes in Heliopolis once in 500 years, but the myth assumed a variety of other forms. CHARLES R. GILLETT.

Phœnix: city; capital of Arizona and of Maricopa County; on the Salt river, and the Maricopa and Phœnix and Santa Fé railroads; 226 miles N. E. of Yuma (for location, see map of Arizona, ref. 13–L). It is in an agricultural, stock-raising, and mining region, and contains 2 national banks with combined capital of $200,000, 3 incorporated banks with capital of $215,200, a savings-bank with capital of $100,000, a State bank with capital of $50,000, and 3 daily and 5 weekly newspapers. Pop. (1890) 3,152; (1900) 5,544.

Phœnix: village; Oswego co., N. Y.; on the Oswego river, the Oswego Canal, and the Rome, Watertown, and Ogdensburg Railroad; 16 miles N. of Syracuse (for location, see map of New York, ref. 3–G). It is in an agricultural region, and has large interests in stock-raising, tobacco-growing, and dairying. The river and canal afford good water-power, which is utilized by saw and flour mills, and other manufactories. There are a State bank with a capital of $35,000, and a weekly newspaper. Pop. (1880) 1,312; (1890) 1,466; (1900) 1,532.

Phœnixville: borough (founded as a forge in 1792, incorporated as a borough in 1848); Chester co., Pa.; at the junction of the Schuylkill river and French creek; on the Penn. and the Phila. and Reading railways; 28 miles N. W. of Philadelphia, 30 miles E. S. E. of Reading (for location, see map of Pennsylvania, ref. 6–I). It is widely known for its rolling-mills, blast-furnaces, and iron-works, and their products, such as iron bridges, girders, columns, and other heavy work, and for its hosiery-factories. There are gas, electric-light, and water plants, a denominational and 4 public schools, public park, library, 2 national banks with combined capital of $300,000, and a daily and 2 weekly newspapers. Pop. (1880) 6,682; (1890) 8,514; (1900) 9,196. EDITOR OF "REPUBLICAN."

Phonautograph: See ACOUSTICS.

Phonetic Laws: the laws governing the changes of sound in the historical development of a language. When a sound-change like that of Old English *ā* (pron. *aa*) to English *ō* is observed to have taken place in a great number of words widely separated from each other in meaning and use, the possibility of anything like collusion or a conscious regulation of one word according to the sound of another is entirely excluded, and it is evident that the change is a matter of individual sounds and not of complete words as such; cf. O. Eng. *hām* > Eng. *home*; *dāg* > *dough* (*dō*); *hlāf* > *loaf* (*lōf*); *strād* > *strōde*; *cnāwan* > *knōw*; *þās* > *thōse*; *nā* > *nō*, etc. If a matter of individual sounds, this change can not have been subject to conscious direction, because in the natural and unstudied pronunciation of words the individual articulations from which the sounds result are made unconsciously. Except after careful acoustic and physiological analysis the speaker is not aware, for instance, that in the word *judge* he employs the compound consonant *dž* twice (i. e. *džŭdž*). He is not aware that the *g* in *give* differs from that in *got*, or that the *m* in *lamp* is different from that in *lamb*, or that the *th* in *thin* differs from that in *then*; or, if he is, he does not without analysis and reflection know wherein the difference lies. The production of speech, moreover, does not consist in the juxtaposition of a

certain number of definite and complete articulations, but in a current of sound checked, deflected, and guided by organs which are in continuous and generally complicated simultaneous movement. As the organs pass from one point of articulation to another speech goes on, and the number of different sounds produced is really infinite. An absolutely correct analysis of speech has not yet been attained, even by scientific observation and reflection.

In view of such considerations as these, it is evident that the production of sounds is not governed by consciousness. Consequently the assumption of sporadic, in the sense of willful, sound-changes, subject to the speaker's choice or caprice, is untenable. The power of an individual willfully to mispronounce a word is undeniable, but an occurrence like this does not constitute a fact of language history. Language is a *social* institution. If a case could actually be found where the willful and capricious mispronunciation of an individual had by imitation been adopted by a whole speech community and become the unconscious possession of their language, then it would be a case of a loan-word in just the same sense as *rouge* is a loan-word from the French.

Phonetic change is in its inception due to minute and unconscious deviations in the speech of individuals. As speech is a social institution in which intelligibility is of even higher importance than expression, these deviations are continually subject to correction, (1) by the necessity of intelligibility, (2) by the impressions received from the speech of others, as well as the impressions received from the speaker's own more accurate articulations. Before, therefore, any deviation can establish itself in the language of the community, it must do so as the resultant of a practically infinite number of modifying forces. The language of a community is therefore in reality an ideal to which the speech of the individual is always being drawn back, but to which in each single case of speaking it may not absolutely conform.

As the conditions which produce the changes of sounds are not dependent on the particular words in which the sounds occur, it is evident that there can be no reason to expect like-conditioned sounds to be differently treated in different words. On the contrary, we should expect a phonetic change to reach throughout the whole like-conditioned material of the language. This expectation finds more and more confirmation as language comes to be more accurately observed in its natural developments. The principle that the laws of sound suffer no exception was first stated by August Leskien in the introduction to his *Declination im Slavisch-Litauischen und Germanischen* (1876), and has since that time been vigorously attacked, vigorously defended, and widely applied in investigation. Though only a scientific dogma, it constitutes the only safe guide in etymological research, and is theoretically defensible within the limits of the perfectly natural developments of folk-speech in a compact and homogeneous speech-community. When a sound-change is in the act of extending itself from the narrow speech-community where it is native to a wider speech area it undoubtedly seems to progress from word to word—i. e. it manifests itself in some words before others; thus in the case discussed by W. D. Whitney, *Indogermanische Forschungen*, iv., 32 ff. Such cases do not, however, contravene in the least the theory of uniformity in phonetic change. They fall under the head of processes for the unification and solidification of language. Phonetic laws are not laws in the sense of physical laws, but, as may be inferred from the foregoing, are socio-historical in character. As Paul has expressed it (*Principien*, chap. iii.): "Sound-law does not pretend to state what must always under certain general conditions regularly recur, but merely expresses the reign of uniformity within a group of definite historical phenomena."

LITERATURE.—H. Paul, *Principles of the History of Language* (*Principien der Sprachgeschichte*), chap. iii.; Strong-Logeman-Wheeler, *History of Language*, chap. iii.; B. Delbrück, *Die neueste Sprachforschung* (1885); K. Brugmann, *Zum heutigen Stand der Sprachwissenschaft* (1885). Opposed to the view here maintained are, e. g., G. Curtius, *Zur Kritik der neuesten Sprachforschung* (1885): H. Schuchardt, *Ueber die Lautgesetze* (1885); F. B. Tarbell, *Phonetic Law* (in *Transactions of the American Philological Association*, vol. xvii., 1886).

BENJ. IDE WHEELER.

Phonetics [noun use of plur. of *phonetic*, pertaining to sounds, from Gr. *φωνητικός*, pertaining to sounds or to the voice, deriv. of *φωνή*, sound, voice]: the science of speech-sounds, and, in the usage of some, also the art of representing their combinations by writing. Speech-sounds are such of the phenomena of the resonance of inclosed masses of air variously excited by the organs of speech as are used for communication of thought. The resonance cavities are the larynx, pharynx, nasal passages, and mouth, with various smaller parts. Each cavity has a separate resonance, and each resonance acts more or less in combination with all the others. The action of the resonance for vowels was first (though incompletely) explained by Helmholtz (*Sensations of Tone*; see Ellis's translation, 2d ed., 1885, pp. 103–119, 123, 538–543). It is necessary to distinguish the mode of exciting resonance and the fixed or variable forms of the resonance-cavities.

I. *Mode of Exciting Resonance.*—(1) "Irrespirates," sounds independent of respiration, which may or may not be carried on at the same time through the nose. The air in the resonance-cavities is excited by smacks, clicks, smokers' mouth-puffs, blowpiper's cheek-puffs, or implosion (due to sudden condensation). All these are recognized elements of language. (2) "Inspirates," sounds arising from drawing in air—(*a*) through the mouth only, as in chirps, whistles, sobs, gasps; (*b*) through the nose only, as in snuffling; or (*c*) through both nose and mouth, as in snoring. Common elements of expression, even in English. (3) "Expirates," sounds arising from expelling air from the lungs. These are the commonest and most important elements of speech. (*a*) "Physems" (a name not in general use), or bellows-actions of the lungs, with constant pressure (force, loudness, and much of modern accent), with discontinuous pressure (jerks, the main element of aspiration), or with condensation suddenly relieved (explosions, one element of post-aspiration). (*b*) "Glottids," or actions of the elastic glottis, which, when the vocal chords forming it are wide apart, give either inaudible breath (physem weak) or "flatus"—that is, audible breath (physem strong). When the glottis is narrowed, but not closed, they give "whisper." When the glottis is closed elastically, they give "voice." When the glottis is closed inelastically, they give the Arabic *hamza*, or "check." These actions also, chiefly by various tensions of the vocal chords, produce variety of pitch (musical accent, singing), and by different arrangements regulate the size and distinctness of the periodical puffs of air on which voice depends (original quality of tone, expression), with other effects not so marked. (*c*) "Arytēnads" (a name scarcely used), or actions of the gristly glottis, giving by various actions the Arabic *hha* or wheeze, and *ain* or bleat, and the Danish *r* (?). (*d*) "Hisses" (generally restricted to voiceless sibilants), arising from flatus driven through narrow passages, as for *s*, *sh*. (*e*) "Sonants" (or voiced stops, voiced explosives), arising from driving the voice into closed cavities, where the air rapidly becomes too condensed to sound. (*f*) "Buzzes" (generally restricted to voiced sibilants), arising from driving the voice laboriously through passages suitable for hisses, and hence producing the effect of a mixture of voice and flatus, as for *z*, *zh*. (*g*) "Vocals" (a name hardly used in this narrow sense, but, like "sonant," sometimes applied to all voiced sounds), arising from driving the voice easily through a partially obstructed cavity, or one which may be periodically obstructed and relieved by a vibrating membrane, as for *l*, *r*. (*h*) "Vowels," arising from letting the voice resound clearly in comparatively unobstructed cavities of the mouth separately, or mouth and nose combined, which modify the original quality of tone.

II. *Fixed Forms of Resonance-cavities.*—(*a*) "Oral vowel positions," the uvula, being pressed against the back wall of the pharynx, shuts off the nasal cavities; the tongue, in part or in whole, is raised to different heights within the mouth, but not sufficiently to touch the palate; the throat (pharynx), in whole or in part, is lengthened, shortened, widened or narrowed; the lips are more or less closed or opened; or all these alterations of tongue, throat, and lips are variously combined. The number of possible oral vowels is infinite; fifteen to twenty of them are common in European languages. (*b*) "Orinasal vowel positions," the nasal passages are open to the larynx by the advance of the uvula, and the various membranes of the nose are variously brought into action, at the same time that the various oral vowel positions are assumed. Each oral vowel generates various kinds of orinasal vowels (generally called simply nasal vowels). The four French orinasals in the words *an*, *on*, *un*, *vin* are best known. (*c*) "Oral consonant positions" have the nasal passages cut off, as for oral vowel positions, and either entirely

obstruct the passage of air, flatus, or voice, as (1) for mutes (i. e. voiceless stops or voiceless explosives), *p*, *t*, *k*, positions without sound and rendered effective only by "glides"; (2) for implodents, with a sound due to implosion, as in modern Saxon, *p*, *b* or *t*, *d* (I., 1); and (3) for sonants (as *b*, *d*, *g*, I., 3, *e*); or are only adapted for "hisses" (such as *f*, *s*, *sh*, *th*, I., 3, *d*), "buzzes" (such as *v*, *z*, *zh*, *dh*, I., 3, *f*), or "vocals" (such as *l*, *r*, I., 3, *g*), by the formation of narrow or choked passages, or the introduction of a (possibly) vibrating valve.* Such positions are very numerous. (*d*) "Nasal consonant positions" have the nasal passage open, but the mouth (generally) closed as for mutes, and are generally accompanied by voice (as *m*, *n*, *ng*), but many other forms occur.†

III. *Changing Forms of Resonance-cavities.*—(1) If while a violin-string is bowed the stopping finger is slid on the finger-board from the nut toward the bridge, the result is a series of musical sounds, changing by insensible degrees. The first and last sounds may or may not be of sensible duration. In each case the changing sounds are called "glides." (2) If the extreme sounds have sensible duration and the glide is short, the glide becomes a "slur," to which case the word will be here specially limited, although musically it has a wider signification. (3) When no glide or slur occurs, there is a "break" or silence during change of position. (4) In speech, glides and slurs are the cement by which elements are bound into syllables. Speech-glides were first recognized in Ellis's *English Phonetics* (1854), and slurs in his *Early English Pronunciation* (part iv., 1874, p. 1130). They generally arise from continuing sound during change of resonance-cavity, but there are also (5) "force-glides," arising from continuously variable bellows-action of the lungs; (6) "pitch-glides," from continuous alterations, chiefly in the tension of the vocal chords; and (7) "glottal glides," from continuous alterations in the degree of separation of the vocal chords, changing from flatus through whisper to voice, and conversely; and (8) "arytēnad glides," arising from continuous changing position of the gristly glottis. (9) "Vowel glides" arise from passing from one vowel position to another, and may be "lip," "tongue," or "throat glides," separately or combined two or three together, the results being "diphthongs" and "fractures" of the most diverse character and of great philological importance. (10) "Mixed glides" arise from passing from a consonant to a vowel position, and conversely, and are most remarkable in the case of mutes, as in *peep*, *took*, because it is solely by the glide that the mute becomes effective. When final, the mute often glides on to a click or some flatus (in English), and often (in English and German) flatus is interposed between the mute and the vowel, producing a passing glottal glide, the habits of different nations and individuals being extremely different. In such words as *see*, *cease*, *seize* there are glottal as well as mixed glides. (11) "Consonant glides" occur when we pass from one consonant position to another, of which one at least is capable of flated or voiced resonance, as in *tree*, where there is a consonant glide from *t* to *r*, and a mixed glide from *r* to *ee*. (12) All these glides give rise to slurs, which are more convenient to the speaker than breaks, because breathing is uninterrupted, and hence they constantly occur between syllables. (13) "Breaks" occur where the passage of breath is interrupted by some suspension of expiration, some check of the glottis, or some mute consonant. The study of glides is one of the most important parts of phonetics for clear enunciation, intelligible singing, and comparative philology.

The above analysis of speech-sounds, here merely indicated, results from the most recent physiological and linguistic investigations, and its great complication would apparently involve immense difficulty in the attempt to find a method of representing speech-sounds to the eye. All the accepted alphabets of both ancient and modern times are more or less defective as representations of the phenomena of speech. When the Greeks borrowed the Phœnician syllabary, they gave it a real alphabetic character. It was in this form that the Romans adapted the same Phœnician characters to their needs, and from these two original sources all modern European alphabets are derived. At an early period the Roman alphabetic system became general for most Aryan languages, and was subsequently used for languages of different families, as Basque and Hungarian. The diverse nature of the selection of speech-sounds and systems of glides and accents in use among the different nations of Europe has caused the Roman letters, individually and in groups, to have different significations in the several countries using them, and to be practically increased in number by the addition of various diacritical marks. These systems of writing were in many cases introduced by "clerks" (ecclesiastics), who were satisfied with a rough indication of the sounds of words at remote periods when the sounds of the languages thus reduced to writing were different from those now in use; but there was always an indisposition to make any changes in orthography, and this indisposition has increased since printing became widely used. Hence the groups of letters have in many instances ceased altogether to recall the sounds of the words, and consequently alphabetical writing has in numerous instances almost reverted to ideographical symbolization. This is especially the case in English, where sign and sound are so practically independent, to the great detriment of education, that no one who sees an English word for the first time knows how to speak it, and no one who hears an English word for the first time knows how to spell it.

Missionary enterprise and scientific linguistics have raised the question of a universal alphabet capable of writing all languages. We are still very far from being able to determine what should be the value, number, or form of the separate elementary symbols in such an alphabet, and how their combination should be indicated. Prof. Lepsius, of Berlin, invented the "linguistic alphabet" (German ed. 1855), adopted under the name of the "standard alphabet" by the English Church Missionary Society in 1858 (2d English ed. 1863), and approved by many other missionary societies. It consists of a mixture of Latin and Greek letters, supplemented by a vast complication of diacritical marks, which render its use so laborious that in special adaptations most of these marks are omitted. It requires new fonts of types, and, notwithstanding the number of its symbols (more than 250), it is defective for well-known languages, both in characters for elementary sounds and in the means of representing glides. Prof. Brücke's *Neue Methode der phonetischen Transscription* (1863) with entirely new letters is also inadequate. In A. Melville Bell's *Visible Speech* (1867)* the characters are formed on the principle of picturing the positions of the speech-organs. It embraces a philosophic consideration of vowels as well as of consonants, and although by no means perfect, it was by far the best and most practical attempt yet made. It has been improved by Henry Sweet, who has also provided a corresponding alphabet (revised Romic) consisting of Roman letters and various other signs already used in printing. (See his paper on *Sound Notation*, in *Transactions of the Philological Society* (1880–81), pt. ii., 177–235.) Neither these, however, nor any other system yet proposed can be considered as an entirely satisfactory solution of the problem. For the purposes of Ellis's *Early English Pronunciation* (1869–89) he introduced a temporary system called "Palæotype," because it can be readily printed with ordinary or old types. It is too complicated and confusing, however, for general use.

In the meantime, the question of particular phonetics, or of writing the sounds of a particular language with sufficient accuracy for native use, is comparatively easy. It will be sufficient to mention here four of the proposed methods of writing English on a phonetic basis. 1. Ellis's Glossic; see his article in *Transactions of the Philological Society*, 1870, pt. i., *On Glosik, a neu sistem ov Ingglish speling, proapoa·zd faur konkur·ent eus, in aurder too remidi dhi difek·ts, widhout ditrak·ting from dhi valeu ov our prezent aurthog·rafi*. As this example shows, glossic often uses combinations of letters to express single sounds, but each of such combinations is used always with the same value, and this is in most cases determined by the commonest value of the same combination in the usual spelling of English at the present day. 2. Sweet's broad Romic (less complicated than the revised Romic mentioned above), in which the most important single sounds are now represented by single signs, generally Roman letters used with approximately their original Latin values. See for slightly different forms of it his *Handbook of Phonetics* (1877, pp. 191, 192); *Primer of Phonetics* (1890, pp. 71–82); *Elementarbuch des gesprochenen Englisch* (3d ed. 1891); *Primer of Spoken*

* Ellis's "hisses" and "buzzes" include what are more often called spirants or fricatives; they should be carefully distinguished from aspirates. English *sh* in *shut*, *th* in *thin*, *this*, for example, are in strict phonetic use not aspirates but spirants or fricatives. See ASPIRATE.

† The terminology of phonetics is different with different writers. See the list of terms in the appendix of Jespersen's book mentioned on the next page.

* See also his *Sounds and their Relations* (1881).

English (1890). Similar to this, but more minute, is the system of indicating the pronunciation in the *New English Dictionary* (since 1884). 3. The World-English alphabet of A. Melville Bell; see his *World-English* (1888). 4. The phonetic alphabet proposed in the report of a committee of the American Philological Association in 1877; see that report (in the *Proceedings* of the Association) and *The Spelling Reform*, by Francis A. March in *Circular of Information No. 8*, published by the Bureau of Education in 1893.

In recent years the study of phonetics has been vigorously pursued, and many valuable investigations have been published. Among the books and papers of importance, besides the work of Sweet, are Sievers, *Grundzüge der Phonetik* (4th ed. 1893, excellent; contains also a useful bibliography); Trautmann, *Die Sprachlaute im Atlgemeinen und die Laute des Englischen, Französischen und Deutschen im Besonderen* (1884–86); W. Vietor, *Elemente der Phonetik des Deutschen, Englischen und Französischen* (3d ed., first part, 1893; Victor was also the editor of *Phonetische Studien*, 6 vols., 1887–93, now succeeded by *Die Neueren Sprachen* with the *Beiblatt*, *Phonetische Studien*); P. Passy, *Étude sur les changements phonétiques*, etc. (1890; Passy is the editor of *Le Maître Phonétique*, 1889 and since; earlier numbers beginning in 1886 were called *Dhi Fonètik Tîtcer*); Rousselot, *La méthode graphique appliquée à la recherche des transformations inconscientes du langage* (1891), and *Les modifications phonétiques du langage*, etc., in *Revue des patois gallo-romans* (1891, pp. 65–208. The work of Rousselot is particularly valuable for experimental observations with apparatus); Techmer, *Phonetik* (1880), and articles in *Internationale Zeitschrift für allgemeine Sprachwissenschaft*; Jespersen, *The Articulations of Speech Sounds represented by Means of Analphabetic Symbols* (1889); Sheldon and Grandgent, *Phonetic Compensations* (in *Mod. Lang. Notes*, June, 1888, 354–374, vol. iii.); Grandgent, *Vowel Measuremets* (in *Pub. of the Mod. Lang. Assoc. of America*, suppl. to vol. v., pp. 148 ff.; an excellent description of a method for determining the shape of the oral cavity in the vowels of natural speech); R. J. Lloyd, *Speech Sounds: their Nature and Causation* (in *Phonetische Studien*, iii., 251 ff., iv., 37 ff., 183 ff., 275 ff., v., 1 ff., 129 ff., 263 ff.; see also the bibliography in Sievers. Lloyd considers the acoustic side especially, making investigations similar to those of Helmholtz, and throwing new light on the problems of vowel-sounds); Johan Storm, *Engtische Phitotogie*, i., *Die lebende Sprache, 1. Abteilung : Phonetik und Aussprache* (2d ed. 1892; this is largely devoted to phonetics in general, and contains admirable discussions of some of the most important works on the subject); R. L. Weeks, *A Method of Recording the Soft-palate Movements in Speech* (in *Harvard Studies and Notes in Phitotogy and Literature*, ii., 213 ff.); L. Soames, *An Introduction to Phonetics* (*English, French, and German*) (1891; a good introduction to the subject for English speakers); Bremer, *Deutsche Phonetik* (Leipzig, 1893).

ALEX. J. ELLIS.
Revised by E. S. SHELDON.

Phonograph: an instrument for recording and reproducing sound. The problem of recording sound was solved long before its reproduction was accomplished. In 1807 Dr. Thomas Young pointed out a method by which a tuning-fork might be made to trace a record of its own vibrations, but nearly half a century seems to have elapsed before this hint was put into practice by Wertheim and Duhamel. A light pointed style is attached to the end of one prong of the fork, and made to press against a surface of smoked glass or paper; and this is then moved in the direction across which the prong is vibrating. The combination of these two motions produces a sinuous line, and the character of this curve is determined by the nature of the motion which at the same time impresses the ear as sound. In the phonautograph of Scott and Koenig (see ACOUSTICS) the tuning-fork is replaced by a stretched membrane at one end of a drum, into which the sound is directed, while the tracing of the style is made upon smoked paper encircling a cylinder. The rotation of this cylinder is compounded with lateral motion in the direction of its axis by means of a screw thread cut upon the axial shaft, and moving in a fixed nut when the handle is turned. In Barlow's logograph, constructed in 1873, the drum is replaced by a short trumpet, and to the vibrating membrane a delicate ink-marker is attached. In 1876 Dr. C. J. Blake obtained very fine tracings by employing the tympanum of a human ear for a logograph. In 1878 Prof. E. W. Blake photographed the motion of an elastic disk set into vibration through sound-waves produced by the voice. To the disk a small mirror was attached, and from this a beam of sunlight was reflected upon a moving photographic plate.

All of the contrivances just described may quite properly be called phonographs. This graphic method has been carried to the utmost perfection by Rudolph Koenig, of Paris; but it implies no attempt to produce a talking-machine, however accurately the peculiarities of articulate speech may be registered. An elaborate talking-machine was perfected by the two Fabers, father and son, in Vienna, the outcome of many years of work. This instrument was exhibited in the U. S. in 1883. An air-blast is sent through a rather complicated arrangement of vents, in which the action of the human organs of speech is imitated as nearly as possible. It is indeed a special form of cabinet organ from which articulate words are uttered in a monotone, each word being phonetically spelled out by skillful manipulation of a keyboard. There is no attempt to register speech, but the mechanical manufacture of speech is successfully accomplished without the reproduction of sounds from any articulate source.

In 1877 Thomas A. Edison applied to a telephone disk a style which pressed upon a strip of tin-foil, his object being the attainment of a self-recording telephone. Accidental motion of the indented foil under the style caused a momentary reproduction of the sounds which had actuated the telephone disk. This suggested his invention of the modern phonograph, which was first exhibited in 1878. A telephone mouthpiece was adjusted close to a cylinder, such as is employed with the Scott phonautograph. To the telephone disk was attached a metal point, made to press gently on tin-foil, with which the cylinder was covered. Into the surface of the cylinder a spiral groove was cut, corresponding to the pitch of the axial screw. By motion of the metal point the plastic tin-foil was pressed into the groove beneath it, receiving thus a series of slight indentations, which constituted the registration of the exciting sound. When this line of indentations was made to pass under the metal point again the variable pressure thus given caused the disk to repeat the vibrations originally impressed upon it by the voice; and a talking-machine was thus secured which gave forth articulation, not in a monotone, but with the variations of pitch, loudness, and quality that had characterized the voice of the speaker. The reproduction was not quite perfect, but it was incomparably superior to the outcome of any previous effort to imitate the human voice.

Interesting as was the phonograph, considered as a triumph of ingenuity, it was not found capable of satisfactory commercial use. Modifications of it were devised, of which the most important were the graphophone, by Bell and Tainter, and the gramophone, by Berliner. In the former of these a cylinder of wax, hardened slightly by admixture of paraffin or some other similar waxy substance, was substituted for tin-foil. In Berliner's gramophone, instead of indentations a sinuous line is made, as with Scott's phonautograph; but this is traced upon a horizontal revolving disk of zinc, covered with a thin coating of wax. The plate is then dipped into a solution of chromic acid, so that the line is etched into the zinc. Such a plate when passed again under the style gives lateral motion to this, which is communicated to the disk, resulting in very satisfactory articulate sound.

Since 1886 Edison has improved the phonograph, adopting the use of a wax cylinder, with two separate mouthpieces, having specially prepared styles—one for transmitter, the other for receiver. The elastic disks are made of glass, and great improvement has been secured in distinctness of articulation, but with corresponding loss of loudness. From the receiving disk a pair of tubes are conveyed to the hearer's ears. To secure the utmost regularity in speed of rotation an electric motor is employed to actuate the wax cylinder. Its delicacy and accuracy in reproduction are very remarkable. Not only talking, but also whistling, singing, whispering, and the playing of any musical instrument whatever may be very perfectly repeated by it.

The uses to which the phonograph may be put are manifold, but the actual uses have been thus far somewhat limited. The wax cylinders are capable of ready transportation by mail, the capacity of each varying from 100 to 1,000 words, according to size. Aside from the purposes of entertainment, the phonograph is used in business as an aid to the stenographer and the typewriter.

W. LE CONTE STEVENS.

Phonog'raphy [Gr. *φωνή*, sound + *γράφειν*, write]: any system of writing in which a phonetic spelling is used. The term, however, is used specifically for any system of writing in which the phonetic elements of words are represented by "simple and easily formed signs, which readily enter into every combination required," the same sign never being used to represent more than one sound or articulation. The name "phonography" was first applied to a system of shorthand writing by Isaac Pitman in the second edition of his system, published in London in 1840, but had been applied as early as 1701 to a little work on phonetic spelling by J. Jones, M. D., London. The appearance of Pitman's system (first ed. London, 1837) marked an era in the history of shorthand writing. By the introduction of a more accurate analysis of the vocal elements of the English tongue, and a more systematic presentation of the shorthand art, Pitman did very much to bring the possibility of verbatim reporting within the reach of persons of ordinary adaptability for the practice of the art. His system has been the basis of every subsequent system which has received any considerable degree of public support. The chief of these are Graham's (that presented in this article), Munson's, Bishops', Cross's Burnz's, Lindsley's, and Osgoodby's. Graham's system is now written by about 50 per cent. of the official stenographers; and a large proportion of the other shorthand writers, in the U. S.

Sign.	Sound.	Name.	Sign.	Sound.	Name.	Sign.	Sound.	Name.
	p	pec.		f	ef.		l	el.
	b	bee.		v	vee.		r	ar.
	t	tee.		th	ith.		m	em.
	d	dee.		Th	thee.		n	en.
	ch	chay.		s	es.		ing	ing.
	j	jay.		z	zee.		y	yay.
	k	kay.		sh	shay.		w	way.
	g	gay.		zh	zhay.		h	hay.
Additional Consonant Signs.								
	r	ray.		w	wĕh.		y	yĕh.
				w	wuh.		y	yuh.
•	h	*hĕh* dot.		s	*iss* circle.		st	*steh* loop.
				ss	*ses* circle.		str	*ster* loop.

FIG. 1.—The consonant signs.

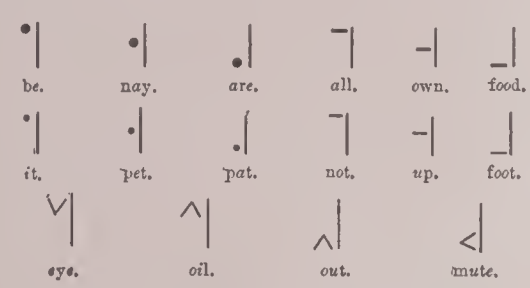


FIG. 2.—The vowel scale.

characters—dots, right-lines, and curves—variously modified and combined. Signs are provided for forty elements in the "working alphabet." The consonants, with their appropriate signs and names, are illustrated in Fig. 1. The vowels are represented by means of dots and dashes. They are written by the side of a consonant stroke, and the vowel-scale is made extensive by giving a different vowel-significance to the dot or dash according as it is written opposite the beginning, middle, or end of the stroke. The vowels are read before or after an adjacent consonant, according as they are written before or after perpendicular or inclined, or above or below horizontal strokes. (See Fig. 2.) They are named by their sound. In rapid writing they are not inserted except to indicate words of unusual occurrence or to vocalize proper names. Indeed, the consonant outlines of words are found to be so legible and suggestive that the vowels are usually left out even in phonographic correspondence. Fig. 3 shows how the consonants are combined in forming words.

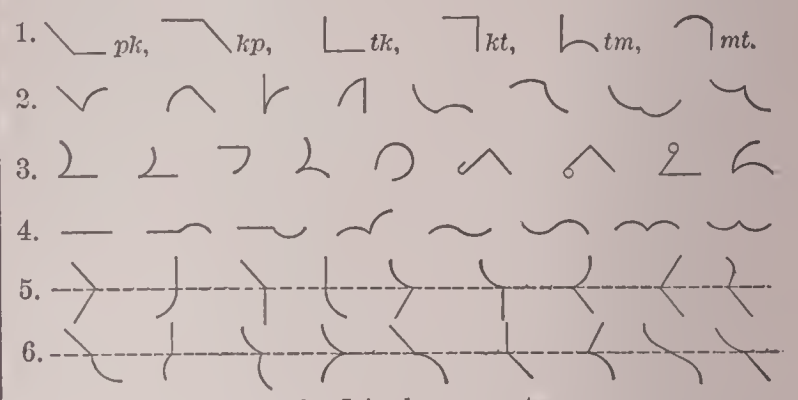


FIG. 3.—Joined consonants.

Modifications of the Consonant Strokes.—The primary consonant strokes are variously modified to indicate the addition of other consonants; thus a small initial hook indicates the addition of *l* or *r*, according to the side on which it is written. A large initial hook indicates the addition *lr* (as in *ler*, *lor*, *lar*) or *rl* (as in *rel*, *ral*, etc.), according to the side on which it is written (see Fig. 4). A small final hook indicates the addition of the sound of *f*, *v*, or *n*; and a large final hook the addition of *shn* (*tion*, *sion*, *cion*, *cian*, etc.) or *tive*, according to the side on which it is written. The *iss* circle when written at the beginning of a stroke (hooked or not) implies that the stroke is preceded by *s*; when written at the end of a stroke (hooked or not), that the stroke is followed by *s*. The *ses* circle occurring initially or finally implies the precedence or succedence of *cis*, *ces*, *sis*, *ses*, *sus*, *sas*, etc. The *steh* loop initial or final indicates *st*. The *ster* loop indicates *str* (as in *ster*, *stor*, etc.), but is not written initially. These circles and loops when written finally, on the side of the *n* hook (by making the hook into a circle or loop), signify the addition of *n-s*, *n-ses*, *cis*, etc., *n-st* or *n-str* to the stroke. The sound of *s* may be added to a stroke modified by an *f* hook by writing the *iss* circle within the hook. *S* may be made to precede a stroke modified by an *l* or *r* hook by writing the *iss* circle within the *l* hook, or by making the *r* hook into a circle. By *halving* a stroke (writing it half length) *t* or *d* is added, according as the stroke is light or heavy; by *lengthening* (writing it double length), *tr*, *dr*, *thr*, or *Thr* is added, according as the stroke is light or heavy; by *widening*, *p* or *b* is added.

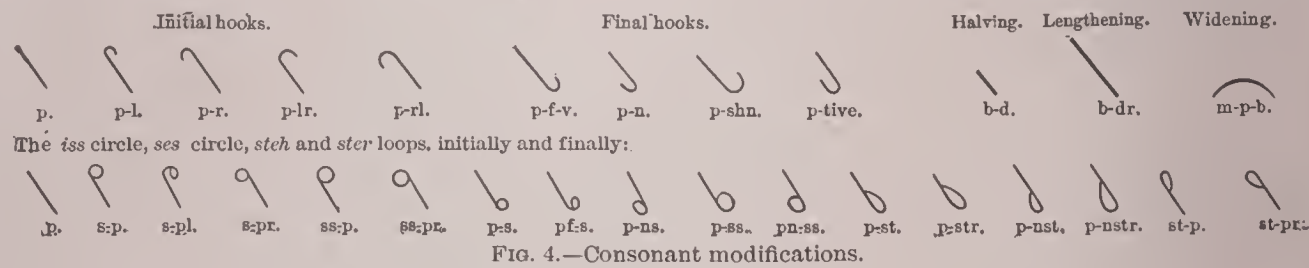


FIG. 4.—Consonant modifications.

Expedients for increasing Speed.—Various other expedients are made use of, as an initial dot or tick or small

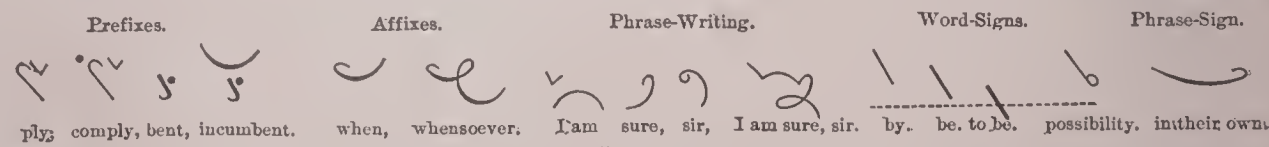


FIG. 5.

circle to imply a prefix, as *con*, *com*, *cog*, *circum*, *contra*, *self-con*, or *self-com*; a final dot or tick (light or heavy), or circle, to indicate the imperfect participle of verbs, an adverbial or other affix, as *ing*, *ings*, or *ly*; *self*, *selves*, *-bleness*, *-fulness*, etc. Other affixes are indicated by an abbreviated termination, as *sv* for "soever" in *whosoever*, *whensoever*, etc.; and the omission of the connecting preposition "of," or of the prepositional phrases "of the," "of a," is indicated by writing two words near together, and the omission of "to" or "two" by writing the following outline just under the line of writing. See Fig. 5.

Two other expedients for increasing speed remain to be noticed—phrase-writing and word-signs. By phrase-writing is meant the junction of several words without lifting the pen. This does not diminish, but rather increases, the legibility of the writing where the words are grammatically closely related, as in the phrase "I am sure." By the term word-sign is meant a primary character, simple or modified, which is memorized as an arbitrary and abbreviated expression of a certain word or words. The principle of word-signs is carried to a great extent, and like phrase-writing is one of the reporter's most important aids for increasing the speed of his writing. See Stenography and Pitman's *History of Shorthand* (1891). Revised by R. Lilley.

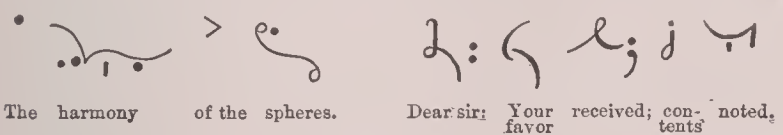
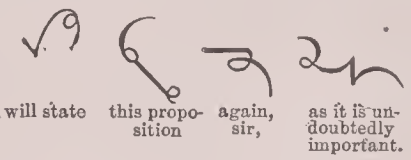


Fig. 6.—The corresponding style.



The reporting style.

Phonolite [from Gr. φωνή, sound + λίθος, stone]: a name given by Klaproth to a dense, hard variety of volcanic rock in allusion to its ring under the hammer (German, *Klingstein*; English, *clinkstone*), a property which is much increased by its tendency to separate into thin slabs. Phonolite is an acid igneous rock very rich in alkali, and is to be regarded as the surface equivalent of eleolite-syenite. Its essential constituent minerals are sanidine, nepheline, and an alkaline pyroxene, called ægirite. It also frequently contains minerals of the sodalite-haüyne group, leucite, hornblende, titanite, apatite, and magnetite. Quartz is never present except as a secondary product, since there is too much alkali to allow of the separation of free silica. Zeolites of various kinds are also very frequent alteration minerals in phonolite.

This rock occurs in dikes, flows, and volcanic necks, for the most part of Tertiary age. It is often accompanied by its tuffs, and in many regions, like the Auvergne, Southern Baden, and Bohemia, forms steep and picturesque mountains of small size. Phonolites are also known in Northern Africa, Italy, the Eifel, England, Brazil, the Black Hills, and Colorado. George H. Williams.

Phormion (in Gr. Φορμίων): an Athenian general who distinguished himself in the wars with Samos, but especially at the siege of Potidæa in 432 B. C. He there fought with Perdiccas, King of Macedonia, against the Chalcidians; in 430 B. C. he led the Acarnanians against the Ambraciots; in 429 B. C. he was victorious at Naupactus against the Peloponnesians, after which he once more commanded the Acarnanians. His tomb was near those of Pericles and Chabrias on the road to the Academy.

Phororhachidæ: See the Appendix.

Phosphates: See Phosphoric Acid; also Apatite.

Phosphines: bases corresponding to amines, bearing the same relation to PH_3 that amines do to NH_3. Triethyl phosphine is $P(C_2H_5)_3$.

Phosphorescence [deriv. of *phosphoresce*, shine like phosphorus, deriv. of *phosphorus*]: the emission of light with little, if any, heat, and in most cases with little chemical change. Phosphorus emits light in the dark, and this is due to slow combustion, the change being of the same kind as that which takes place when phosphorus burns actively in the air. Phosphorescence is frequently observed to a very marked degree in sea water. The cause of this is not known, but the phenomenon is believed to be connected with the presence of minute organisms from which the light is given off. Some substances have the power to emit light after having been exposed to a bright light. Prominent among these are the sulphides of calcium, strontium, and barium. According to Becquerel, phosphorescence is a power possessed by all substances, but in most cases it lasts only a very short time. With calcium sulphide it lasts several hours, and the sulphides of strontium and barium have this power to even a greater extent than calcium sulphide. The cause of the phosphorescence in such substances is not known. See also Fluorescence. Ira Remsen.

Phosphoric Acid: the principal acid formed by the element Phosphorus (*q. v.*). It occurs in nature mainly in the form of the calcium salt, calcium phosphate. This is the principal constituent of the ashes of bones. It occurs also as phosphorite and, in combination, in the mineral apatite. It can be made in the laboratory (1) by burning phosphorus which converts it into the oxide, P_2O_5, and then boiling this in water solution; (2) by oxidizing phosphorus with nitric acid. On the large scale it is made from bone-ash or phosphorite, by treating with sulphuric acid, filtering, and evaporating. When its solution is evaporated to the proper consistency the acid crystallizes out on cooling in the form of large crystals having the composition represented by the formula H_3PO_4. This is called *orthophosphoric acid* to distinguish it from two other varieties of the acid to be mentioned below.

Phosphates are the salts of phosphoric acid, or, more especially, of orthophosphoric acid. This acid is tribasic, and therefore capable of yielding a great variety of salts. Each of the three hydrogen atoms contained in its molecule, H_3PO_4, can be successively replaced by metallic elements. Those salts which are derived from the acid by the replacement of one or two of the three hydrogen atoms are called *acid phosphates*. Examples are *mono-sodium phosphate*, H_2NaPO_4; *di-sodium phosphate*, HNa_2PO_4; *secondary calcium phosphate*, $HCaPO_4$; *primary calcium phosphate*, $H_4Ca(PO_4)_2$, etc. The last two salts mentioned are also called *acid phosphates of calcium*. One or both are contained in the preparation commonly called Horsford's acid phosphate. The *normal phosphates*, or *neutral phosphates*, are those that are derived from orthophosphoric acid by the replacement of all the hydrogen by metallic elements. Thus *silver phosphate*, Ag_3PO_4; *tertiary calcium phosphate*, $Ca_3(PO_4)_3$, etc., are normal phosphates. Among the more important phosphates are those of calcium. As has been said, tertiary calcium phosphate is the chief constituent of bone-ash. It forms 85 per cent. of this mixture. Calcium phosphate exists everywhere in fertile soils, and is taken up by the plants, from which in turn it finds its way into the animal body. It is evident, therefore, that it is of fundamental importance, and that a soil must either contain this salt or something from which it can be formed. See Agricultural Chemistry and Fertilizers.

Metaphosphoric acid, HPO_3, is formed when orthophosphoric acid is heated to 400° C. (750° F.). Under these conditions the latter loses water as represented in the equation:

$$H_3PO_4 = HPO_3 + H_2O.$$

This is the more common commercial form of phosphoric acid, being known in the market as *glacial phosphoric acid* (*Acidum phosphoricum glaciale*). Boiled with water it is converted into ordinary or orthophosphoric acid, the reaction above represented being reversed. The salts of metaphosphoric acid are called *metaphosphates*. The acid is monobasic, and it was formerly called monobasic phosphoric acid. Its composition is similar to that of nitric acid, HNO_3, and chloric acid, $HClO_3$.

Pyrophosphoric acid, $H_4P_2O_7$, is formed by heating orthophosphoric acid to 200°–300° C. (400°–600°F.). The change effected is similar to that which takes place in the conversion of the ortho-acid into the meta-acid (see above). It is represented by the following equation:

$$2H_3PO_4 = H_4P_2O_7 + H_2O.$$

The acid is tetrabasic, and was at one time called tetrabasic phosphoric acid. When a secondary salt of orthophosphoric acid is heated to a sufficiently high temperature a pyrophosphate is formed. Thus di-sodium phosphate yields sodium pyrophosphate:

$$2HNa_2PO_4 = Na_4P_2O_7 + H_2O.$$

So also when a primary phosphate, such as mono-sodium phosphate, is heated high enough to decompose it, it yields a metaphosphate:

$$H_2NaPO_4 = NaPO_3 + H_2O.$$

The case with which the acid phosphates and the acid itself undergo change when heated gave rise originally to considerable difficulty in their study. By a masterly investigation of these substances Graham succeeded in explaining the relations between them and the products formed from them, and he thus laid the foundation of the views at present held in regard to acids. IRA REMSEN.

Phosphor-iridium: Holland's compound. See IRIDIUM.

Phosphor'oscope: a device invented by Edmond Becquerel for showing the phenomenon of phosphorescence in bodies which shine but for a very minute portion of time after their insulation. By suitable perforations in a disk revolving over a box in which is the substance to be examined, sunlight is allowed to fall upon it and to be cut off before the observer can see it through another aperture. By giving to the disk a sufficiently rapid rotation observations may be made after an interval of less than $\frac{1}{4000}$th of a second after light has ceased to shine upon the substance. In this way it has been discovered that many substances are phosphorescent (i. e. capable of emitting light) which have never before been known to be so; but there are still a large number of bodies which have no appreciable phosphorescence. Revised by IRA REMSEN.

Phosphorus [Mod. Lat., from Gr. *φωσφόρος*, light-bringing; *φῶς*, light + *φέρειν*, carry, bring. Cf. *Φωσφόρος*, name of the morning star]: one of the chemical elements. In the eighteenth century the name phosphorus was applied to every body that gave light without burning. Gradually, however, the name came to be applied only to the element which was discovered in the latter part of the seventeenth century by Brandt (1669), of Hamburg, who obtained it in experimenting on the distillation of extract of urine with charcoal. Phosphorus is manufactured by first making from bones a soluble acid phosphate of lime through the agency of sulphuric acid, and mixing and distilling this with charcoal in earthen retorts at a red heat. Bone-ash contains nearly 20 per cent. of phosphorus, this being the precise proportion in pure *tricalcic phosphate*; but the amount of phosphorus obtained in practice is only from 8 to 11 per cent. The process is also expensively consumptive of fuel and destructive of apparatus, as well as of the health of the operatives, these facts much enhancing the cost of phosphorus. The importance of phosphorus is, however, so great—chiefly as a material for making matches—that the production is carried on on a very large scale, and the annual production of phosphorus is something over 3,000 tons. There are two principal factories—one in France, at Lyons, the other in England, at Oldbury near Birmingham. Some phosphorus is also made in Sweden and at Philadelphia, Pa.

Common commercial phosphorus is a slightly yellowish body of wax-like consistence, and translucent. It is generally cast into the form of sticks, which, on account of their dangerous inflammability, must be preserved under water. It melts at 44° C. or 111° F. to a liquid of oily consistence, which may be cooled if undisturbed much below the melting-point again without solidifying, but then at once solidifies on agitation. Although flexible and highly sectile at ordinary temperatures, it becomes brittle and breaks with a crystalline fracture at the freezing-point of water. It may be crystallized from bisulphide of carbon, in which it is soluble, the crystals belonging to the regular system. It boils at 290° C. (554° F.), forming a transparent vapor nearly four and a half times as heavy as air. Phosphorus is slightly soluble in ether and in fixed oils, considerably so in benzene and in many essential oils, including oil of turpentine, largely so in bisulphide of carbon.

Red phosphorus or *amorphous phosphorus* is formed from ordinary phosphorus when the latter is long exposed to the light. The same change takes place when phosphorus is heated for a time in an atmosphere free from oxygen, and rapidly when it is heated to 300° C. in a tube hermetically sealed. This variety of phosphorus differs very markedly from the ordinary variety. It is a red powder. It does not emit light. It does not melt at a low temperature. It is not poisonous, and can not be easily ignited. Further, it is insoluble in bisulphide of carbon. When heated to 260° C. in an atmosphere of carbon dioxide it is converted into ordinary phosphorus, and when heated to this temperature in the air it takes fire, and in burning forms the same product that ordinary phosphorus does.

Oxides of Phosphorus.—There are two known oxides of phosphorus: (1) phosphorous anhydride (P_2O_3), a soft, white, readily volatile powder formed by the slow oxidation of phosphorus in a limited supply of dry air; and (2) phosphoric anhydride, or phosphoric pentoxide (P_2O_5), the product of the burning of phosphorus with flame in the air. It appears as a white smoke. This phosphoric pentoxide as made in quantities is a snow-white amorphous powder, which sublimes at a moderate heat below redness. It is highly deliquescent, and when added to water combines with it with great heat and explosive violence.

In addition to the acids mentioned under the head of PHOSPHORIC ACID (*q. v.*) phosphorus yields two other acids. These are *phosphorous acid* and *hypophosphorous acid*. The former has the formula H_3PO_3. Its salts are called *phosphites*. The latter has the formula H_3PO_2; and its salts are called *hypophosphites*. Revised by IRA REMSEN.

MEDICINAL USES OF PHOSPHORUS.—Pure phosphorus is locally an intense irritant and caustic to animal tissues, and taken internally is a virulent poison, whether in large single dose or in repeated administration of small quantities. Even in a single fatal dose, however, the symptoms may not begin till several hours after swallowing the poison, and death does not generally occur till after several days. There are the usual signs of irritant poisoning—viz., nausea, vomiting, and sometimes purging, with abdominal pain, but the latter symptom is not so severe as with other corrosive poisons. A garlicky breath, luminosity of the eructations and sometimes of the secretions, profound disturbances of the nervous system, such as delirium, convulsions, coma, with extreme general prostration, follow, and the individual may die suddenly from collapse and syncope, or more slowly after sinking into coma. Then a peculiar feature of phosphorus poisoning sets in—namely, jaundice, from fatty degeneration of the liver. This symptom is often preceded by a remission in the symptoms, which should not be considered as a favorable sign. After death there is found profound structural disintegration of the tissues, with special tendency to fatty degeneration of many of the organs, and extravasations of blood into their tissue. In chronic poisoning, however, no symptoms occur except a profound general debility, in which condition the subject may sink away and die. The antidotes in phosphorus-poisoning that seem to be of most use are permanganate of potassium and peroxide of hydrogen. Oil of turpentine is worse than useless. Given medicinally in doses of a minute fraction of a grain, phosphorus is sometimes of benefit in conditions of nervous debility, and especially in neuralgias and bone disease. Under its use the patient's general state may improve and the special morbid symptoms abate. Phosphorus is most commonly given in pill form, the minute dose being dissolved by warmth in some form of fat which congeals on cooling. It may also be given in solution in appropriate fluid mixture, but most of these solutions have an excessively offensive taste. As slow poisoning by phosphorus is very insidious, the drug should be taken only under the observation of a physician. Revised by H. A. HARE.

Pho'tius: ecclesiastic; held a high position in the civil service of the Byzantine government, and was distinguished for his learning and literary taste, when in 858, on the deposition of Ignatius, he was hurried through all the ecclesiastical degrees, and installed by the Emperor Michael III. as Patriarch of Constantinople. A council of 318 bishops, held at Constantinople in 861, confirmed the election, but Pope Nicholas I. objected to the irregularities of Photius's elevation, and convoked a council at Rome in 862, which deposed and excommunicated him. Photius then gave the conflict a doctrinal turn, and the Council of Constantinople (867) condemned and excommunicated Pope Nicholas I. because of heretical views, thereby laying the foundation of the schism between the Eastern and Western churches. In 867 Photius was deprived by Basilius the Macedonian of his office and sent into exile, and Ignatius was reinstated; but after the death of Ignatius he returned to Constantinople, and was once more placed on the patriarchal throne. In 886 Leo the Philosopher again exiled him, and he died a few years after in an Armenian monastery. Of his works, the *Myriobiblon* or *Bibliotheca*, a collection of extracts and summaries of a large number of Greek authors in 280 sections (edited by I. Bekker, 1824), the *Lexicon* (edited by Porson, 1822, and by Naber, 2 vols., 1866), the *Nomocanon*, a collection of acts and decrees of councils up to the seventh œcumenical council, and his letters are of great interest. A collected edition is found in Migne's *Patrologiæ Cursus Completus*.
Revised by B. L. GILDERSLEEVE.

Photo-engraving: the term applied to a variety of processes in which the action of light and the use of certain chemical substances supplant the work of the engraver. About the year 1826 Nicéphore Niepce, a Frenchman, discovered that bitumen, under certain conditions, became sensitive to light, losing solubility by its action. He coated a sheet of metal with bitumen dissolved in oil of lavender, exposed it under a drawing to the rays of the sun; the bitumen became insoluble in all those parts except where the lines protected it; the latter were then dissolved away with oil of lavender, and the metal thus laid bare was etched with an acid. Many modern processes are based upon this action of bitumen, but in others different substances, rendered insoluble by light, are employed, being quicker in their action, although the finest results are still obtainable by the bitumen process.

The modern method of producing a photo-engraved metal block is as follows: A collodion negative is first made of the line drawing, giving clear white lines on a black ground. If from a photograph, or a washing drawing, or from any picture or object where there is a *gradation* of color, what is termed a *half-tone* process must be employed. This consists in placing in front of the sensitive plate a transparent screen having a network of fine lines mechanically ruled upon it, which breaks up the image into a mass of fine dots, varying in size according to the amount of light composing the various parts of the image passing through the network. A polished plate of metal, such as zinc, brass, or copper (the last being used for the finest work), is next coated over with the sensitive solution—bitumen dissolved in benzole or albumen rendered sensitive by the addition of bichromate of ammonium or potassium. When this is dry, the plate is exposed to light beneath the collodion negative and afterward treated with the necessary solvent, turpentine being used for the bitumen and water in the albumen process. With the latter method the plate is dried and dusted over with finely powdered asphaltum, the surplus brushed off, and the plate held over a stove until the asphaltum just melts. An image capable of resisting the action of acid etching-fluids is thus produced upon the metal plate. It may be mentioned that with some processes the image instead of being printed direct upon the plate is transferred to it. The plate is next coated over at the back and sides with an acid-resisting varnish, and then immersed in the acid etching-bath. If upon copper, the etching mordant used is perchloride of iron. The action of the mordant is to bite into the metal where unprotected by the image, and in this manner the printing-plate is produced. Such a plate can be printed from in the ordinary printing-press.

Photogravure.—In printing from a photo-engraved plate the ink is taken up and transferred to paper by the raised or unetched parts of the plate, but in photogravure the ink fills up the intaglio engraved on the plate by the acid and is lifted away again by the paper pressed upon it. The process of making a photogravure plate is as follows: From the ordinary photographic negative a positive transparency is made. A piece of carbon tissue (paper coated over with gelatin containing lampblack) is sensitized in bichromate of potassium and exposed to light beneath the positive. A copper plate is dusted over with very finely powdered resin or asphaltum, and heated, which gives it an etching-ground, rendering it capable of holding the ink. The exposed carbon tissue is mounted upon the copper plate and subjected to the action of hot water. This dissolves away the gelatin unacted upon by light, leaving a negative image upon the copper. It is then etched with a solution of perchloride of iron, and the photograph cleared off, leaving a plate that may be printed from in the same manner as a copperplate etching or mezzotint engraving.

LITERATURE.—H. D. Farquahar, *The Grammar of Photo-engraving* (New York); W. T. Wilkinson, *Photo-engraving* (New York); Carl Schraubstädter, *Photo-engraving* (St. Louis); W. E. Woodbury, *The Encyclopædia of Photography* (New York); Julius Verfasser, *The Half-tone Process* (London); H. K. Blaney and W. E. Woodbury, *Photogravure* (New York); Geynet, *Photogravure sur zinc et cuivre*, (Paris).

WALTER E. WOODBURY.

Photography [Gr. *φῶs*, *φωτός*, light + *γράφειν*, write]: the art of producing permanent images or pictures by means of the chemical action of light, or, more strictly, of "radiant energy."

Early History.—The first authentic record of an attempt to utilize the action of light for producing pictures appears in the early years of the nineteenth century. In 1802 Thomas Wedgwood, son of the famous potter, published in the *Journals* of the Royal Institution a paper giving an account of a "method of copying paintings on glass and making profiles by the agency of light." The sensitive surface which he employed was obtained by impregnating paper or white leather with a solution of nitrate of silver. When this was exposed to sunlight under a design on translucent material the prepared surface darkened in proportion as the light reached it, with the result that a copy of the design in light and dark was produced. Davy, who worked with Wedgwood, afterward found the chloride of silver more sensitive than the nitrate, and succeeded in reproducing the strongly illuminated images formed by the solar microscope; but no device was found for rendering these results permanent. Exposed to daylight the light parts soon darkened, producing a uniform tint over the whole surface and obliterating the picture. As Davy says of it, "Nothing but a method of preventing the unshaded parts of the delineation from being colored by exposure to the day is wanting to render this process as useful as it is elegant." As it was, the process was of course a failure, and the development of photography was delayed for nearly forty years for want of a solvent for the unchanged chloride of silver.

Niepce's Asphalt Process.—A permanent result was, however, obtained in 1814 by Niepce, of Châlons. Having discovered that asphalt is rendered insoluble by the action of light, Niepce exposed a film of dry asphalt varnish on polished metal under a drawing. The film was then soaked in a mixture of oil of lavender and white petroleum, which dissolved the parts which had been protected, laying bare the metallic surfaces, and thus bringing out a copy of the drawing. By this process Niepce also succeeded in securing pictures of landscapes in a camera, many of which were exhibited by him in England in 1827. Although these "heliographs" were not very satisfactory as pictures, the process still survives in modified form in the asphalt process for photo-mechanical printing. In the heliograph method of Niepce is found the idea which lies at the basis of all successful photographic processes for making camera images—the development of an invisible or "latent" image by treatment after exposure. In 1829 Niepce associated himself with Daguerre, but died in 1833 without arriving at any important results. Daguerre, however, pursued the work, and in 1839 brought out the process known by his name.

The Daguerrotype.—The original daguerrotype process was in outline as follows: A carefully polished surface of silver (plated on copper) received a delicate film of silver iodide by fuming with the vapor of iodine. After exposure in the camera for some time there is no visible change produced; but the action of the light is made apparent by placing the plate over a dish of heated mercury, whose vapor condenses on the parts which were illuminated, and in proportion to the chemical effect producing an image in white amalgam of mercury and silver. The image was made permanent by means of a strong solution of common salt. It was soon found that the plates were more sensitive, and thus the time of exposure shortened by using bromine vapor with the iodine; and also, on suggestion of Sir John Herschel, that hyposulphite of soda (sodium thiosulphate) gave a better solution for "fixing" the image than common salt; while both the appearance and the permanency of the pictures were improved by gilding the silver portions with a solution of gold. The pictures taken by this method were of great fidelity and beauty, and were very popular for portraiture until the invention of the collodion process some twelve years after Daguerre's discovery. The first photographic portraits from life were made by this process by Dr. J. W. Draper, of New York, in 1839. The great defect of the method, from the present standpoint, is that no copies of the original daguerrotype are possible, except by an electrochemical method. Daguerre received from the French Government, on the publication of his process, a pension of 6,000 francs, while Niepce's son, Isidore, who was associated with Daguerre after the death of his father, was given a pension of 4,000 francs.

The Calotype.—While Daguerre was working in France, Fox Talbot, in England, was experimenting on the lines suggested by Wedgwood and Davy. He found that paper soaked in common salt solution and then brushed over with silver nitrate gave a film of silver chloride more sensitive to light than the chloride in the state used by Davy. With this Talbot was able not only to make prints of drawings, lace, ferns, etc., but also to secure images in the cam-

era. Another step was taken with the discovery by Rev. J. B. Reade of the accelerating power of gallic acid, and in 1841 Talbot patented the calotype process. By it a latent image is formed on silver iodide paper and developed by nitrate of silver and gallic acid. The result is a "negative," or picture in which the natural lights and shades are reversed; but, as the paper is somewhat translucent, and can be made more so by waxing, "positive" copies may be produced in indefinite number by exposing sensitized paper beneath it. This method of securing prints by "contact-printing" is essentially the same as that employed now. Among the defects of the calotype process were the lack of transpareney of the paper and the fact that its texture was copied in the positive print. The introduction of glass instead of paper is due to Sir John Herschel, who recognized its value on account of transpareney, rigidity, and indifference to chemical agents. In the first attempts to use a glass support the film of silver salt was formed on it by subsidence from water. It proved, however, to be of little sensitiveness, and did not adhere well to the glass.

The Albumen Process.—Niepce Saint-Victor, seeing the necessity of an adherent substance to hold the silver salts, coated glass plates with albumen (white of egg) containing the iodide and bromide of potassium and common salt. On drying and heating, the albumen became insoluble, and the film was sensitized by a bath of silver nitrate, which reacted with the salts in the albumen, forming the iodide, bromide, and chloride ("haloids") of silver. A similarly prepared albumen surface on paper was used for positive printing. The results were much finer and more brilliant than those of the calotype process.

The Collodion Process.—In 1851 Scott Archer substituted for albumen, collodion, a solution in alcohol and ether of pyroxylin, made by the action of nitric acid on cotton, and closely allied to the explosive guncotton. The collodion process could be worked with greater certainty than the albumen; it displaced the daguerrotype, and in various modifications was practically the only process used for making negatives for over twenty-five years. In this process collodion containing soluble bromides and iodides is flowed over a glass plate, and the film, when partly dry, is immersed in silver nitrate. After exposure the latent image is developed by means of an acid solution of a reducing agent, such as ferrous sulphate or pyrogallic acid. This developer does not affect the silver haloids, but reduces the silver nitrate adhering to the film to metallic silver, which is deposited on those parts on which the light has acted, and in proportion to the amount of that action, so that an image is built up in finely divided silver. This image can be intensified by further application of nitrate of silver and developer, and is fixed by hyposulphite of soda. The negative is then washed to remove all soluble substances, dried, and used for the production of positives in the way already indicated.

Collodion Dry Plates.—In this so-called wet-collodion process the plates must be exposed immediately after their preparation. This inconvenience led to many attempts to impart keeping qualities to the film. The most successful of these modifications consisted in washing off the excess of silver nitrate after the bath in that solution, coating the surface with some "preservative," and drying. The "preservatives" were all organic substances of some description, tannin, morphine, coffee, tea, and tobacco being among those recommended by various photographers. The "dry plates" thus prepared kept for a considerable time, but were much slower than the original wet plates.

Emulsion Processes.—About 1864 a collodion film was used in which the silver salts were contained in the state of emulsion, and in 1871 the first successful attempts with a gelatin emulsion were made. This last process developed in the following seven or eight years into the gelatin dry-plate method, which since that time has been in general use. In both of these emulsion processes the silver haloids formed by double decomposition are emulsified in a mass of the vehicle, the soluble products of the reaction removed by washing, and the emulsion rendered more sensitive, or "ripened," by standing for some time, in the case of collodion; or, in the gelatin process, by boiling or treatment with ammonia. The development of the latent image is effected by means of ferrous oxalate or an alkaline solution of some reducing agent such as pyrogallic acid. The exquisite sensitiveness of the modern gelatin dry plate is due to the mode of development as well as to the nature of the vehicle and the state of the emulsified salts.

The Action of Light and of the Sensitizer.—It has been seen that all successful negative processes depend on the use of salts of silver. The action of light on the silver haloids results in their partial reduction with loss of halogen. This occurs with comparative slowness when the salts are pure; but when they are in intimate contact with some substance which readily takes up the halogen set free by the light, the change goes on with greater rapidity. To the class of halogen absorbants belong silver nitrate, gelatin, tannin, and many other organic substances. These substances act, therefore, as accelerators or sensitizers when associated with the silver haloids. Referring to the various processes which have been outlined, it is seen that in the successful cases some halogen-absorbing substance has been employed. The greater sensitiveness of the calotype paper, as compared with Wedgwood and Davy's preparations, lay in the presence of an excess of silver nitrate. In the albumen and wet-collodion processes, again, it is free nitrate of silver which gives sensitiveness; in the dry collodion, the "preservative"; while in the present dry plate the *rôle* of sensitizer is played by the gelatin, which is an especially efficient halogen absorbant. In the daguerrotype process it is the silver plate itself which aids the action of light by taking up the halogen.

Ripening.—The greatly increased sensitiveness of the ripened gelatin emulsion has been found to depend on a purely physical change in the imbedded particles of silver bromide, which increase in size as the ripening proceeds. This fact is indicated by the color of the light transmitted through the emulsion, which changes as the process goes on from reddish to gray or grayish violet.

Development.—The first attempts in securing the camera image were directed to the discovery of a "printing-out process," as it would now be called; that is, a process in which the delineation of the picture should be complete in the camera. Daguerre's efforts in this direction were unsuccessful, and his discovery of the mercury development is said to have been the happy result of an accidental exposure to mercury vapor of a plate which had been tried in the camera and discarded as a failure. The hint was not lost on the other workers in photography, and from that time all negative processes were by development of the latent and invisible image produced by the light. The most important developers which have been employed are acid solutions of pyrogallic acid or ferrous sulphate in presence of silver nitrate, ferrous oxalate, and alkaline solutions of pyrogallic acid, etc. All developers are reducing agents which carry on the reduction begun by the light. The action of the acid developers has been explained under the collodion process. The result is the formation of an image in relief. With the ferrous oxalate and alkaline developers, on the other hand, the picture is built up by growth from beneath, the silver of which it consists being supplied by the particles of silver haloid underlying and in contact with the material of the latent image. In this case the image is sunk in the film, forming an intaglio. The alkaline developers are much more powerful than the others, and could not be employed in connection with silver nitrate, as in the wet-collodion process, where they would cause a deposit of silver over all the plate. A number of substitutes for pyrogallic acid have been proposed in recent years, among them hydrochinon, para-amidophenol, eikonogen, and methol.

Positive Printing—The Silver-print.—Since the picture obtained by exposure in the camera and subsequent development is a negative, in which the light parts of the object are represented by a dark deposit of silver, it is necessary to combine with this negative process a positive one, which shall give an image whose shading corresponds with that of the original. As already stated, the usual method of accomplishing this is in principle the same as that used by Talbot. The common silver-print is made on paper coated with egg albumen, which has been "salted" with chloride of sodium or ammonium, and sensitized by floating on a strong solution of silver nitrate. The dry paper is usually fumed with ammonia shortly before it is used. After proper exposure to sunlight under the negative, the print is fixed by immersion in hyposulphite of soda. In the fixing bath the picture acquires an objectionable reddish tint, which is corrected by "toning" with a solution of gold. Combined fixing and toning baths are sometimes used. Other silver-printing processes employ gelatin or collodion in place of albumen. After the prints are toned and fixed, all the soluble substances which they retain must be completely removed by thorough washing with water. If this is not effectually done, the photographs become in time faded and

discolored. When dry they are trimmed and mounted on cardboard, and burnished by being passed between heated metallic rollers.

Among the printing processes which depend upon sensitive substances other than silver salts, the more important survivals are those employing potassium or ammonium bichromate in gelatin or other sensitizer, the blue-print process, and the platinotype process.

Carbon Processes.—Gelatin containing bichromate is rendered insoluble in water by action of light, and its "tackiness" destroyed. The first fact is utilized by mixing some pigment with the chromated gelatin, which is removed with the soluble portions during development (in water), leaving an image in pigmented gelatin; the second, by dusting powdered pigment over the film after exposure, when adhesion to the unaffected parts brings out the picture. In the latter case the lights and shades reproduce those of the plate under which exposure was made; hence the printing must be under a transparent positive. Processes of this sort are known as "carbon" processes.

Blue Prints.—Blue prints are made on paper coated with a mixture of a ferrous salt, usually ammonio-citrate of iron, and ferricyanide of potassium. The image is developed and fixed by merely washing in water, which brings the reduction products into reaction with the result that insoluble Turnbull's blue is formed, and dissolves the unaltered salts, leaving a picture in blue on a white ground. This process is largely used on account of its cheapness and simplicity for copying plans, and by amateurs.

The Platinotype.—In the platinum process the paper is coated with ferric and platinum salts. Light reduces the ferric to a ferrous salt, and this, when brought into solution by the developer (oxalate of potassium), reduces in turn the platinum salt, giving an image in platinum black. The platinotype is very soft and beautiful, resembling a fine engraving, and has the additional merit of being absolutely permanent.

Direct Positives.—A thin negative, produced by short exposure or insufficient development, appears as a positive when seen by reflected light against a black background. This fact has been used for making collodion positives directly, as in the "ambrotype," in which the glass plate receives a dark backing, and in the ferrotype, or "tintype," in which the support and background are a plate of enameled iron.

Photo-mechanical Printing.—A number of photographic processes for the preparation of plates and blocks, from which impressions may be made by mechanical printing, have been developed, some of which are of great perfection, and have largely displaced wood-engraving for purposes of illustration. Most of these depend in their photographic part on the behavior of bichromated gelatin toward light, which has already been alluded to. The limits of this article admit only of a brief sketch of one or two of these processes, and the reader is referred for details and descriptions of others to the books on the subject whose titles are given at the end.

The Woodburytype.—In the Woodburytype, development (by hot water) of a bichromated gelatin film gives an image in relief. When dry, the film is stripped from its glass support and forced, face down, by hydraulic pressure on a plate of lead. The gelatin image withstands the enormous pressure, and sinks into the lead surface, producing a mould. From this mould the prints are made. The ink is a mixture of gelatin, water, and coloring-matter. The mould is oiled, and a pool of ink poured on it; then a sheet of specially prepared paper is laid on top and pressed down under a platen, which squeezes out all the ink except that filling the depressions of the mould; this is allowed to set, and on removing the paper adheres to it, forming a relief image whose varying thickness gives gradations of shade.

The Stannotype.—The stannotype process is similar to that just described, but does away with the hydraulic pressure and lead mould. The exposure is made under a positive, so that the gelatin image is itself a mould like that obtained in lead in the last process. It would, however, be destroyed if brought in contact with the ink, and is therefore protected by a facing of tin-foil, and then used for printing in the same way as the lead mould of the Woodburytype.

Photolithography.—In photolithography advantage is taken of the fact that those portions of a bichromated film affected by the light acquire the property of holding greasy lithographic ink. The "artotype" is a form of photolithograph. Other processes give relief blocks for printing by etching with acid the metal which supports the gelatin or asphalt image.

Use of Artificial Light.—While direct or reflected sunlight is generally employed both for the production of the camera image and for positive printing, artificial light may be used to advantage in some instances. The electric arc-light has occasionally served for photographic illumination since the earliest days of the daguerrotype; but the light that has proved most available is that of burning magnesium, which is much used for photographing dark interiors and for the instantaneous "flash-light" pictures. For copying by means of the camera, making negatives of microscopic objects, contact printing on dry plates for transparencies, and on gelatino-bromide paper, gas or oil light is commonly employed.

Chemical Action of Light.—Light from different sources, even if of the same luminous intensity, shows marked differences in its chemical effect. It is well known that ordinary white light is composed of a great number of rays of different colors, and that this difference in color is an expression of a difference of wave-length or vibration-frequency. When white light is passed through a glass prism, its component rays are refracted more strongly as their wave-length is less, so that a narrow beam is spread out in fan shape and produces on a white screen a "spectrum" of color extending from the least refrangible red through yellow, green, and blue to violet. Light and color form but one of the modes in which the radiation from a luminous source or "radiant energy" can manifest itself. Each has in general, besides this power of exciting vision, a heating and a chemical or "actinic" effect. Nor are these effects limited to the visible spectrum; the heat extends far into the region beyond the red, and chemical action is found beyond the violet; moreover, the intensity of these effects is not similarly distributed; luminous intensity reaches its maximum in the yellow part of the spectrum; the greatest heating effect is usually in the infra-red; while the chemical action differs with the substance on which it is exercised, and in the case of the silver salts used in photography is most in the blue and violet, and almost altogether absent in the yellow and red.

This fact has several important consequences. From the moment of making the sensitive emulsion until the negative is in the fixing bath, the material of the film must be protected from all actinic rays except those of the camera image; and the inactivity of the red and yellow makes it possible to conduct all necessary operations in light which has been filtered through glass or paper of red or orange color, instead of in the uncertainty of utter darkness. Again, this fact explains the frequent failure of the photograph to give in its light and shade a truthful representation of the effect of colored objects. Reds and yellows photograph black, while the blues usually appear much lighter than in nature. This difficulty has been in part overcome in the "ortho-chromatic" and "iso-chromatic" plates, in which, by the application of certain dyestuffs (first suggested by Vogel, 1873), the film is rendered sensitive to the usually inactive rays, and a more naturally shaded picture is secured. Finally, the photographic lens has to receive a somewhat different form from that of the optical lens. For light in its passage through lenses suffers dispersion, or separation into color, along with the refraction by which the image is formed. In a single lens this results in the production of a series of colored images, the red one farthest from the lens and the violet one nearest. By the combining two lenses whose dispersive power is opposed, most of this effect can be done away with and a single sharp image formed. It is, however, impossible to bring all rays to exactly the same focus, and in optical lenses the correction is made for the most luminous rays, so that the actinic rays form an image whose position differs somewhat from that of the visible one. Consequently, after focusing sharply with such a lens, the negative would be found blurred. The elements of the photographic lens are therefore ground so that the actinic and the visual foci shall coincide.

Lenses.—The photographic camera is a development of the camera obscura which was described by Porta in the sixteenth century. Light entering a darkened room through a small orifice forms images of the objects without; but a lens in place of this simple opening gives images which are much brighter and sharper. The lenses for this purpose must be of the convex class, as these alone give "real" images which can be caught on a screen. The lenses used

in photography may be grouped in the following classes: (1) single corrected lenses; (2) rapid rectilinear; (3) wide-angle rectilinear; (4) portrait lenses. All except the single lenses consist of two combinations, which differ in detail and are mounted at different distances apart, according to the special work for which they are intended.

The focus of a lens is the point in which rays which enter parallel meet after emergence. The distance from the optical center of the lens to the focus is called the focal distance, or, in the case of compound lenses, the "equivalent" focal distance, being so termed from comparison with a single lens of equal power. The image is formed at a distance from the lens which is greater as the object is nearer the lens; for very distant objects, nearly at the focal distance.

Diaphragms.—Accompanying the lens are a number of diaphragms or "stops," which are brass plates with circular openings of different diameters. Placed in the lens-tube in a slot provided for their reception, the diaphragms cut off the outer rays of the entering beam to a greater or less extent, and, by correcting certain deficiencies of the lenses, increase the sharpness of definition and the depth of focus. Since the light admitted through the diaphragm varies as the area of its opening, or the square of its diameter, the time of exposure must be varied inversely as these diameters. The size of the diaphragm is usually expressed in terms of the focal distance of the lens; thus, $\frac{f}{10}$ means that the diaphragm marked in this way has an opening whose diameter is one-tenth of the focal distance of the lens to which it belongs.

Photographs without a Lens.—Since images are formed by admission of light through small apertures, it is possible to take photographs without a lens. To get clear definition, the diameter of the orifice must be several hundred times less than its distance from the sensitive plate, so that the exposures have to be very long. The images have, however, the advantage of being entirely free from all distortion.

The Camera.—The camera is a light-tight wooden box, or, as in many modern cameras, a framework of wood whose parts are connected by a bellows of leather, so that the camera may be light and occupy little space when closed. In front is fixed the lens, and at the back is a screen of ground glass for focusing the image by an arrangement which serves to shorten or lengthen the camera body. With the camera are one or more plate-holders, usually carrying two plates back to back, and which fit the back of the camera so that the film of one of the plates may occupy exactly the position of the focusing screen. The plates in the plate-holder are protected from the light by a slide which is withdrawn during the exposure. Light is admitted for the exposure either by uncapping and capping the lens-tube, or by means of a mechanical shutter fitted to the tube, which is controlled by a pneumatic bulb, and, in case of "instantaneous" or very brief exposures, is operated by a spring released by air from the bulb.

"Detective" cameras, which are much in vogue, are small boxes with mechanical adjustment for focusing, and a finder, consisting of a small auxiliary lens and ground glass screen for ascertaining the position of the image. In these cameras the film is on a flexible support, as paper or celluloid, in a continuous roll wound on two spools at the back. After an exposure the film is reeled from one spool to the other, a mechanical check indicating when a proper amount of fresh surface is brought into position. The shutter is made to flash across the opening by pressing a button.

Printing.—In printing from negatives, the negative is placed in a "printing-frame," glass side out, and the prepared paper faced down on it and held in close contact with the film by a back secured by springs. The back is in two parts, hinged together so that one part may be opened to examine the progress of the printing, while the paper is prevented from shifting by the other.

Photography in Natural Colors.—One of the earliest dreams of photographers was to fix the natural colors of the camera image. Until quite recently all attempts in this direction were unsuccessful. Within a short time encouraging results have been obtained by Lippmann by a method based on the interference of light. Lippmann's process has been improved by Messrs. Lumière, who are said to have applied it successfully to landscapes and portraits. At present the necessary exposure is long, and no copies can be made, while the picture is clearly visible only when viewed at a certain angle.

Ives's Process.—A process which gives colored images by an indirect method has been brought out by F. E. Ives. In it nature is imitated by a superposition of monochromatic images. Starting with the Young-Helmholtz theory, that all color is the result of three primary sensations responding to red, green, and blue-violet rays respectively, which being excited, singly or together, produce all possible tints, three negatives are made of the colored object, one through a screen which allows only red to reach the plate, a second in green, and a third in blue-violet light. Transparencies from each of these negatives are made, and the three pictures projected by a lantern through red, green, and blue color screens respectively. When the images are superposed on the screen a picture resembling the natural object in tint is produced. This process has also been applied with moderate success to the production of photo-engravings by preparing blocks from the three negatives and printing in superposition with properly colored inks.

For the so-called *New Photography*, see X-RAYS.

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Photolithography: See PHOTOGRAPHY.

Photom'eter [Gr. *φῶς, φωτός*, light + *μέτρον*, measure]: an instrument for the comparison of artificial light sources with a standard. All such instruments are based upon the power of the observer to determine by inspection when two contiguous fields of view are equally bright. Reliable judgment of this character can be formed, as has been pointed out by von Helmholtz, only when *the lights illuminating the two fields of view are identical in color—that is to say, in composition.*

The above may be regarded as the fundamental assumption in all photometric operations. The lack of precision in photometry as frequently practiced is indeed due chiefly to the attempt to compare *unlike* sources of light without taking into consideration their differences in quality.

It follows that for lights which differ in composition a class of instruments must be used in which each wave-length in the spectrum of the standard is compared separately with the corresponding wave-length in the spectrum of the light under investigation. Such instruments (spectrophotometers) have, however, not been largely introduced in the commercial measurement of gaslight or of electric lamps. The present article will be confined to the consideration of photometers designed for the comparison of similar light sources.

The earliest of these photometers appears to have been due to Bouguer, although frequently ascribed to Rumford. It consists simply of an upright rod casting shadows upon a

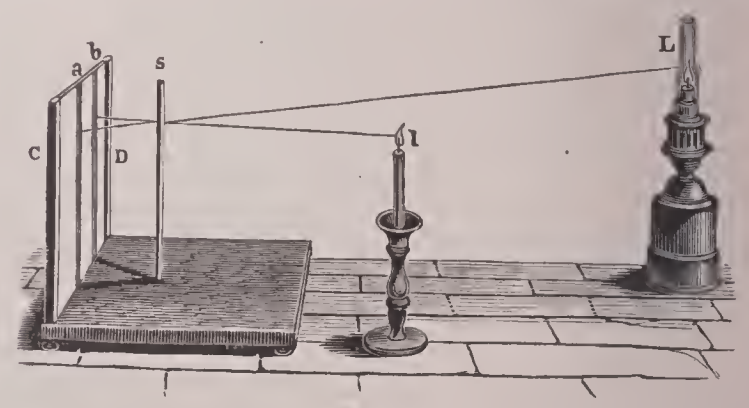


FIG. 1.

white screen placed behind it (Fig. 1). If the only light falling upon the screen come from the two light sources *l* and L, which are to be compared, the spaces occupied by the two shadows which the rod *s* will cast upon the screen will be illuminated respectively by the source to which the shadow in question is not due. The brightness of the two fields within the areas covered by the shadows may now be made equal by adjusting the distances of the two sources of light,

when we have the following simple relation between their intensities and their distances from the screen,

$$\frac{I_1}{I_L} = \frac{D_1^2}{D_L^2},$$

where I_L and I_1 are the illuminating powers of L and l respectively and D_L and D_1 are their distances from the screen. This relationship holds in the use of all photometers based upon the principle stated in the opening paragraph of this article.

Rumford pointed out the conditions under which this instrument will give the best results, the chief of which consists in arranging the apparatus so that the two shadows, instead of being widely separated as in the figure, will be contiguous and separated by a well-defined boundary-line. Thus constructed, the Rumford-Bouguer photometer is as sensitive as any known form when used with lights of *identical* composition. It is, however, more sensitive to slight color differences, and brings out more strongly than many other forms the uncertainties to which the photometric process is subject when we attempt to apply it to dissimilar sources.

Photometers of the above type have been almost entirely abandoned in industrial work because of the greater convenience of a form devised by Robert Bunsen.

The Bunsen photometer is so constructed that the two fields of view, the illumination of which is to be brought into equality, lie between the light-sources, which are placed at the ends of a track or bar (the photometer bar). This bar carries a scale which may be divided equally throughout to advantage in 1,000 parts, or in such manner as to be direct reading in standard candles or in some other unit. The essential feature of the Bunsen photometer, however, is the disk. This in the original form consisted of a piece of unsized paper of considerable thickness, a portion (usually a central circular spot 2 or 3 cm. in diameter) of which had been rendered translucent by treatment with oil or paraffin.

The appearance of the disk by reflected light is that of a dark spot upon a bright ground. A considerable portion of the light which is reflected from the surface of the opaque portions of the paper and serves to render it visible is transmitted by the translucent part. By transmitted light the reverse is true, and when the disk, mounted upon a suitable car, is shifted along the bar between the two lights to be compared it passes through an intermediate stage where the translucent and the opaque portions, whichever side one may view them from, present an almost identical appearance. This happens when the illumination on both sides is alike, and it only remains to note the position of the disk upon the bar and to apply the formula given in a previous paragraph. Sometimes for convenience in preparation the center of the disk is protected by being clamped between two flat, circular pieces of metal or wood, and the whole is dipped into melted paraffin. This gives an opaque spot in the middle of a translucent screen, in which case all the above-mentioned appearances are reversed.

In order to render possible simultaneous observations of the two sides of the disk two mirrors are mounted obliquely on either side, as shown in Fig. 2, in which D is the disk, M M are the mirrors, and A A is the aperture through which the observer looks. The arrows indicate the directions in which the rays come from the two light-sources. Fig. 3 shows the bar or track and the position of the bar between the two sources. L_r and L_l indicate, respectively, the directions in which light comes from its sources.

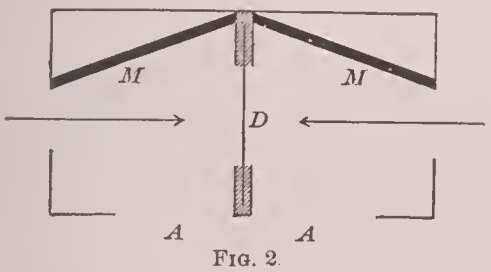


FIG. 2.

Many modifications of the Bunsen disk and substitutes for it have been devised, but only one of these offers such a decided advantage over the original form as to make it necessary to describe it here. This is the photometer of Lummer and Brodhun, in which the rays from the two sources are reflected obliquely from the direction of the photometer bar so as to make an angle of 90° with one another and of 45° with the bar. At the point in which they cross each other a pair of rectangular prisms, cemented together, are placed, as shown in Fig. 4. These would form a complete cube with faces perpendicular to the two rays were it not that a portion of the left-hand prism is cut away, as shown in the diagram.

The result of this arrangement is that a bundle of rays, r_1 r_2, from the observer's right enter the prism b_1 c_1 b_2.

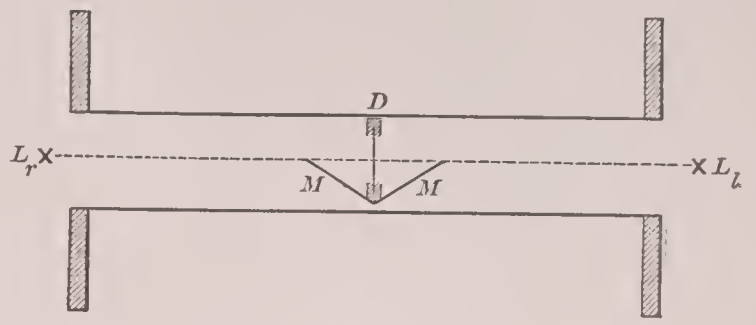


FIG. 3.

Those portions which reach the interface between a_1 and b_2 (also a_2 b_2) are totally reflected, while those between a_1 and a_2 pass through. To an observer at O the appearance is that of a bright ring with a dark center. If, further, the bundle of rays l_1 l_2 fall upon the prism b_1 c_2 b_2, only those which reach the face a_1 a_2 will be transmitted. When the intensities of the two rays are equal the dark center will disappear. When l is brighter than r the center will be brighter than the ring.

This form of photometer possesses a higher degree of sensitiveness than those previously described. Working upon a photometer bar of 1,000 divisions, with similar in-

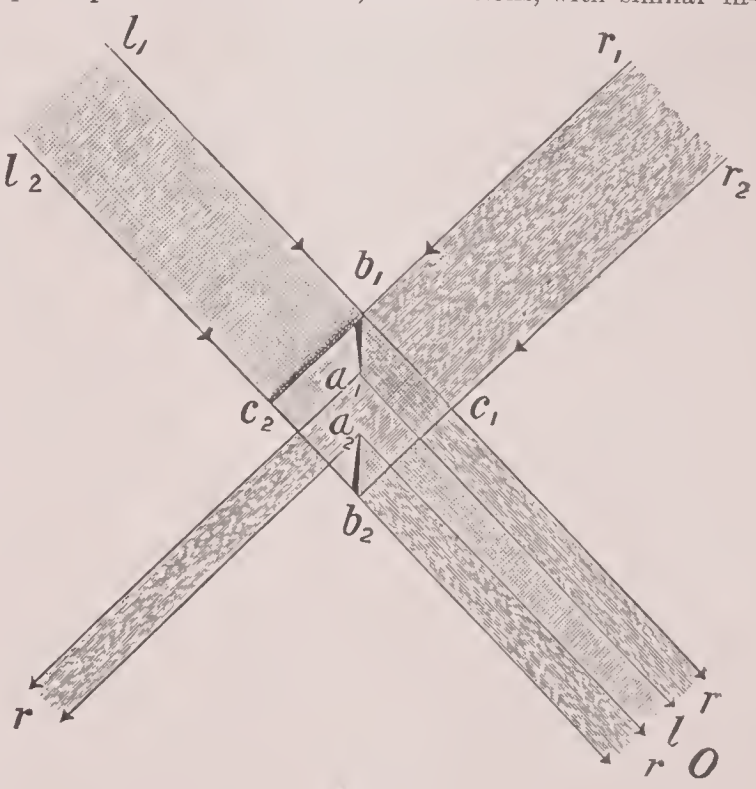


FIG. 4.

candescent lamps at the ends, the lamps being maintained at the same candle-power, a series of fifty readings made with the ordinary Bunsen photometer and with the Lummer-Brodhun photometer respectively gave as the mean error of a single setting:

Lummer-Brodhun	± 0·884 s. d.
Bunsen	± 1·459 s. d.

The sensitiveness to slight color differences is less in case of the Lummer-Brodhun than in other photometers. A comparison with the Bunsen disk, which probably comes second in this respect, gave for the change of voltage to which a 100-volt glow-lamp could be subjected before the color difference between it and a similar lamp at constant voltage with which it was being compared was observable with certainty:

For Lummer-Brodhun	8·6 volts.
For Bunsen	5·76 volts.

This lack of sensitiveness to color differences affords at least some apparent advantage, since the observer is freed from a disturbing element; whether the readings, rendered more concordant on this account, are really of greater accuracy is an open question. The chief advantage of the

Lummer-Brodhun form undoubtedly lies in the fact that observations are made through a telescope, only one eye being employed. The errors thus avoided are not inconsiderable, as will appear from the following experiment:

Ten observers in the physical laboratory of Cornell University (1889) made a series of observations, using the Bunsen photometer and employing the two eyes simultaneously in the customary manner, for the purpose of determining this error. Two lamps of intensities I_r and I_l were placed at the right and left ends of the bar. The ratio $\frac{I_r}{I_l}$ was 1·0032 ± ·0015. The mean of ten readings by these observers, however, gave:

Observer.	$\frac{I_r}{I_l}$	Observer.	$\frac{I_r}{I_l}$
A	1·0590 ± ·0040	F	1·0902 ± ·0057
B	0·9704 ± ·0044	G	1·0733 ± ·0053
C	1·0021 ± ·0022	H	1·0293 ± ·0042
D	1·0191 ± ·0072	I	1·0297 ± ·0050
E	1·0182 ± ·0039	J	1·0220 ± ·0027

It will be noted that all but one of the observers set the disk persistently to the left hand of its true position. The error appears to be analogous to that which arises in the attempt to bisect a straight line by judgment formed in unaided vision. It disappears in those methods in which only one eye is used.

For further information concerning photometers, see PHOTOMETRY; for a discussion of light standards, see CANDLE and CARCEL. The reader is further referred to Palaz, *Photometrie Industrielle.* E. L. NICHOLS.

Photometry [Gr. *φῶς, φωτός*, light + *μέτρον*, measure]: the operation of measuring the intensity of light. In setting such a process on a satisfactory scientific basis, a great difficulty is met with in the fact that the effect measured is not a physical one, but merely an excitation of the optic nerve, the amount of which does not permit of any precise determination. Making abstraction of the different colors of light, and considering only ordinary white light, the principles on which photometric investigations are conducted are these: A comparison of the intensity of two lights can be made only by increasing or diminishing one or both of them until they appear to the eye to be equal. For example, in comparing the light from a gas-jet with that of a candle, we may, by using various instruments, and by putting the jet at different distances, so diminish the light which comes from the latter that the eye shall see side by side the light of the candle and one-fifteenth the corresponding part of the light of the gas-jet; if they then look equal, we shall know that the light emitted by the gas is fifteen times that emitted by the candle. The instruments by which these various comparisons are made are called photometers. See PHOTOMETER.

If all light were of one kind the application of this method of comparing lights would offer no difficulty; but, as explained in the article LIGHT, this agent is a heterogeneous mixture of light of widely varying wave-lengths. No accurate comparison can therefore be made between lights of different colors; in any case the comparison will be a matter of guesswork, and people will guess differently from each other when two lights of different colors appear equal. Yet some system of photometry is not only a necessity in astronomy, but in the practical comparison of different systems of illumination. Let us therefore inquire what view we shall take of the relation between the intensity of beams of light of different colors.

It is shown in the article on LIGHT that, when considered as a physical agent, light is nothing but radiant heat. Hence the only absolute measure of the intensity of a ray of light is the heat or radiant energy which it conveys. If we form its spectrum by dividing it into its prismatic colors, the proper measure of the intensity of each color, or each region of the spectrum between two given wave-lengths, is the amount of heat which is there conveyed; but even the intensity of the heat at a given point of the spectrum will depend on the way in which the spectrum is formed. If we proceed by the units adopted in the article LIGHT, we may classify the parts of the spectrum as follows: That of wave-length between 3 and 4 units; that between 4 and 5; that between 5 and 6; that between 6 and 7, etc.

Of course we could subdivide these regions into as many others as we chose. Then a complete statement of the intensity of the different parts of the spectrum would be merely a statement of how much heat was conveyed by the light between these several limits of wave-lengths. When, however, we refract the light by a prism these four regions spread out unequally. Thus the heating effect in different parts of the spectrum will not give a correct expression even for the amount of heat belonging to that part of the spectrum. It follows that we must correct any determination of the relative amounts of heat thus made, by allowing for the different degrees in which the parts of the spectrum are spread out. There are, however, two insuperable difficulties in the way of reducing photometry to a mere measurement of heat. One is, that the very object of photometry is to determine visibility, and not to measure heat. The eye must therefore be the sole arbiter. Besides this, the eye is so much more delicate than any instrument for measuring heat that it will perceive a ray of light the heat from which could never be detected. What is then really wanted as a basis of photometry is a determination of the relation between the amount of heat carried by rays between each two limits of wave-length and the corresponding visibility of the light. It must not be forgotten that there can be no general comparison for either the heating or the illuminating effect of different parts of the spectrum. In fact, the relative intensity of radiation in different parts of the spectrum depends on the nature of the body from which the light comes, and the absorbing media through which the light has passed. Such expressions as "the brightest part of the spectrum," or "the relative heat in different parts of the spectrum," can be true only of the spectrum of some one body—the sun, for example—or of a given substance at some given temperature—iron at 2,000°, for example.

There are two possible units by which the purely illuminating effect of light of different wave-length can be compared. One is afforded by the determination of the least quantity of light that can be seen. If we agree to take this quantity as a unit at each part of the spectrum it will afford us a basis for comparing the luminosity of light of different colors. Yet another unit would be the smallest amount of light by which the eye could read, or distinguish letters at a given distance. Should we hang up a page containing a few sentences in large print—or, better yet, the test types used by oculists—and then illuminate them with red light, yellow, green, blue, etc., until the eye could just distinguish them, we should have a basis for such a comparison; but from what has already been said it will be seen that the results of this comparison would be incomplete unless the amount of heat carried by these various units of light was also determined. This is quite within the power of science, and, in fact, Prof. Langley has already made researches in this direction. When a table can once be constructed, showing for light of each wave-length what fraction of a unit of heat per second must be conveyed to produce a definite effect upon the human eye, we shall have a scientific basis for photometry. S. NEWCOMB.

Photo-relief Printing: See PHOTOGRAPHY.

Phranza, or **Phranzes**, GEORGE: last of the Byzantine historians; b. 1401, d. 1478; was chamberlain of Manuel II., Palæologus. At the siege of Patras (1429) he saved the life of Constantine, afterward emperor, but was himself taken prisoner and made to endure a harsh captivity. He was protovestiary of Constantine XIII. At the capture of Constantinople by Mohammed II. his entire family were made slaves; his daughter died from her sufferings, his son was murdered in the sultan's harem, but he and his wife escaped to Sparta and thence to Corfu, whence he conducted some diplomatic negotiations. Finally he retired to the monastery of Tarchaniotes, where he wrote his valuable *Chronicon* or Byzantine History. This covers the period from 1259 to 1477, and is interesting and reliable. It was published at Vienna in 1796 in folio. Bekker gave a new edition with Latin translation in 1838. E. A. GROSVENOR.

Phrenology [Gr. *φρήν, φρενός*, faculty, mind + *λόγος*, discourse, reason]: the so-called science of mental faculty as exhibited in the shape, size, and contour of the skull. This mode of investigating the mental capacities of individuals rose into prominence through the "systems of phrenology" of Franz Joseph Gall (1758–1828) and Kaspar Spurzheim (1776–1832). As a method by which the external examination of the "bumps and hollows" of the skull is made to reveal the intellectual and emotional gifts of particular men—so considered, the whole scheme is now known to be worthless. The only semblance of justification it has is found in the facts of brain LOCALIZATION (*q. v.*); but this extends only to the senses and movement, and shows all men to be alike in their localizations. It gives no ground

whatever to the elaborate pretense of the "phrenologists" to describe character. It is possible that morphology may some day show that certain ratios in skull measurements may, in the process of evolution, have come to have some significance for mental faculty in great averages, but even that is forbidden to us in the present state of anthropometric research. See PHYSIOGNOMY. J. MARK BALDWIN.

Phryg'ia (in Gr. *Φρυγία*): a province in the western half of the peninsula of Asia Minor, whose boundaries varied greatly in different epochs. The Phrygians emigrated from Macedonia and founded a powerful empire, whose capital city was situated on a hill across the gulf from Smyrna and within sight of the city. It is now called Tantalis, or city of Tantalus. The Acropolis walls and the tomb of Tantalus still exist. Later on the Phrygians secured a large portion of the crumbling Hittite empire, and removed their capital into the interior. This was the city of the Midases and the Gordiuses. About this city of Midas many remains of the Phrygian civilization still exist near the modern village of Kumbet. (See MIDAS and GORDIUS.) The best account of Phrygia and the Phrygians is in Perrot and Chipiez, *History of Art in Phrygia*, etc. (London, 1892), pp. 1–231, where all the literature relating to the subject is cited.
J. R. S. STERRETT.

Phrygian Language: the language of the ancient Phrygians, located in western central Asia Minor. The language is known to us only through a few glosses and brief inscriptions, but, so far as can be judged from these scanty remains, it was an Indo-European tongue, bearing close relations to the Armenian, and also, though more remotely, to the Balto-Slavic group. According to the reports of Herodotus and Strabo, the Phrygians were anciently regarded as related both to the Armenians and the Thracians. (Cf. Herod., vii., 73; Strabo, c. 47, 295.) The Phrygian glosses are collected in Lagarde, *Gesammelte Abhandlungen*, pp. 283 ff. (1866). See also Fick, *Spracheinheit der Indog. Europas*, pp. 408 ff., and *Zum Phrygischen, Bezzenberger's Beiträge*, xiv., 50 f. BENJ. IDE WHEELER.

Phry'ne (in Gr. *Φρύνη*): a Greek hetæra (see HETÆRÆ) of surpassing beauty, who was employed by Praxiteles as a model for his Cnidian Venus, and by Apelles for his Venus Anadyomene. She was born at Thespiæ in Bœotia in humble circumstances, but when Alexander the Great destroyed the walls of Thebes she offered to rebuild them. When accused of profaning the Eleusinian mysteries, and summoned before the tribunal of the Heliasts, Hyperides, her defender, threw off her veil and exposed her breasts, whereupon the judges immediately acquitted her, and the people carried her in triumph to the temple of Aphrodite.
Revised by J. R. S. STERRETT.

Phry'nichus (in Gr. *Φρύνιχος*): one of the framers of Attic tragedy, the first to bring female characters on the stage, and the first to develop a true dialogue, though the lyric element was still predominant, and Phrynichus was best remembered by his sweet and graceful melodies, which were sung as late as the time of Aristophanes. The most famous of his pieces was the *Phœnician Women*, *Φοίνισσαι*, brought out with great splendor by Themistocles in 476 B. C. to commemorate the victory over the Persians, and soon afterward imitated by Æschylus in his *Persians*. An earlier piece, *The Capture of Miletus* (*Μιλήτου ἅλωσις*), is memorable for the story told by Herodotus that the audience was so moved by the representation of the sufferings of their kindred that they burst into tears, and the poet was fined 1,000 drachmæ —a significant warning against realism in art. Fragments are to be found in Nauck's *Tragicorum Græcorum Fragmenta*. B. L. GILDERSLEEVE.

Phthalic Acid ($H_2C_8H_4O_4 = C_6H_4(COOH)_2$), **Alizaric Acid, Naphthalic Acid** [*phthalic* is a deriv. of *(na)phthalene*]: an acid obtained first in 1836 by Laurent, by boiling naphthalene tetrachloride with nitric acid. It crystallizes in white nacreous laminæ arranged in rounded groups; is slightly soluble in cold water, readily soluble in alcohol and ether. By distillation with an excess of lime it yields benzene and calcic carbonate; with a smaller proportion of lime, calcic carbonate and benzoate. It forms acid and neutral salts, and yields substitution products with bromine, chlorine, nitric acid, etc. By distillation it yields *phthalic anhydride*, $C_8H_4O_3$. When this is heated to 195° C. with resorcin it produces fluorescein. Fluorescein forms a red crystalline powder; crystallizes in yellow needles from methylic alcohol; and its solution in an alkali exhibits a most beautiful and intensely green fluorescence. Fluorescein has become of great industrial importance as a basis for the preparation of the beautiful dye called *eosin*, which rivals safflower and saffronin for dyeing rose-red. Eosin is the potassium salt of tetrabrom fluorescein. Other dyestuffs, also called *phthalic acid colors*, are made by heating phthalic anhydride with other substances belonging to the class of phenols. Besides eosin and fluorescein the more important are *phenol phthalein*, used as an indicator in volumetric analysis, *pyrosin*, which is tetrajod fluorescein, and *gallein*, which is pyrogallol phthalein. Phthalic-acid colors are among the most brilliant of the artificial dyes, and are used on cotton, silk, and wool, for the preparation of lakes, printer's inks, etc. C. F. CHANDLER.

Phthisis: See CONSUMPTION and CLIMATE.

Phycis: See FORKED-BEARDS.

Phycol'ogy [Gr. *φῦκος*, seaweed + *λόγος*, discourse, reason]: the botany of the algæ, or seaweeds, in the broadest sense. It thus includes the green members of the PROTOPHYTES, PHYCOPHYTES, and CARPOPHYTES (*qq. v.*). See also DESMIDS, DIATOMS, FUCOIDS, KELP, RED SEAWEEDS, and STONEWORTS.

Phycomyces: See MUCORACEÆ.

Phyco'phytes, or **Phycoph'yta** [from Gr. *φῦκος*, seaweed + *φυτόν*, plant]: a branch of the vegetable kingdom in which the result of the sexual union of two cells is the formation of a single "resting-spore" (zygospore or oöspore). Phycophytes are the lowest plants which exhibit sexuality, and by this they are easily separated from the PROTOPHYTES (*q. v.*). They are distinguished from the CARPOPHYTES (*q. v.*) by the simple spore which results from the sexual act, in contrast with the many-celled "fruit" of the higher group.

The structure of the plant-body ranges from the simple cell, as in PROTOCOCCUS, DESMIDS, and DIATOMS, to the large KELP and other FUCOIDS (*qq. v.*) with stems and leaves. Phycophytes are separable into two well-marked classes, and seven orders as follows: Class I., *Chlorophyceæ*; Orders, *Protococcoideæ*, *Conjugatæ*, *Siphoneæ*, and *Confervoideæ*. Class II., *Phæophyceæ*; Orders, *Phæosporeæ*, *Dictyoteæ*, and *Fucoideæ*. In the first, second, and third orders some of the families are degraded, chlorophyll-less parasites and saprophytes. All others are independent plants (holophytes), possessing chlorophyll (or an equivalent), although sometimes hidden by brown or smoky coloring matter, as in the Diatoms, Kelps, and Rockweeds. See also EMBRYOLOGY IN PLANTS. CHARLES E. BESSEY.

Phylac'teries [from Gr. *φυλακτήριον*, guard-post, safeguard, amulet, deriv. of *φυλακτήρ*, watcher, guard, deriv. of *φυλάσσειν*, guard, watch]: properly, amulets worn to protect the person from evil influences. In the New Testament the name is given to the leathern cases containing on fine parchment the four passages, Ex. xiii. 1–10; xiii. 11–16; Deut. vi. 4–9; xi. 18–21. They are fastened by leathern straps to the forehead and the arm, and also to doorposts and the like. This custom has been maintained from very ancient times by the Jews, and is based upon a literal interpretation of Ex. xiii. 9, 16; Deut. xi. 18.
Revised by S. M. JACKSON.

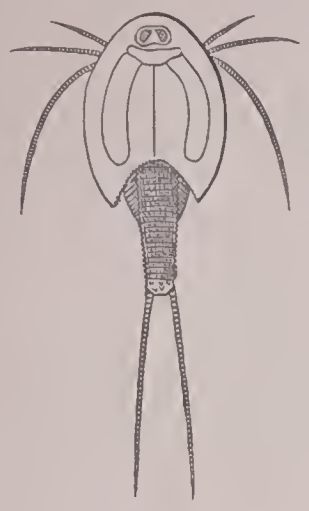
Phy'læ [= Lat.= Gr. *φυλαί*, plur. of *φυλή*, tribe, clan]: the tribes into which ancient Attica was divided. Their number was originally four, but after the expulsion of the Pisistratidæ it was raised to ten by Cleisthenes; two more were afterward added in honor of Antigonus and his son Demetrius. At the head of each tribe was a phylarch, who superintended the registering of the members of the *phyle*, organized the choirs for the festivals, presided over the communal assemblies, and commanded the contingent of cavalry. Afterward, however, the office was divided, the phylarch retaining only the military duties, while the civil duties were transferred to a new office, that of the *epimeletes*. To the Athenian senate each phyle sent fifty members. J. R. S. STERRETT.

Phylar'chus (in Gr. *Φύλαρχος*): Greek historian of the third century B. C.; wrote the history of Greece from the expedition of Pyrrhus against the Peloponnesus down to the death of the Spartan king Cleomenes (220 B. C.), of whom he was a passionate partisan. Fragments are to be found in Müller's *Fragmenta Historicorum Græcorum* (vol. i., pp. 334–358; vol. iv., p. 645). B. L. G.

Phyllo'ma: See MORPHOLOGY (*Vegetable*).

Phyllop'oda [Mod. Lat., from Gr. *φύλλον*, leaf + *πούς*, *ποδός*, foot]: the lowest or most primitive group of Crusta-

cea, embracing segmented forms provided with numerous (ten to sixty, or more) pairs of leaf-like feet. In some the segments are easily seen in the anterior region of the body; in others this portion is covered by a "carapax" formed by a duplication of the skin, which either covers the body like a scale, or is folded so that it forms a bivalve shell, in which the body can be entirely retracted. None are marine; most species live in fresh water, but some are found in strong brine, for example in Great Salt Lake. It is interesting to note that Schmankewitch has pointed out that by transferring fresh-water forms to brine he was able to change not only specific but generic characters. Another fact of interest is that the eggs require desiccation and then reimmersion in water before they will develop. Corresponding to the development of the carapax noted above three families are recognized, the *Branchiopodidæ*, without carapax, the *Apodidæ*, with simple carapax, and the *Estheridæ*, inclosed in a bivalve shell. To the first belong the "fairy shrimps" common in roadside pools in the spring, and the brine shrimps; the second family occurs in North America only, W. of the Mississippi. The *Estheridæ* of the ponds are liable to be mistaken for small bivalve molluscs. To the naturalist these forms possess the greatest interest, as they probably represent the stock from which all other Crustacea have descended. They occur in all geological ages from the Cambrian to the present.



Apus equalis (after Packard).

LITERATURE.—Lankester, *Quarterly Journal Micros. Sci.* (xxi., 1881); Packard, *Monograph of Phyllopoda* (in Twelfth Annual Report U. S. Geological [Hayden's] Survey); Claus, Development, *Arbeiten. a. d. zoolog. Inst.* (vi., Vienna, 1886).

J. S. KINGSLEY.

Phyllostom'idæ [Mod. Lat., named from *Phyllos'toma*, the typical genus; Gr. *φύλλον*, leaf + *στόμα*, mouth]: a family of bats, so named from the leaf-like nasal appendages. The nostrils are in the front part of the cutaneous nasal appendages or open by simple apertures at the extremity of the muzzle; true molars are developed; there are four upper incisors, and the stomach is sacciform.

Phyllotaxy: See BOTANY and LEAF.

Phylloxe'ra [Mod. Lat.; Gr. *φύλλον*, leaf + *ξηρός*, dry]: a genus of plant-lice. There are but few species so far known as indigenous to Europe, but about twenty species have been described from the U. S.

The genus is essentially gall-inhabiting. It is distinguished from the other genera of the *Aphididæ* by the three-jointed antennæ (the third joint much the longest), by the simple venation of the wings, and by these being carried flat on the back, and not roof-fashion, as in the more typical Aphides.

For a long time the term *phylloxera* was known only to the naturalist; but since about 1870 the grape phylloxera, or *Phylloxera vastatrix*, Planchon, a species which injuriously affects the grapevine, has attracted so much attention, particularly in Europe and North America, that it has come to be known as *the* phylloxera. This insect, while it occasionally acquires the gall-making habit, normally dwells underground upon the roots of the food-plant. A native of North America, discovered in New York in 1854 by Fitch, it is found from Canada to the Gulf wherever the grapevine grows, and has doubtlessly existed on the wild vines from time immemorial. Early in the history of grape-culture in the U. S. the gall-making type was observed on the leaves of certain varieties, especially on the Clinton. The more normal root-inhabiting type was not suspected, however, till discovered by Riley in 1871. Meanwhile, about 1865, a peculiar grape-root disease began to attract attention in France. At first noticed in the lower valley of the Rhône, it spread rapidly until the entire destruction of the grape interest was threatened. In 1879 infested vines had been taken up and destroyed from nearly 3,000,000 acres. For several years annual appropriations amounting to almost $200,000 were made by the government for the carrying on of phylloxera investigations, and in 1874 a reward of 300,000 francs ($60,000) was offered for the discovery of an effectual remedy. The study and investigation which this induced soon brought to light the facts that the insect producing the disease was identical with that which is indigenous on American vines, and that it was imported into France from the U. S. in 1863 on vines sent to French nurserymen. It now occurs in all the vine-raising countries of Europe, and has been reported from South Africa, Algeria, New Zealand, and Australia.

Natural History of the Insect.—The species, as already intimated, presents itself in two types—the one (*gallicola*) gall-inhabiting, the other (*radicicola*) root-inhabiting. The former is easily distinguished from the latter (see accompanying figures) by lacking the tubercles or warts on the back. On carefully opening one of the galls we find it to contain the mother-louse and many pale-yellow eggs scarcely one-hundredth of an inch long, and not quite half as thick. The louse is about ·04 inch long, of a dull-orange color, and looks like an immature seed of the common purslane. The eggs hatch in six or eight days, and the young lice differ from their mother in their brighter yellow color and more perfect legs. Issuing from the mouth of the gall, the young lice scatter over the vine, most of them finding their way to the tender terminal leaves. Here they begin sucking the sap, forming galls, and depositing eggs, as their parent had done before. This process continues during the summer until the fifth or sixth generation. Every egg brings forth a fertile female, which soon becomes wonderfully prolific. By the end of September the galls are mostly deserted, and those which are left are usually infected with mildew, and eventually turn brown and decay. The young lice attach themselves to the roots and thus hibernate. It is an important fact that the gall-inhabiting insect occurs only as a parthenogenetic and apterous female form. It is but a transient summer state, and does, compared with the other or root-inhabiting type, but trifling damage.

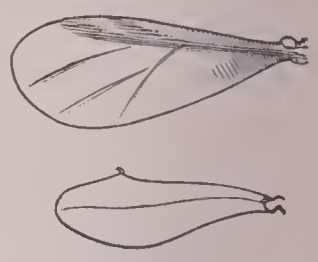


FIG. 1.—Upper and under wings of phylloxera.

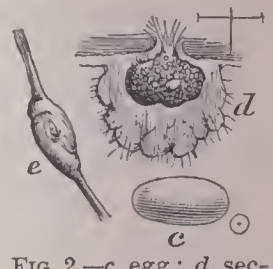


FIG. 2.—*c*, egg; *d*, section of gall, showing mother-louse and eggs; *e*, swelling of tendril; dot and lines showing natural size.

The more normal or root-inhabiting type presents many more forms and many interesting biological traits. The newly hatched lice are precisely like those which hatch in the galls, but, as they develop, rows of tubercles appear on the back where only minute short hairs were observed before (Fig. 5). During winter these young are found, somewhat dulled in color, adhering closely to the roots. As vegetation starts in spring they become active, rapidly enlarge, and soon begin laying unimpregnated eggs, for there are at that time no males. These bring forth females, which in their turn develop and lay unimpregnated eggs, and this virginal reproduction continues for five or six generations, the development increasing in rapidity with the heat, but the number of eggs decreasing. In July some of the individuals show little wing-pads at the sides, and begin to issue from the ground and to acquire wings. These winged individuals become very numerous in August, and continue to appear in diminishing numbers thereafter till the leaves have fallen. They are all females, and carry in the abdomen from three to eight eggs of two sizes, the larger ones about one-fiftieth of an inch long and half as wide; the smaller, three-fourths as long. These eggs are also unimpregnated, and are laid by preference on the under side of the more tender leaves,

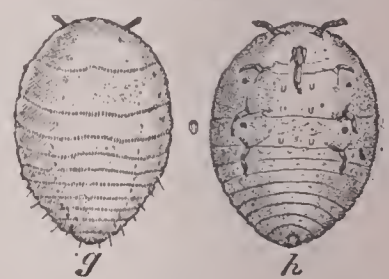


FIG. 3.—Mother gall-louse: *g*, dorsal; *h*, ventral view; natural size indicated between them.

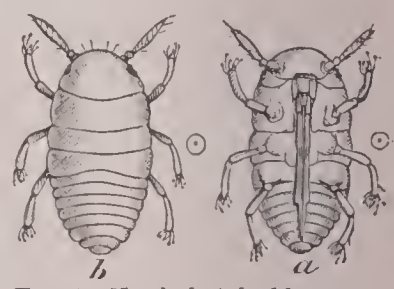


FIG. 4.—Newly hatched larva: *a*, ventral; *b*, dorsal view; natural sizes in circles at sides.

attached by one end amid the natural down. They increase somewhat in size, and give birth in about ten days to the true sexual individuals, the larger eggs producing females, the smaller males. These individuals are born fully developed, and are wingless and without mouth parts. A remarkable fact is that some of the females that never acquire wings, but always remain on the roots, also produce the few different-sized eggs from which males and females hatch. The sexes pair soon after hatching, and the female is delivered on the third or fourth day of a solitary egg, and then perishes. This impregnated egg is never laid on the leaf, but always on the wood, in sheltered situations above ground, or on the roots underground. The young hatching from it is the normal parthenogenetic mother, which lays a large number of eggs, and recommences the virginal reproduction and the cycle of the species' curious life. The impregnated eggs laid early in the season doubtless hatch the same year, but most of the eggs pass the winter before hatching, and from this fact are known as "winter-eggs."

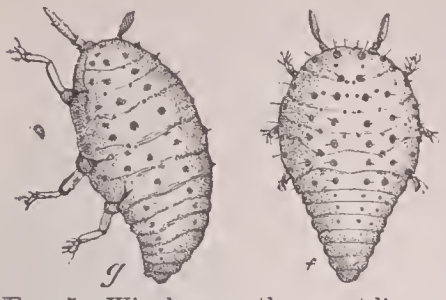


FIG. 5.—Wingless mother root-lice: *f*, dorsal; *g*, lateral view; natural size indicated at side.

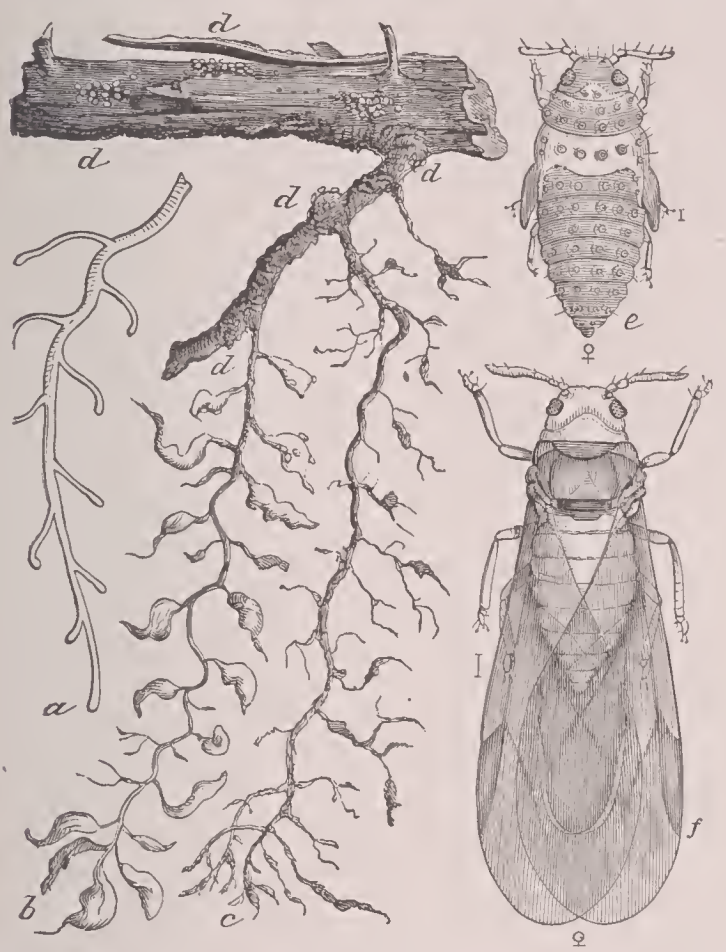


FIG. 6.—*a*, healthy root; *b*, root on which the lice are working, showing the knots and swellings caused by their punctures; *c*, root deserted by them, on which the rootlets have begun to decay; *d d d*, lice on the larger roots, natural size; *e*, female pupa, dorsal view; *f*, winged female, dorsal view, greatly enlarged.

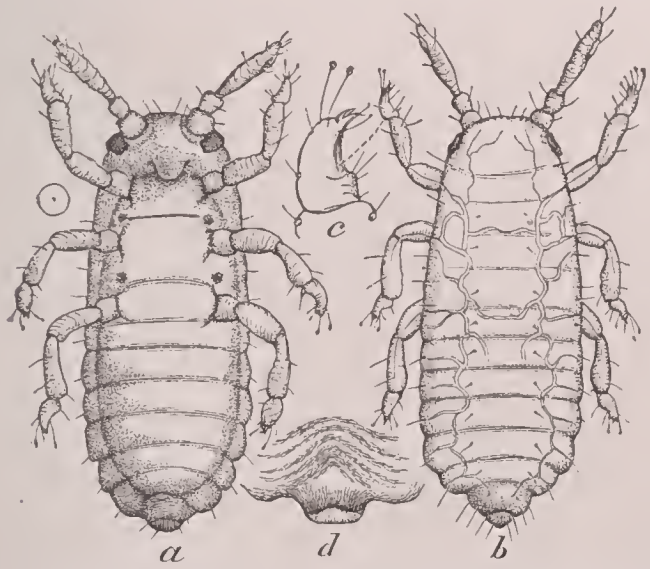


FIG. 7.—True female phylloxera: *a*, ventral view, showing obsolete mouth and solitary egg occupying nearly the entire body; *b*, dorsal view; *c*, tarsus; *d*, contracted anal joints after the egg is laid; dot in circle showing natural size.

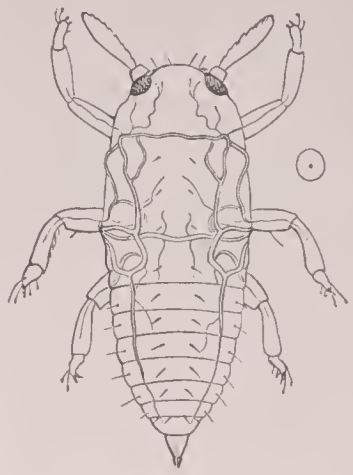


FIG. 8.—Male phylloxera: dot in circle showing natural size.

Appearance of the Phylloxera Disease.—A vine attacked by phylloxera has the more fibrous roots covered with little swellings; and a careful examination of the swellings during the growing season will disclose numerous yellowish lice of different ages, and groups of brighter yellow eggs barely visible to the naked eye. The swellings in course of time rot, and the lice settle on the larger roots. Vines that are more susceptible to the disease generally show external signs the second year of attack in a sickly, yellowish appearance of the foliage and in stunted growth; while the third year they frequently perish, when on examination the lice are no longer to be found—they have left or died—and all the finer roots have decayed and wasted away.

Spread of the Disease.—The wingless phylloxera travels over the surface of the ground from vine to vine, or beneath the ground where roots interlock; while in the winged form it may fly or be carried as many as 15 or 20 miles, and, under exceptional conditions, even more. Through man's agency, by commerce in plants and cuttings, it may be carried to indefinite distances. Hence the importance of precautionary measures in grape-producing countries still free from the scourge, and the wisdom of laws—such as have been enacted by Australia, Algiers, Italy, Germany, and other countries—prohibiting the importation of vines from infested regions.

The Disease more Virulent in Foreign Countries than where it is indigenous.—A certain harmony or mutual adaptation exists between the autochthonous fauna and flora of a country, the result of a long-past "struggle for existence." Plants and animals suffer most from diseases which they have not been accustomed to. American vines, though showing a varying power of resistance to the attacks of phylloxera, are less susceptible than the European vine, which has been so long under cultivation and which is more highly developed and more tender.

Practical Considerations.—Of the many remedies that have been proposed, none is universally practicable or satisfactory. Such an underground enemy is measurably beyond man's reach. Submersion, where feasible, is a sufficient protection. Bisulphide of carbon and sulpho-carbonate of potassium have proved useful, while petroleum emulsions may be used to advantage. Having discovered that the cultivated American vines possess a varying degree of resistance to the disease, there has been an immense demand from Europe for cuttings of the least susceptible of American vines. Many vineyards in France are being replanted with American vines. In 1881 22,000 acres in seventeen departments were so planted, while by 1890 719,500 acres in forty-four departments were covered with American vines. The varieties most employed are Clinton, Taylor, Jacques, and those more particularly belonging to the species *æstivalis*, as Cunningham, Norton's Virginia, Herbemont, Cynthiana, etc.

C. V. RILEY.
Revised by VERNON L. KELLOGG.

Phylogeny [from Gr. *φῦλον*, tribe, race + root of *γίγνεσθαι*, be born]: a term introduced by Haeckel to include the evolution of the race. Ontogeny, the contrasted term, includes the development of the individual from the germ. See MORPHOLOGY.

Phy'salis [from Gr. *φυσαλλίς*, bladder, kind of plant with bladder-like husk or calyx]: a genus of annual or perennial herbs of the family *Solanaceæ* or nightshades, embracing about thirty species, seventeen of which are found in the U. S. The *P. peruviana*, otherwise known as strawberry tomato, ground-cherry, winter-cherry, yellow alkekengi or Cape gooseberry, is cultivated in gardens in England,

France, and the U. S., and bears an edible fruit inclosed in a balloon-shaped netted angular calyx. The *P. alkekengi*, probably a native of Spain or North Africa, bears a brilliant scarlet berry, and is an ornamental garden plant. An American species, *P. philadelphica*, or purple ground-cherry, has a dark-purple berry an inch in diameter, which is sometimes preserved. Revised by CHARLES E. BESSEY.

Physap'oda: See ENTOMOLOGY.

Physeter'idæ [Mod. Lat., named from *Physe'ter*, the typical genus, from Gr. φυσητήρ, blower, bellows, kind of whale, deriv. of φυσᾶν, blow, blow up]: a family of toothed whales, containing the sperm-whale (*Physeter*) and pigmy sperm-whale (*Kogia*). Its members have a blunt head, which projects forward in advance of the jaw; the blowhole well forward, and in the sperm-whale on the left side; there is no back fin. The skull, which is unsymmetrical, has its front upper edges turned upward to form a sort of basin in which rests the cartilage containing the spermaceti. The halves of the lower jaw are anteriorly in contact for some distance, and in the adult teeth are present in the lower jaw only. See CACHALOT. F. A. LUCAS.

Physical Education: the training of muscles and nerves, which constitutes the modern practice of gymnastics. Though the term physical education is of comparatively recent date, and the thought suggested complicated and extensive, the idea itself is older than any records, and the underlying principles and methods which we now apply consciously and understandingly were prehistorically applied, perhaps unconsciously, yet at least effectively, as shown by the physique developed. As we compare the physique of to-day with that of two or three thousand years ago, we find very slight differences. Again, in those races which are still in their childhood as to mental and social development, we find essentially the same physical proportions. This physique has resulted from the physical activity necessitated by the environment of the generations which have preceded.

Ancient Aims and Methods.—In the earliest records we learn nothing of any conscious body training. The early peoples did what they were forced to do, hunted, farmed, or took care of their flocks, each one doing a multitude of things, and thus getting, perforce, a good all-round body training. Their relations to their neighbors were not always pleasant, and it was important to be able to fight effectively; hence the practice with the club, bow, spear, and sword naturally assumed a prominence in the education of the youth. Here we find the first hint of physical education in the training of the body for a definite future end. In all primitive peoples this seems to have been the main factor, and has determined the body training toward endurance of fatiguing travel, running, swimming, and in the use of weapons. The plays of childhood, then as now, tended to the imitation of the most attractive occupations of the parents, so again we have the use of toy weapons as well as spontaneous games which arose from the pure enjoyment of physical activity. Strength meant so much to the more warlike of the primitive peoples that it is not surprising that they worshiped it as an attribute of the gods, and sought to develop it by constant practice, crowning the strongest, bravest man as hero and leader. In studying the early records we find that the ideals of the peoples affected markedly the physical life. Warlike nations tended to skill and endurance in the use of weapons and armor, while others, as in India, prized grace and suppleness.

The Greeks.—Among the early Greeks the ability to wield effectively the sword and spear, javelin and bow, to run, climb, and endure fatigue transcended in practical value all other accomplishments, so it is not surprising to find that the education of the youth consisted essentially of this training. Later the ideals of the Greeks became broader, and we have the conscious training for grace and symmetry. The physical training of the Greeks was of a general character, consisting largely of games and contests, including running, leaping, wrestling, throwing the discus and spear, boxing, use of bow, various games with balls, and swimming. Many gymnasia were maintained for systematic training in athletics and gymnastics. The physical life was considered as of equal importance with the mental in the palmy days of Athens, and at the contests in Olympia and elsewhere the successful competitors were crowned with olive as were the poets and orators. The educational value of gymnastics was recognized by them in addition to the merely utilitarian, and "mens sana in corpore sano" is here first suggested.

The spirit of friendly contest was gradually lost, and professionalism resulted from the lowering of physical ideals, gymnastics and athletics becoming a duty of the slaves for the amusement of their effeminate masters. The Romans borrowed generously from the Greeks in their ideas of body training, outdoing them in building magnificent baths and gymnasia; but in their history is repeated the same change in physical ideals and resulting effeminacy. The barbarians who conquered them possessed the physical power in which they were wanting.

Middle Ages.—Until the invention of firearms military success was dependent upon bodily strength. We find this holding true through the Middle Ages, when the educational side of exercise was ignored and only the utilitarian valued. In contrast to this military attitude was the monkish, in which the body was disowned and the soul only regarded. On the one hand, we have chivalry developed with strength, grace, and beauty as ideals, while in sharp antagonism we have the monasteries filled with men who looked upon the body as a fetter to the soul, a thing to be scourged and starved into subordination. With the advent of gunpowder the utilitarian stimulus to training was lost, for men no longer won battles by brute force, and physical training became a thing of the past, aside from the spontaneous games of childhood and youth.

Beginning of Modern Gymnastics.—Luther began a reaction from this condition, though little was accomplished for many years. A German physician, Mercurialis, published a treatise (*De Arte Gymnastica*, 1573) on the old Greek gymnastics in which he emphasized the hygienic effects of exercise. Similarly an English physician, Thomas Fuller (1654 to 1734), advocated a return to the Greek methods. Montaigne and Locke made strenuous efforts in behalf of a broad education to include physical training, but it remained for Rousseau by his *Émile* (1762) to rouse general public interest in the movement.

Germany.—Basedow, Salzmann, Pestalozzi, Gutsmuths, Vieth, and Nachtigall became successively interested, and established gymnasiums in connection with certain schools. They worked enthusiastically, devising new movements and testing them, selecting and systematizing those which seemed valuable. The movement had not become general, till Jahn, an accomplished gymnast, conceived the idea of nationalizing Germany by educating the youth, and rousing in them the spirit of patriotism. To this end he organized societies for systematic instruction and training in gymnastics and athletics. He also invented many pieces of apparatus, such as the parallel and horizontal bars, and greatly enriched systematic gymnastics by adding new and varied exercises. Jahn is indeed the father of modern gymnastics. His influence spread quickly through Germany; societies were organized in the towns and villages, and the youth became strong, active, brave, and patriotic. Much credit must be given to Spiess, also, for suggesting many features which popularize gymnastics. After the German war for independence the gymnasiums flourished till 1819, when they were suppressed for political reasons, but revived in 1844. The spread of gymnastics in the U. S. and other countries at this time was due to exiled teachers from Germany. In Switzerland a complete system was organized by Clias at the same time Jahn was working in Germany, and this extended throughout the schools and spread to France, Italy, and England. The German influence has been preponderate in the U. S. At Milwaukee a normal school for the training of gymnastic teachers has been maintained by the Turners for years, and their societies are found in all the larger cities supporting well-equipped gymnasiums, constantly used by the enthusiastic members, and always exerting a strong influence for the broader school curriculum which shall include gymnastics. A marked characteristic of the German system is that it grows spontaneously, because it embodies the play instinct, and rouses all the stimulating emotions of play, at the same time giving the needed exercise.

Swedish System.—Ling, the founder of the Swedish system, was familiar with what Jahn and others were doing in Germany and Denmark, but worked out a system of movements from an entirely different standpoint. He analyzed movements into elements, each performed by as few muscles as possible, thus claiming to localize the will and train coordination. After drilling on these elementary movements for "purity" he combined them into groups forming complete exercises. The resemblance to the a-b-c method of learning to read is striking. Ling's aims were hygienic, educational, therapeutic, and military, and he worked out

what must be regarded as the most definite system of physical training that has yet been evolved. He formulated the idea of progression, making it more extensive than the Germans, because he forced all to begin with rudimentary movements, while the Germans built upon what the pupils already knew. Ling made a rigid artificial progression, while with the others the natural power was the guide to progress. He made a "day's order" the unit of work, insisting that all parts of the body should be exercised, and that exercise should begin gradually, reaching a maximum of effort before the end of the work, and finishing with slow easy movements to aid the heart to resume its normal beating. He worked constantly for discipline and initiated each movement by a command, thus keeping the attention fixed. This necessitated the naming of all movements, and has resulted in an extensive nomenclature. Music can not be used with the order movements, and is deprecated by the Swedes. The Swedish work was introduced in the form of "movement cure" by Taylor, of New York, many years ago. Dio Lewis based his "Mutual Help" gymnastics for schools upon the Swedish idea of analysis, but made the valuable addition of resistance in all the movements. Since 1889 a strong effort has been made to introduce the unmodified Swedish system generally into the schools of the U. S.

Physical Training in England.—England's contribution to physical training has been chiefly the development of sports and games, such as archery, football, cricket, tennis, boating, hare and hounds, handball, etc. These furnish undoubtedly as complete and thorough body development as was gotten in the primitive days. Dr. Parke has stated it very strongly: "The national games of English boys are infinitely superior to any system of artificial exercise ever devised." The great difficulty is that such games can not be made available for the proper development of all the children of the nation, owing to lack of time and space. In 1862 Lord Elcho made a strong effort for scientific physical training, and soon after Maclaren began his work at Oxford, which has resulted in such valuable contributions to our knowledge of the hygiene of exercise and training. (*Physical Education*, 1869, and *Training in Theory and Practice*, 1874.)

In the United States.—Between 1821 and 1879 several of the schools and colleges in the U. S. established gymnasiums, chiefly influenced by the Germans. The building of the Hemenway gymnasium in 1879 by Harvard College marks the beginning of an era in gymnastics in the U. S. Its influence may be seen in the rapid increase in the number of gymnasiums, all founded, essentially, upon the Harvard system of measurements and appliances. These now number more than 1,000, including the Y. M. C. A. gymnasiums, and have cost millions of dollars.

The Harvard System.—The Harvard system of developing appliances started in 1869, when Dr. Sargent took charge of the Bowdoin College gymnasium as student-instructor. At this time the equipment of a gymnasium consisted of certain German apparatus, parallel bars, horizontal bar, trapeze, etc., which were used by a few of the students only. The mass of the students were not experts in these exercises, and did little or nothing in the way of gymnastics aside from the enforced military drill, from which they revolted. They were hardy fellows and accustomed to heavy outdoor work, yet few were really well developed, most of them having done work which left its impress in characteristic asymmetry and faulty attitudes. A careful study of the problems thus presented led to the formulation of certain general principles which have since served as valuable guides. It was seen that attitudes necessitated by occupations became fixed habits in ratio to the length of time they were held uncorrected by other attitudes; also that in individuals possessing unequal muscular development faulty attitudes were often the result of the apparent shortening of stronger muscles, the increased tonicity of these muscles exerting a constant pull with the result mentioned. Thus the necessity of supplementing the development due to occupation was clearly seen, and also the rational method of effecting this by the local development of the relaxed weaker muscles. To do this economically and definitely various machines were devised which offered the required resistance. The first of these was the adjustable chest-weight (1869). This exercising-machine enabled one to exercise so much of the body that it was practically universal in its application, and was adopted by the gymnasiums of the U. S. till now it is a staple part of their equipment. The chest-weight was followed by other "developing appliances" as this kind of apparatus came to be called, all from the same motive, to furnish means selectively to build up weak and relaxed muscles to the best advantage. Such developing appliances are the high and low pulleys, leg-machines, wrist and ankle machines, chest expanders and developers, quarter circle, abdominal machine, etc., forty in number, devised chiefly between the years 1869–79. Dr. Sargent's gymnasium in New York was the first to be at all fully equipped with this apparatus (1878), and the Hemenway gymnasium, Harvard University, was the next (1879); this is one of the most fully equipped in the U. S. The developing appliances were devised to supplement other gymnasium work, not to replace it. The movements are practically similar to the Swedish, but differ essentially in that they are all made against external resistance which can be adjusted to strength, hence co-ordination is trained to an economical expenditure of energy in overcoming such resistance. This is an important distinction which serves as one basis for the classification of movements, for in slow free movements, such as the Swedish, much of the resistance comes from the contraction of antagonistic muscles. The individual's need may be made the basis of work, and a clear prescription given specifically directing his work toward the attainment of his ideal form and condition, not only from a physical standpoint, but in relation to his intellectual activity. This makes it important to have a trained physician study the individual and decide the problems presented in each case.

Zander, of Sweden, has devised an elaborate set of apparatus for resistive movements both active and passive, answering much the same purpose as the developing appliances, but too expensive to be generally available.

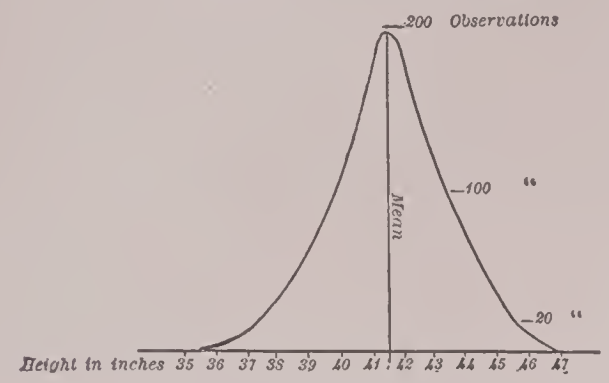
Anthropometry.—Doubtless for ages measurements have been taken as a means for comparing muscular development and recording the progress of an individual while in training. These measurements were chiefly of the height, weight, upper arm, forearm, chest, thigh, and calf, and were made at first with no idea of collecting data, but for immediate limited use. About 1870 anthropologists and ethnologists became interested, and by their suggestions gave an impetus to a broader consideration of the subject. The value of the measurements of a large number of individuals of school and college age was now first realized as contributing to a study of the rate of growth, influences affecting growth, males as compared with females, different nationalities, etc.; all questions of vital importance. To the more obvious measurements taken previously were added bone lengths, joint circumferences, and girths of important parts of the head, trunk, and limbs, together with certain strength tests, as grip, number of times pull-up and push-up, strength of back, leg, and chest muscles, of expiratory muscles, capacity of lungs, and a record of color of eyes and hair, history of diseases and habits, and nationality of parents and grandparents. This list of measurements was definitely selected and methods of taking formulated in 1878, and presented by Dr. Sargent in a report to the American Association for the Advancement of Physical Education in 1886, to insure the general use of the same methods, and hence to make the results of all examinations comparable. Valuable tables of measurements have been contributed since 1869 by Baxter and Gould, army recruits; Galton, of boys, 1875; Bowditch, of school children, *Rep.* State Board of Health, Massachusetts, 1877–79–91; Roberts, *Com. Rep. British Association*, 1878; Hitchcock, Amherst students, 1887–89–90–92; Erismann, Russian factory employees, 1889; Pagliani, Italian children; Wood, Wellesley students, 1890; Porter, school children of St. Louis, 1893; Sargent, Harvard students, etc. The number of persons of whom complete measurements had been charted in percentile grades was 15,000 in 1893.

The method of graphically representing the values of individual measurements relative to the whole mass of measurements by percentile grades, published by Galton in 1885, has been of the greatest assistance in studying the statistics gathered, bringing to light as it has numerous minor problems before overlooked. This method also made possible the charting of tables so that they can be used quickly and conveniently.

Attention is now being directed to the necessity for tests which shall show the condition of an individual as a vital unit, not merely as a mass of muscle and bone; tests of quickness, accuracy, endurance of mental and muscular power, of voluntary muscular control, delicacy of adjustment of automatic control, of circulation general and local,

of respiration, response of circulation and respiration to exercise, fatigue, tone of nervous and muscular systems, etc. These are problems constantly facing one practically interested in physical education, but so difficult of approach that little has yet been done. Mosso, Demeny, Galton, Warner, and others are working on the problems in Europe, and Harvard University has established a laboratory for such research in the U. S.

Charting Measurements.—The classification of large numbers of individuals shows a remarkable uniformity in the distribution of variation of corresponding measurements. The law of this variation is shown by the chart given herewith, of heights of individuals of the same age. It will be



Curve of distribution of 848 observations. Heights of boys five years old. From Bowditch's tables.

seen that at the center we have by far the larger number of observations suggesting for this age a tendency to a "medium" height. All other measurements may be similarly plotted and the means determined. Putting these means together, of all the items measured we may determine the parts of what may be called a medium or normal individual. By a similar method were gotten the data for modeling the statues representing the normal college student, male and female, exhibited by Dr. Sargent at the Columbian Exposition, Chicago, 1893. This medium individual, of course, shows the actual general type prevailing, not the highest type perhaps attainable, and the test of its correctness is the fact that if a number of new measurements of the same class of individuals is added it does not change this type, but merely falls into proper relation to it. Dr. Porter has contributed a valuable study of the relation of weight to scholarship in school children of St. Louis. He has taken weight as an index to strength and development, and has expressed the relation of weight and age to scholarship in percentile grades. This has brought out the fact that large children take higher intellectual rank than small ones in all the grades of the school, and that the rate of growth is practically the same for all grades of intellectual precocity. President Hyde of Bowdoin College has shown that scholarship and physical development in college work go similarly hand in hand. Dr. Bowditch has clearly shown the rate of growth in children of school age, and demonstrated the physical superiority of girls from eleven to fourteen years of age, due to their more rapid development. See Sargent, *N. A. Rev.*, Feb., 1883; *Physical Training in American Colleges and Universities*; Hartwell in *Report of the Commissioner of Education* (1886), p. 663; and J. Stanley Hall, *A Bibliography of Education* (1886). D. A. Sargent.

Physical Geography: the geography of nature, or the science of the surface of the earth and its envelopes. The structure of the earth and the history of the changes to which the structure and surface configuration are due are the field of geology; the general form of the earth as a spheroid belongs to geodesy; its motions and its relations to other planets and the sun belong to astronomy; the distribution of human races on the earth belongs to ethnography; the partitioning of the earth among governmental organizations to political geography; and the redistribution of natural products through human transportation to commercial geography. Physical geography includes physiography, or the classification and explanation of the various elements of the surface configuration; oceanography, or the description and study of the aqueous envelope; meteorology, or the description and study of the gaseous envelope; zoögeography, or the natural distribution of animals; and phytogeography, or the natural distribution of plants. See Geography, Physiography, Hydrography, Ocean, Meteorology, and Geographical Botany. G. K. Gilbert.

Physical Training: See Physical Education.

Physics, or **Physical Science** [*physics* is from Gr. *φυσικός*, natural, deriv. of *φύσις*, nature]: literally, the knowledge of the processes, both mechanical and vital, which occur in nature. In this sense the word physical has the same meaning as natural, but in the development of science the words have been specialized and the former has been used so as to exclude the study of organized bodies and the mineral world. Thus physics lies between pure mathematics—that is, arithmetic, algebra, and geometry—on the one hand, and natural history on the other hand. Chemistry is properly a physical science, but custom has excluded it from the domain of physics. The following is a list of the principal divisions of physics:

I. Mechanics (*q. v.*), which includes kinematics (see Motion), Dynamics (*q. v.*; see also Energy), Statics (*q. v.*; see also Composition of Forces), or the subject may be divided according to the nature of the body studied. Thus we have the mechanics of a particle, of a rigid body, of an elastic body, and of a fluid, the last being subdivided into Hydrostatics (*q. v.*) and hydrodynamics (see Hydraulics).

II. The secondary physical sciences, viz.: Optics (*q. v.*, where its subdivision into different departments, light, etc., is given); Acoustics (*q. v.*; see also Refraction of Sound, etc.); Electricity (*q. v.*); Magnetism (*q. v.*; see also Magnetism of Iron and Magnetism, Terrestrial); and the branches dealing with the action of pressure and heat in changing the volumes and physical states of bodies, for which see Heat, Gas, Liquids, Pneumatics, Thermodynamics, etc. R. A. Roberts.

Physics of Vegetation: See Physiology, Vegetable.

Physiocrats: See Political Economy.

Physiognomy [from Gr. *φυσιογνωμονία*, art of judging a man by his features, deriv. of *φυσιογνώμων*, judging by features; *φύσις*, nature + *γνώμων*, judge]: the art of interpreting the character of man by facial conformation and expression. It was first presented as a systematic study by Lavater in 1775. It was included in the systematic phrenology of Gall and Spurzheim. While much has been, and is still, claimed for physiognomy inconsistent with the facts of the natural history of man and the laws of physiology, the face may be regarded as an index, by facial expressions developed both voluntarily and involuntarily, of the prominent characteristics of intellect, emotion, and will. The physiognomy of infants, while the intellect is latent, expresses only happiness and pain or sorrow. With the training of the tongue and lips in phonation, and the development of the language of expression by the control of the muscles of the eye, the nostrils, and mouth, combinations of facial lines and individuality of features become established. By electrical excitation of muscles and groups of muscles of the face, the various expressions of mirth, sorrow, impotency, power, etc., may be produced irrespective of the mental condition—expressions which the subject's character had never developed. In hypnotic experimentation, also, the state called catalepsy is favorable to the systematic study of the muscles of facial expression. Recent research shows that a large part of facial expression is acquired by unconscious imitation of that of others. See Charles Bell, *The Anatomy of Facial Expression*; Darwin, *The Expression of the Emotions*. Also see Face.

Revised by J. Mark Baldwin.

Physiography [Gr. *φύσις*, nature + *γράφειν*, write]: as a part of physical geography, the science which describes, classifies, and explains the forms of the earth's surface. The features of the earth are conveniently grouped according to form, and also under the processes by which they have been produced. In this article they are arranged primarily according to form, and those of like form are classified by genesis. The processes through which they originate are: 1, diastrophism, or uplift and downthrow; 2, volcanism; 3, erosion and deposition by water; 4, erosion and deposition by wind; 5, erosion and deposition by waves; and, 6, erosion and deposition by glaciers. These are described under *Dynamic Geology* in Geology (*q. v.*).

Features of the Land.—Upon the uneven surface of the earth rests a great body of water which, being gathered in the hollows, divides the surface into a submerged or oceanic portion, and an emergent portion, the dry land. As viewed on the map and in respect to climate and various activities of man, the relation of the land to the ocean is of great importance, and the shapes of the land, as defined by coasts, are distinguished as continents, islands, peninsulas, etc.

Continents are the greatest of the land areas. Their ex-

tent, connections, and peculiarities of outline depend on what may be regarded as an accidental condition—the amount of water on the earth's surface; but they may also be regarded as the summits of the greater prominences of the earth's surface, and these prominences are the result of subterranean processes, the nature of which is little understood. See CONTINENT and EARTH.

Islands are in general small continents, and similarly owe their character to the accident of ocean-level, but something more specific can be said as to their origin than in the case of continents. Some of them are produced by the local and narrowly limited uplift of the ocean-floor; others by the building of subterranean volcanoes whose peaks are finally carried above the surface; yet others are occasioned by the elevation or subsidence of broad tracts of the earth's surface, elevation bringing above water the shoals of the ocean-bed, subsidence causing the sea to overflow the lower parts of the land, leaving plateaus or mountains as islands; yet another class have an organic origin, being formed by the growth of coral reefs which eventually reach the surface. Low and temporary islands are formed along some coasts through the shifting of sands by winds and currents. Out of fresh-water lakes, which usually result from the flooding of tracts previously dry, pre-existent hills and mountains sometimes project as islands, and certain rhythmic factors in the flow of streams cause them to divide their waters from time to time so as to inclose islands. See ISLANDS and RIVERS.

Peninsulas, differing from islands only in their narrow connections with mainlands, may be ascribed to all the causes which originate islands, and in the progressive development of geographic forms there is a constant interconversion of islands and peninsulas. Upon the subsidence of land or rise of water new peninsulas are won from the mainland, old peninsulas are converted into islands, and islands are submerged; by the reverse process new islands emerge from the waters, old islands become joined to the land, and old peninsulas become surrounded by land. A special variety of peninsula, called a *spit*, is built by waves and currents in a peculiar manner. A wind which drives waves against a shore also drifts the water along the shore. Sand and pebbles rolled upon the beach by the waves are carried by the current in the direction of its motion, and wherever the current leaves the shore, as, for example, at a cape, the drifted particles come to rest, being built into a low embankment, chiefly submerged but rising a few feet above the water. Currents from other directions, and especially tidal currents, often curve the spit at its end, and in this way the end sometimes grows broad, as in Sandy Hook, N. J., so as to produce the typical peninsular outline. The barriers or banks of the coast from New Jersey to Texas are of similar character, and are essentially peninsulas, though often temporarily converted into islands. See COAST.

Isthmuses, being only those parts of peninsulas which distinguish them from islands, hardly deserve special mention. In general they express only a relation between a pre-existent surface form and a particular position of water-level; but there is one variety which is a work of construction. Where an island lies close to the mainland or close to another island, the waves and currents usually build a spit from one land toward the other, and the completion of this process unites the two by a natural causeway, which is overrun by the water only during the most violent storms.

Capes also in general express the relations of ancient forms to modern ocean-level. They are original salients of land masses. There is, however, a special type depending on the modifications of shores by waves and currents. An examination of the map of the Atlantic coast from Virginia to Florida will show a series of cusps which are largely independent of the forms of the neighboring mainland. They consist of low bars of sand, and are probably associated with eddies of the oceanic circulation.

Passing now to those interior features of the land which depend upon the slope or relief of the surface, we recognize that certain ones are convex or prominent, others are concave, and yet others are intermediate in character. The principal convex features are plateaus, mountains, hills, and ridges; the concave, basins, valleys, and gorges; the intermediate, slopes, plains, terraces, and cliffs.

Plateaus are broad uplands of somewhat even surface. They may be indefinitely bounded; they may be limited on all sides by cliffs overlooking adjacent areas, or descending cliffs may limit them on one side and ascending cliffs or slopes on the other. Their surface may be continuous, or may be interrupted by stream gorges or by valleys. A plateau traversed by many deep waterways is said to be dissected. Many plateaus, including all the greatest, are produced by the uplifting of plains; others are sculptured from greater uplifted masses, and owe their forms to the presence in those masses of tabular bodies of resistant rock; yet others are produced by the flooding of an upland with lavas which, yielding less rapidly to subsequent erosion, not only themselves survive, but protect the rocks beneath them while the surrounding country is worn down. Plateaus of moderate size, and especially those with lava caps, are called "table mountains," and in the western part of the U. S. the term "mesa" is applied to small plateaus definitely bounded by cliffs. See PLATEAU.

Mountains differ from plateaus by having narrow or acute summits, and they are always bounded by steep slopes. Many are due to uplift along relatively narrow belts, accompanied with folding and faulting of the rocks. Others are built by the heaping of lava and scoria about volcanic vents. Yet others are residua of plateaus which have suffered stream dissection until the extension of gorges and valleys has obliterated the original even top. As the dissection of plateaus proceeds more rapidly in soft rocks than in hard, the residuary mountains usually mark the positions of the harder parts of the great mass originally lifted in the creation of the plateau. See MOUNTAIN and VOLCANOES.

Hills are prominences smaller than mountains. Some of them, like some mountains, are volcanic heaps, and many, like other mountains, are produced by the dissection of plateaus and plains; but none are the direct results of uplift. A large number are occasioned by glacial deposition, and a few by æolian deposition. Hills due to differential wear by rain and streams are partly located by hard rock masses and partly by the positions of minor divides, which often have no relation to rock texture. Where the degrading agent is glacial ice, relative hardness is probably the chief determining condition. Hills of glacial drift are limited to the tracts which were overrun by the Pleistocene glaciers (see PLEISTOCENE PERIOD), and arise from the irregularity of the process by which the detrital load of a glacier is deposited. Hills of æolian origin (see DUNE) are traveling bodies of sand, and are essentially related to the rhythmic process by which the wind transports such material. In general hills are round-topped as compared with mountains; but in arid regions the hills containing cores of hard rock are apt to have acute summits, and in the Western U. S. such hills are partly discriminated by the term "butte."

Ridges, being merely long and narrow hills or mountains, may seem ill entitled to consideration as a separate class; but usage has given them a distinctive name, and several of the processes of their genesis are equally distinct. The greatest of ridges are produced by uplift and are called mountain ranges, and the same process is appealed to in explanation of certain very small ridges measuring but a few yards in height and a few rods in width. Among glacial deposits the moraine, the osar or esker, and many drumlins are ridges. Where streams deposit their detrital loads in deltas the heaviest deposits are made next the banks, so that the water, when at low stage, flows between parallel ridges or natural levees. The spits, barriers, and bars of gravel and sand which are built along coasts by the action of waves and currents are submerged ridges, and if afterward the coast is lifted above water, these appear as ridges of the land. Perhaps the most important of the ridge-producing processes is dissection. When a plain is lifted so high as to be dissected by its streams it often happens that the principal streams run parallel to one another, and as their valleys broaden the intervening tracts are reduced to ridges. Ridges of similar origin on mountain-flanks are called "spurs." When a plateau consisting of folded strata is deeply dissected, as, for example, in the Appalachian district, the ridge is the most important of the resulting features. The original folding and faulting of the rocks causes the outcrops of the various beds to occupy long, narrow, parallel belts; and the unequal degradation of these, dependent on differences in the qualities of the rocks, produces a system of parallel valleys and ridges.

Basins are tracts limited by divides or water-partings. They are thus units with reference to the drainage of the land by rivers. They may be regarded as secondary results of the various causes which produce mountains and other uplands. Their interior shapes depend largely upon the action of streams, which are ever engaged in remodeling the

face of the land, excavating here and filling there. It is a general law of stream sculpture that the upper slopes are steeper than the lower, and basins are therefore in general concave in cross profile, as the name implies. Exceptions to this rule are introduced by local uplift, and other exceptions depend on the great differences among rocks in their ability to oppose and retard the work of water. Thus basins are diversified. See RIVERS.

A special class of basins, those which do not drain to the ocean but are completely encircled by water-partings, deserve separate mention. They are known as interior or closed basins. Many of them, including the greatest, arise from the unequal uplifting of the land, and this process is supplemented, especially in the arid interiors of continents, by local accumulations of alluvium, which gathers with relative rapidity along the bases of mountains. In a region of great rainfall the alluvial process is inoperative, because the entire water-supply of a basin escaping from it at one point constitutes so powerful an agent of transportation that an alluvial dam can not be formed across it. Where the rainfall is so scanty that the rivers are not perennial, the local mountain storm may create at the critical point an alluvial dam which is not immediately removed, and which, once established, tends to grow and become permanent. This is well illustrated in the Great Basin of the Western U. S., where uplift has produced a multitude of ranges trending N. and S., and the storm-swept alluvium from these has partitioned the intervening valleys into many separate basins. Valleys of various kinds are also dammed by lavas and thus divided into basins; and the heaping of volcanic ejecta about a vent walls in a circular basin called a "crater." In districts where the prevailing rock is limestone a considerable part of the drainage is often subterranean, the rainwater finding its way through crevices to stream-bearing channels beneath. Such crevices are in time enlarged, assuming funnel forms, when they are known as "limestone sinks" or "swallow-holes," and they are often afterward clogged at the bottom and converted into basins. The irregular heaping of sand by the wind leads to the inclosure of small basins, and in arid regions basins are sometimes hollowed out by the erosive action of the wind. The action of a stream upon its channel produces a somewhat uneven bed, so that if the water is afterward dried away there remain a series of small basins. On a greater scale ice-streams produce uneven beds, and the great areas overrun by Pleistocene ice abound in lake basins carved from the rock. Most of these are shallow, but a few, like the hollows holding the Laurentian lakes, are deep. Many other basins arise from the obstruction of valleys by morainic drift, and the uneven surfaces of the greater moraines abound in small hollows. The glaciated area is thus characterized by its numerous basins, and as the rainfall is abundant, these are mostly occupied by lakes and ponds. See BASIN and LAKES.

Valleys are lowlands between uplands. Many valleys are individual basins, but others are parts of drainage basins, and yet others belong to several basins. An important class are caused by differential uplift, or perhaps by a local sinking of the land. Another important class are carved out by streams in the dissection of a plateau. The ice of the Pleistocene period was chiefly instrumental in altering the forms of valleys which had been previously created by streams, but such alteration was sometimes of greater importance than the original stream work. The name valley is commonly applied only to those hollows having at bottom lowlands of some width, but in physical geography the term is sometimes used generically for all hollows of the land surface, including valleys proper and gorges. See VALLEY.

Gorges.—The channel occupied by a stream may be excavated from the rock or earth beneath or inclosed by the building of banks with detritus brought by the stream itself. When a stream flows at base-level, it retains a constant depth of channel, building on one bank as much as is cut away from the other. If the tract is lifted into a mountain or plateau, the stream at once cuts its channel deeper, producing a trench or gorge. When uplift is arrested, a limit to down-cutting is eventually reached, and the stream then moves to the right and left laterally, broadening the gorge and producing a valley. The gorge is thus the first step of dissection and the prelude to the valley. Where uplift is unequal or where the rocks traversed are of diverse character, the valley phase is reached earlier by some parts of the stream than by others, and thus many streams traverse alternately valleys and gorges. Gorges are produced also by stream-action in a district the configuration of which has been modified by volcanism or by glaciation, and in general they testify to the recency either of a drainage system or of conditions by which it is affected. The synonomy of the word *gorge* is extensive but chiefly local. The *ravine* is of small size; a *glen* in North America is similar to a ravine, but in Great Britain is a narrow valley; the use of *chasm* is largely poetic, but always implies vertical walls; *clove* is restricted to the Catskill Mountains and neighboring regions; *cañon* is a term widely used in the western parts of the U. S. See GORGE and CAÑON.

Slopes.—The meaning of the word mountain includes the idea of mass; the meaning of valley includes that of volume. If we avoid these implications and give attention only to the surface, we see that it is composed of various facets or slopes—for example, the sides of mountains, the sides of valleys, etc. A special terminology applies to the various features of slopes. Surfaces nearly level are *plains*; a class of fragmentary plains are *terraces*; surfaces nearly vertical are *cliffs*; and certain slopes of intermediate grade have also received names.

Plains.—Tracts of land are rendered approximately level and smooth in various ways. When sediment is deposited beneath a lake or ocean, the agitation of the water tends to prevent it from coming to rest on prominences and thus leads to the filling of hollows, and the ultimate result is an even surface. Many of the great plains have been thus formed beneath the water and afterward lifted into dry land. Other plains are produced by streams, which work toward this result by two processes. (1) A river flowing at base-level, that is, having its surface but little above the body of water to which it discharges, pursues a sinuous course, and washes away the bank on the outer side of each curve, at the same time building up the bank on the inner side. In this way it enlarges its valley, and it also spreads over the bottom of the valley a sheet of alluvium. The surface of this sheet, being overflowed when the volume of water is greatest, is called the flood-plain of the stream. Although the material just beneath the surface of the flood-plain is deposited by the stream, the plain owes its extent primarily to the action of the stream in cutting at the sides of the valley so as to enlarge it. (2) Wherever a stream deposits more than it excavates, so as to build up its bed, it produces a plain by burying all inequalities of the pre-existent surface under its alluvium. Deltas are plains of this character, and wherever the local conditions cause a stream to deposit its load in an interior valley, the result is a detrital plain known as an alluvial cone. Such plains surround the bases of the mountains of the Great Basin. When a tract remains for a very long time with the same relation to the sea, its streams all arrive at base-level and open out broad valleys, and eventually the divides between the valleys waste away so that the whole tract constitutes a single plain. This is called a base-level plain, and when the process of formation is approximately complete, but the positions of some divides are still marked by hills, it is known as a *peneplain*. A few plains have been produced by great floods of lava filling depressions and obliterating previous rugosity of the surface. A more important class are ascribed to the destructive and constructive processes pertaining to coasts. The waves attack promontories, cutting them away and accumulating the material in contiguous bays. Their tendency is thus to render the surface more even; and if a continent is slowly depressed, so as to permit the waves to accomplish their work progressively over the whole surface, there results a subaqueous plain, and this, through subsequent uplift, may become part of the land. It is called a plain of marine denudation. See PLAIN, DELTA, and FLOOD-PLAIN.

Terraces are subordinate and nearly level plains interrupting steeper slopes. Usually they are bounded upon one side or both by cliffs. Where a series of them occur on the same slope, they are comparable to a flight of stairs. Whenever a stream held long at base-level has developed a broad flood-plain, and the land is afterward lifted so that the stream can deepen its valley, the old flood-plain is left as a terrace on the side of the valley. Developing a new flood-plain at the new base-level, the stream may obliterate the terrace, or a second uplift may cause it to abandon the newer flood-plain and thus leave two terraces at different heights. Repetition of the process may produce an indefinite number of terraces on the same valley-side; but a series may also result from the continuous descent of a stream channel toward an ultimate base-level, provided the descent is so slow that it does not prevent a considerable amount of

lateral cutting. When a region occupied by level strata of alternating character is trenched by streams, the sides of the gorges are eaten back by the wash of rains, which removes the rock as fast as it is disintegrated by frost, etc. As some beds are disintegrated more rapidly than others, the valley-side is carved into a series of terraces. Terraces of another type were produced by the Pleistocene glaciers, which at various stages of their recession occupied the lower parts of valleys, and received against their flanks flat-topped accumulations of alluvium which remained after the ice had disappeared. The sloping strands wrought on coasts by the waves, and the deltas built at the mouths of rivers, both appear as terraces if subsequent changes cause the waters to retreat. See TERRACE.

Cliffs are produced directly by uplift when the rock on one side of a fracture rises above the other. The steep faces of some mountains are of this origin. The sides of a gorge are cliffs due to stream-cutting, and in stream valleys a cliff or bluff is produced wherever the meandering current encroaches on the valley-side. In the latter case the cliff is associated in origin with the flood-plains, and in terraced valleys such cliffs sometimes occur in series. The same differential process which develops terraces from level strata of alternating texture also develops cliffs, and cliffs and terraces constitute a stairway. Cliffs are also produced by unequal erosion by glaciers, and at the heads of mountain glaciers the ice eats backward by a sapping process, producing a semicircular cliff known as a cirque or amphitheater. Where waves erode a coast, their direct work is limited to a zone at the water-level, and they undercut higher masses of land, causing them to fall away in cliffs. See CLIFF.

Taluses.—The stability of a precipitous cliff depends on the strength of its material, and it wastes away as rapidly as its rock is fractured by frost or sudden heating. Loosened fragments fall to the base, and there accumulate in a steep slope which eventually extends to the top. Such a sloping heap of detritus, called a talus, is found at the base of every cliff which is not by some process perpetually renewed. Its grade, known to engineers as the earth slope, makes an angle of about 30° with the horizon.

FEATURES OF THE WATER.—By outline, by size, and by relation to land, bodies of water are distinguished as oceans, seas, lakes, bays, straits, etc. The forms of their bottoms are distinguished as deeps, oceanic plateaus, shoals, etc.

Oceans.—The earth's aqueous envelope, collectively known as the ocean, is divided, through the relation of its parts to continents, into a number of parts, likewise called oceans. The ocean basins are but complements of the continental prominences, and are referable to the same unknown cause. It is probable that the ocean-beds are of heavier material than the continents, and that an adjustment of level is prevented by this difference of density, but the cause of the difference is not understood. See OCEAN.

Seas are small oceans, and their basins are referable to the same general cause; but it is generally believed that while the ocean basins are part of the original configuration of the earth, or at least of immense antiquity, some of the sea basins are relatively young, having been produced by the submergence of land basins through the depression of large continental tracts.

Lakes.—The basins occupied by lakes and ponds have already been discussed as basins of the land. Given an interior basin, or cup-like hollow, the existence of a permanent lake is a question of climate. After every storm the water gathers in the bottom of the basin, and a portion of it at least is thence evaporated. The rate of evaporation depends on climate and the extent of the water surface, and the extent of water surface has its maximum determined by the size of the basin at the level of the lowest point of its rim. Thus the special configuration of the basin and the local conditions of rainfall and evaporation determine whether or not it shall contain a permanent lake, and if permanent whether the lake shall have outlet over the rim. The basins of all lakes are slowly filled by sediments washed into them from the sides; the channels of lake outlets are gradually deepened by the outflowing streams; thus in two ways physiographic processes tend to abolish lake basins, and but for the persistence or recurrence of the processes which create them, they would cease to diversify the face of the land. See LAKES.

Bays, the converse of capes, are re-entrants of the land. Some of the larger are called *gulfs*, and some of the least inclosed *bights*. It is possible that some are remnants of the primordial topography of the globe, but the greater number may be ascribed to the local uplift of the promontories that partly inclose them, and to the flooding of basins by the depression of broad continental tracts. Where the submerged hollow of the land was previously a stream valley, the resulting bay is called an *estuary* or drowned river valley, and the name *fiord* is applied to submerged valleys originally shaped by glaciers. The extension of spits into shallow water sometimes partitions off a portion of the sea which is known as a *lagoon*.

Straits, the converse of isthmuses, have a similar history which need not be recited. When the passage between an island and mainland is extensive, it is sometimes called a *channel*, and the word *sound* has a local but not consistent use in the same sense.

The configuration of the bed of the ocean, becoming known only through the plummet, has been little discussed with reference to its causes. Doubtless the greater features, the deeps and oceanic plateaus, result from the same causes which have produced the ocean basins themselves. By comparison with the volcanic peaks which project above the surface, it is easy to infer that many prominences of the ocean-floor are due to eruption. The idea formerly prevalent, that the sea-bottom has become smooth through sedimentation, has been largely dispelled, first, by the discovery that the bed of the deep sea is not more level than the surface of the land; second, by the discovery that the sediments washed from the land are not widely spread, but fall to bottom chiefly near the shore. The submerged belts close to the coast are indeed smoothed and shallowed by sedimentation, but they constitute only a small part of the oceanic area. By reason of their contrasted character they are sometimes called the continental shelves. The points of the ocean-bed which approach the surface are sometimes acute, and are then called reefs; more often they are comparatively smooth, and are designated as shoals or banks. It is probable that most of the shoals are submerged islands or capes whose surfaces have been leveled by sub-aërial processes of sculpture.

DIFFERENTIATION AND INTERPRETATION OF FEATURES.—In the brief outline of the subject here presented only the principal topographic species and their more important genetic varieties have been mentioned, and no attempt has been made to explain how the varieties are discriminated. It is in general true that all the various topographic forms produced by each physiographic agency are essentially distinct from all the forms produced by each other agency, notwithstanding the fact that the resemblances are often so great that the same name may with propriety be applied to results from several processes. Thus certain results from uplift, from aqueous erosion, from glacial deposition, and from littoral deposition have such formal resemblances that they are all called ridges; but comparative study shows that there are details of form by means of which each individual ridge may be referred to its cause. These criteria are supplemented in many instances by differences of material and differences of topographic relation. Through attention to such distinctions an intelligible meaning is found in each feature of the landscape; and each interpretation of a topographic form is a contribution to the history of the globe's surface. To ravel that history the geologist studies the internal structure, the geographer the surface configuration. The earlier history is discovered by the geologist alone; there is an intermediate chapter to which both contribute, and the closing paragraphs belong to the student of geography.

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Physiologus (Gr. *Φυσιολόγος*): the title given to a Greek treatise composed in the early Christian centuries, in which the habits or qualities of beasts, birds, reptiles, and even precious stones are related as affording allegorical or mystical illustration of Christian truths. The natural history of the book is of the most fabulous kind, as is illustrated by the account of the panther. This beast, says the *Physiologus*, when he has eaten his fill, sleeps three days; then wakes and lifts up his voice, at the same time emitting with his breath a wonderfully sweet odor. Attracted by this, all the other animals from far and near approach, except the serpent, which is the panther's enemy. So Christ, risen from the dead on the third day, gathered about him both Jews and Gentiles; but the serpent is the devil, whom Christ overcame. Still better known than this is the account of the fabulous Phœnix, symbolic of the Resurrection.

There is much uncertainty about the date and circumstances of the composition of the *Physiologus*. It is probable that it was originally written at Alexandria in the second century A. D., and intended for the edification of Christian believers of a mystical turn of mind. It immediately became extremely popular, and for many centuries was a source of allegorical illustrations for Christian writers and preachers. It was translated into many languages—Latin (early fifth century), Ethiopic, Armenian, Syriac, Arabic, Anglo-Saxon, German, Icelandic, English, French, Provençal, Spanish—not all of these, of course, directly from the Greek original. No small part of the remarkable attributions of qualities to animals, so common in all the literatures of Europe, is due to the wide circulation of this treatise in its many forms. The Greek text is best printed by Pitra, in the *Specilegium Solesmense* (vol. iii., 1855); the Latin text, by Cahier, *Mélanges d'Archéologie* (vols. ii.–iv.). For an account of the origin, character, and diffusion of the work, and a bibliography of the editions of the various texts, see F. Lauchert, *Geschichte des Physiologus* (Strassburg, 1889; has also a Greek and a German text). See also the introduction of F. Hommel, in his *Aethiopische Uebersetzung des Physiologus* (Leipzig, 1877). A. R. Marsh.

Physiology [Gr. *φύσις*, nature + *λόγος*, discourse, reason]: that department of natural science which treats of the laws, processes, and phenomena of living organisms. The prominent features of the physiology of the human being are vital force and nutrition. Vitality is the first condition of animal existence—the condition determining growth and maintenance; nutrition supplies the material of the germinal and incipient stages of organism, the mature growth of the body, and constant renewal and regeneration which counterbalance the waste of tissue metamorphosis.

The blood is the circulating nutritive fluid of the body—one-thirteenth of the entire weight, or about 12 lb. It is alkaline, and has a specific gravity of 1·052. It consists of the plasma, or water with albumen, fibrine, and salts in solution, and the solid elements, the red and white blood-cells and blood-plaques. The blood-cells constitute from one-third to one-half of its volume. The white are the largest, but relatively few—one to three or more hundred of the red. The white have active amœboid movements, and probably migrate from the vessels under certain circumstances to form new cells and tissues or for processes of repair. Red corpuscles carry oxygen from the lungs to the tissues; they convey nutritive matters, and bring about changes in certain of the products of digestion. Spectroscopic analysis of red globules reveals hæmoglobin, salts of potash, and many other substances.

The heart is the center of the circulation, propelling the blood into the arteries with a force of 51½ lb.—a force steadily decreasing as the arteries subdivide and approach the capillaries. Capillary circulation is effected chiefly by a remaining element of cardiac force. The veins return the blood to the heart. The veins are more numerous than the arteries—have a much greater capacity; hence, the venous blood circulates with less rapidity than the arterial. Venous return is aided by the compression of the integuments, exercise, and the presence of valves in the veins. In 1553 Servetus discovered the circulation of the blood through the lungs. In 1603 Fabricius demonstrated the valves of the veins; he was Harvey's preceptor at Padua. In 1616 Harvey demonstrated the general circulation of the blood, publishing his researches in 1628. In 1661 Malpighi discovered cells in the blood; in 1673 Leuwenhoeck determined these anatomical elements more definitely; in 1770–75 William Hewson discovered the white blood-cells.

Respiration is a double act of inspiration and expiration, expansion and contraction of the lung. Freshly inhaled air parts with oxygen in the vesicles of the lung, which is taken up by the red corpuscles of the blood, while expired air is loaded with carbonic-acid gas, received from venous blood. Respiration is an involuntary act, formerly regarded as reflex from the presence of impure air in the lung, now established as largely emanating from the cognizance which the medulla oblongata takes of the nutritive demand of all parts of the body for a constant supply of oxygen. Certain lower animals have no lungs, but receive the oxygen by direct surface absorption, or through structures which are the analogues of lungs.

The materials of the blood are supplied by food after preparation by the processes of digestion. Appetite and hunger are also sensations of centric origin, indicative of the nutritive demands of the tissues. Food must be varied in character, and include nitrogenous substances, hydrocarbons, carbohydrates, water, and a proportion of salts. The preliminary steps of digestion are mastication, insalivation, and deglutition. Albuminous substances are digested by the gastric and pancreatic juices, starchy and saccharine substances by the saliva and pancreatic and intestinal juices, and fatty substances by the secretions of the small intestine, pancreas, and liver. Emulsified food is but little absorbed from the stomach, but chiefly by the lacteals of the bowels, and emptied by the thoracic duct into the blood. The lacteals are a part of the general lymphatic or absorbent vessels distributed throughout the body, discovered by Eustachius and Asellius in the sixteenth century. Secretion is the action of special glands in the body, which elaborate elements of the blood for special purposes, as the fluid bathing the pleura and peritoneum, the synovial fluid lubricating joints, mucus to moisten the air-tubes and intestines, saliva, gastric and intestinal juices to digest food. Excretion is a glandular separation from the blood of effete products—the urine, fæces. Fæcal matter is partially *débris* of digested food. Bile is to be regarded secretory so far as it aids digestion. Certain ductless glands—the spleen, suprarenal capsules, thymus, thyroid, pituitary, and pineal glands are specially concerned in the elaboration of the blood. Nutritive waste and supply and glandular activity evolve heat to maintain the normal temperature of the body—in the healthy adult, 98·5° F., with little variation.

The nervous system was divided by Bichat into the cerebro-spinal and the sympathetic. The first comprises the brain, spinal cord, motor and sensory nerves, and nerves of special sense. The brain and cord have gray and white substances; the gray is ganglionic, composed of cells which originate force or receive impressions; the white is tubular, nerve-tracts which transmit motor stimulus from the brain to the muscles or sensory impressions from the body to the brain. The rapidity of nerve action is about 111 feet per second. Motor nerve-fibers terminate in neural plates upon the surface of the muscular fiber. Sensation is received by the tactile bodies of the hands and feet, the sensative papillæ of the skin, taste-buds of the tongue, etc. The brain comprises the cerebrum—the seat of the mind—the basal ganglia, the cerebellum, pons Varolii, and medulla—controlling vital functions. The spinal cord is a column of nerve-fibers connecting the brain with their distributions throughout the body. It possesses a vast number of nerve-cells, and is the seat of independent reflex action; it also has a partial control of co-ordinated action of groups of muscles. The cranial nerves proceed from the brain to their destination without entering the cord; they are partly nerves of special sense—sight, hearing, smell, and taste; the facial nerve governs the expression of the face; the pneumogastric nerve has important connections with the action of the heart, respiration, and movements of the larynx, and also influences the digestive processes.

Speech is produced by movements of the larynx, tongue, teeth, and lips, methodically trained to create sounds, which, by custom, are representative of ideas; it is an artificial method, the invention of man, and slowly developed and perfected. Sight is the impression received by the brain of light and the images of objects, transmitted through the optical media of the eye to the sensitive retina and optic nerve. Hearing is a transmission of sound-waves to the tympanum, and, by the system of ossicles and resonating canals and cavities, to the filaments of the auditory nerve. Generation, or reproduction of definite species and of individual characteristics, is the result of predetermined law. Conception begins with the fecundation of germinal elements, which

develop vitality, motion, and nutritive growth; by successive steps—cellular multiplication, nutritive membrane, nerve-canals, primitive blood-vessels, heart, lungs, glands, lateral walls of the body, inclosing cavities, budding of the extremities, and facial conformation—the embryo progresses to the perfect human being.

Revised by EDWARD T. REICHERT.

Physiology, Vegetable: that branch of science which deals with the activities of the cells, tissues, and organs of living plants. To treat of these exhaustively would far exceed the limits of this article, so only a general outline of the subject is here given. For convenience, the phenomena involved may be considered under five heads, viz., Nutrition, Growth, Reproduction, Physics of Vegetation, and Plant Movements.

NUTRITION includes all those activities which have to do with the supply of matter to meet the wants of living cells. It must be remembered that the life of a cell involves the use of matter, and that as long as a cell is living it must have a continual supply of certain substances. Accordingly we find that every mass of living protoplasm under favorable conditions is continually absorbing watery solutions. Imbibition is one of the most pronounced of the properties of living protoplasm, and its absence is one of the marked distinctions between living and dead cells. Along with the water thus absorbed are taken in the various substances dissolved in it; these may have been solids dissolved in the water, or liquids, or even gases. It appears, however, that solutions are not always absorbed without modification; thus, of a 2-per-cent. solution outside of the cell proportionately more water than dissolved substance may be absorbed, so that the solution in the cell may have a strength of no more than 1 per cent.; or the opposite may occur, and the strength of the solution in the cell may be greater than that outside of it. This selective power may even bring about chemical changes in the watery solutions, when the plant-cells absorb certain constituent parts of the chemical compounds.

Once absorbed, the solutions diffuse through the watery protoplasm and the watery contents of the vacuoles, "cell-sap." This diffusion continues from cell to cell in thin-walled tissues, and is here known as osmosis, the thin cell-walls serving as permeable membranes through which the solutions pass. In laboratory experiments the rate of diffusion varies greatly, and is dependent upon the solution itself, the substance in which it diffuses, and the temperature; thus hydrochloric acid diffuses more than twice as rapidly as common salt, and seven times as rapidly as cane-sugar. This law must hold for solutions in plants also.

Gases also are absorbed directly by living cells, and these are diffused through other gases in the plant, or they enter into watery solutions as described above.

In all the foregoing the plant is simply taking material, but the latter does not yet properly constitute a part of its living substance. It is still unassimilated plant-food, and must undergo considerable changes before the plant can make use of it. One of the best known of the assimilative processes is that by which the plant obtains its carbon, hence called carbon-assimilation, or, on account of its great importance, often spoken of as assimilation exclusively. The term here used, carbon assimilation, is to be preferred, inasmuch as it permits us to speak of other kinds of assimilation in the plant.

Carbon assimilation takes place only in protoplasm which is stained with chlorophyll. When a green mass of protoplasm is supplied with carbon dioxide (CO_2), it is able in the sunlight (or other strong light) to break up this compound and to use its carbon. At the same time some of the water (H_2O) is broken up and its constituents are united with those of the carbon dioxide. The successive steps can not be given with certainty. One of the best-known compounds formed in the series of changes is starch ($C_6H_{10}O_5$), which may usually be detected in the green cells after they have been exposed to the light for some time. The results thus far may be expressed as follows:

$$\begin{aligned} 5 \text{ molecules of } H_2O &= \quad H_{10}\, O_5 \\ 6 \text{ molecules of } CO_2 &= C_6 \quad\; O_{12} \\ \hline 1 \text{ molecule of starch} &= C_6\, H_{10}\, O_5 \\ \text{Excess of oxygen} &= \quad\; O_{12} \end{aligned}$$

Now, while starch is not made in such a direct way, it is worthy of note that in the chemical changes involved there is a setting free of oxygen as required by the expression above. In some cases the carbon compound formed at this stage is not starch, but something equivalent (physiologically) to it, as oil, or possibly glucose ($C_6H_{12}O_6$). These carbohydrates are readily taken into the protoplasm as constituents of its substance, from which in turn it may build a cellulose wall ($C_6H_{10}O_5$), or form glucose ($C_6H_{12}O_6$), sucrose ($C_{12}H_{22}O_{11}$), inulin, gums, oils, acids, etc. The importance of carbon assimilation may be inferred at once from the fact that about one-half of the dry substance of plants is composed of carbon, all of which has been obtained from carbon dioxide by the process outlined above.

Another important assimilative process is that by which nitrogen is obtained. This substance, although not present in such large quantity as carbon, is of high importance on account of its entering largely into the composition of protoplasm, and especially the cell nucleus. Inasmuch as about 80 per cent. of the air is free nitrogen, it might be supposed that plants derive it from this source, but careful experiments show this not to be the case. On the contrary, the nitrogen is derived from compounds in the air and water, chiefly in the form of nitrates of various bases (e. g. soda, potash, lime, ammonia, etc.), or some ammonia salt (e. g. the nitrate, chloride, sulphate, carbonate, etc.). In the higher plants it has been shown that these compounds undergo decomposition and reconstruction in the leaf, the result being the formation of proteid substances; but it is also held that probably every living cell is capable of taking part in these processes.

Of the assimilation of sulphur and phosphorus still less is known than in the case of nitrogen. We know that sulphur is absorbed in the form of sulphates (of ammonia, potash, lime, and magnesia), and some of these are to be found in the cells of plants, but where and how they are broken up is not known. It has been suggested that the crystals of calcium oxalate which occur in many plants are residua of chemical changes by which sulphur was set free from calcium sulphate. If true, this would show that the assimilation of sulphur takes place in all active tissues of the plant. Phosphorus is absorbed in the phosphate of lime, which undergoes decomposition in the tissues, but the details of the process are not known.

A number of other substances—e. g. potassium, calcium, iron, etc.—enter into the proper food of plants as solutions of their salts, which afterward undergo decomposition, thus allowing their assimilation. They are commonly called the "ash" of plants, and are often erroneously regarded as consisting of unassimilated matter. That they enter into the vital activities of the plant has been shown by the experiment of withholding them, with the result that the plant so treated always languishes or dies.

Even after the various substances which constitute plant-food have become assimilated they undergo many chemical changes. Every living tissue, and perhaps every living cell, is the seat of chemical changes in assimilated matter, whose results have in many cases been made out by chemists who have made numerous analyses, but in no case are the details of these chemical changes certainly known. We know that in many of these operations oxygen is absorbed by the active cells, and that as one result of their activity they excrete carbon dioxide. These after-changes of assimilated matter have been known in physiology as metastasis or metabolism.

To the foregoing general account of the nutritive activities of plants should be added the following: In homogeneous-celled holophytes (i. e. green plants whose cells are all alike) every cell performs all the operations noted above; but in heterogeneous-celled holophytes there is a division of labor, some cells or masses of cells engaging in certain activities quite different from those engaged in by other cells or tissues. Thus in a moss the cells of the root-hairs (rhizoids) which clothe the subterranean part of the stem engage in the absorption of watery solutions almost exclusively, and since they do not take part in carbon assimilation they are destitute of chlorophyll. On the other hand, the cells in the leaves are active in carbon assimilation, and have an abundance of chlorophyll. They absorb carbon dioxide and but very little, if any, water or soluble food-matter. The cells of the leaves and stem must therefore obtain their supply of watery solutions from the cells in the soil. The cells contiguous to those which absorb the solutions from the soil absorb from the latter, those next removed now absorb from those newly supplied, and so on from cell to cell to those at the upper extremity of the plant. In this way, by simple absorption from cell to cell, water and solutions are transported to all portions of the plant-body. Now, many of the cells above ground are often in contact with

dry air into which some of their water evaporates. The cells which suffer this loss of water repair it by absorbing water from contiguous cells, and these absorb from still others, and so on. There is thus a general upward movement of water in the moss-stem due to the loss of water from the leaves. Again it is seen that the carbohydrates are formed in the green cells alone, and from these they are diffused and absorbed as solutions from cell to cell throughout the plant. Thus there may be an upward movement of water while there is a downward diffusion of carbohydrates (and probably of other assimilated matters also).

In a plant with a still more complex structure, as, for example, the common sunflower, the cells of the surface of the roots absorb watery solutions, which are then absorbed from cell to cell in the large and numerous roots, finally passing in the same way from cell to cell in the stem and even to the leaves and flowers. The loss of water by evaporation from the leaves is much less proportionately than from the leaves of mosses, the latter consisting of but a single layer of unprotected cells, while the active cells in the sunflower-leaf are protected by a layer of specially modified thick-walled cells (the epidermis) less pervious to moisture. When, however, the stomates (breathing pores) are open for the ingress and egress of gases, much moisture escapes, and this is replaced by absorption from cell to cell as in the moss. The fact that moisture escapes through the open stomates has led to the assumption that they are for the purpose of permitting moisture to escape, and that the leaves of higher plants are "organs of evaporation." On the contrary, the stomates are clearly for preventing as far as possible the loss of water, while permitting the free interchange of gases, and the leaf is rather a skillfully devised structure in which a multitude of thin-walled cells gorged with moisture are exposed freely to the air with a minimum of loss of water by evaporation.

The stomates of the leaves and stem when open admit the external gases to the intercellular spaces of the whole plant, and also allow the internal gases to escape into the air. There is thus a respiration in plants of the high organization of the sunflower, but when examined closely this does not differ in any essential from the simple absorption and excretion of gases by a single-celled plant.

In the hysterophytes (parasites and saprophytes) the solutions absorbed consist partly or wholly of assimilated matter. When this includes the carbon products of assimilation the plant does not develop chlorophyll, as in the dodders, Indian-pipes, broom-rapes, and the vast assemblage of "fungi." When, however, there is little or no absorption of carbon compounds, chlorophyll is present and the leaves are well developed, as in the mistletoe. In the dodders the absorption is performed by suckers (outgrowths) on the stems, and as a consequence the roots do not develop. In these leafless, rootless, and eventually almost stemless plants there is probably little assimilation of any kind; they are nourished much as the flower and fruit-clusters of ordinary plants are. The evaporation of water is probably as rapid in hysterophytes as in holophytes of equal structural complexity and similar habits. The fungi quickly lose their water and become wilted and dried up when their supply of moisture is cut off. On the other hand, among the flowering hysterophytes the absence or small size of the leaves greatly reduces the amount of evaporation. Clearly, also, the respiration of hysterophytes is less than in holophytes, there being little or no absorption of carbon dioxide. Oxygen, however, is absorbed, and carbon dioxide excreted by most if not all hysterophytes.

Growth.—A young cell consists of a nucleus and a solid (continuous) mass of protoplasm closely invested by a wall. During the nutritive processes described above the substance of the protoplasm is increased, and this requires an increase in the area of the wall; these two increments constitute the simple growth of the cell. Later, the absorption of water and the formation of a large vacuole, with or without an increase in the mass of the protoplasm, may require the increase in the area of the wall; this, also, is growth of the cell. In its increase in area the wall is first distended by the internal pressure, and new matter (cellulose) is secreted upon or in it, thus permanently increasing its area.

In simple plants every cell may grow, producing an aggregate growth of the whole plant-body. As each cell reaches a certain size it divides into two, which then grow, and divide again, and so on. Continued growth thus involves the growth of the cell and its fission, and where the plant-body is made up of similar cells the growth is general throughout it. Where, however, the plant-body is made up of dissimilar cells, involving and implying dissimilarity of function, growth is confined to particular masses of cells, occupying definite portions of the plant-body or its organs. In such a case we generally say that growth is confined to the younger cell-masses; this is necessarily true, but conveys little information; it would be more accurate to say that such and such cell-masses have a short growing period, while others retain their power of growth for long periods. The woody stem of an ordinary dicotyledonous shrub or tree consists of masses of different kinds of cells which soon lose their power of growth; thus the wood-cells, vessels, and even the parenchymatous cells of the wood, pith, and bark are soon incapable of growth in size, and retain but little longer the power of growth in thickness of the wall. In the same stem certain other cells (lying between the wood and bark) retain their growing power for many months.

Reproduction.—One of the most important functions of plants is reproduction, or the formation of new individuals from the living cells of those already existing. For a discussion of this subject, see Reproduction (*in Plants*).

The Physics of Vegetation.—Since all parts of plants are composed of matter, it follows that they are subject to physical forces. In a living cell there is no suspension of the action of any force or of any physical law. Every atom of matter in the cell is as much under the control of force as it was before it entered into living matter. In the cell there are many forces, and what we see is the resultant of all, not of one alone, and it is this complex result which sometimes has puzzled us. We can no more reasonably doubt that the matter in living cells is still subject to physical forces because of apparently paradoxical results than we can entertain doubts of the mutual attraction of all matter because smoke rises, or the similar poles of magnets repel one another. It is only when we take a superficial view of such cases that they appear paradoxical.

It is not necessary, even if it were possible, to discuss in detail the action of the various physical forces upon each mass of matter in living plant-cells. It concerns us more in this place to note the behavior of the living cells, cell-masses, or the whole plant under the influence of physical forces of varying intensities.

Heat.—For every cell there is a certain range of temperature in which it is active, culminating in an *optimum* temperature; above this its activity decreases rapidly to its *maximum* temperature, where all activity ceases. In like manner below the optimum temperature activity decreases; not so rapidly, however, until the *minimum* is reached, where activity ceases again. This range of activity is not the same for all plants, and in many-celled plants it often differs considerably for different parts of the plant-body. Prof. Sachs, of Germany, determined this range for the germination of the following seeds:

SEEDS.	Minimum.	Optimum.	Maximum.
Indian corn.....	9·4° C.=48·92° F.	34° C.=93·2° F.	46° C.=114·8° F.
Pumpkin	14·0° C.=57·2 ° F.	34° C.=93·2° F.	46° C.=114·8° F.
Wheat.....	5·0° C.=41·0 ° F.	29° C.=84·2° F.	42° C.=107·6° F.
Barley.....	5·0° C.=41·0 ° F.	29° C.=84·2° F.	37° C.= 98·6° F.

Common observation shows that plants differ much as to the degree of heat necessary for germination, as well as for other activities, but we have little in the way of careful measurements upon anything more than the germination of seeds. Certain experiments appear to indicate that the range in green parts of plants is much greater than has usually been supposed, in some cases approaching 0° C. and in others reaching 50° to 55° C. (122° to 131° F.), or even more. On the other hand, it is certain that other parts of plants will not endure such temperatures; e. g. roots and underground stems.

When the maximum temperature for a plant-cell is exceeded, a point is generally soon reached where by coagulation of the albuminoids or by some other changes the structure of the protoplasm is permanently altered, rendering further activity impossible, even upon the return to a favorable temperature. Such a cell is "dead." Reduction of the temperature below the minimum sooner or later results in a similar permanent alteration of the structure of the protoplasm, with the consequent "death" of the cell. Here it is noticed that watery cells can not endure as low temperatures as those which contain little water; e. g. a dry embryo in a kernel of Indian corn will endure a temperature of 40° or more below 0° C. (−40° F.), but when it has

made a little growth a slight frost (0° C. or 32° F.) will quickly kill it. In many respects the results of too great a reduction of temperature are similar to those produced by too great an elevation; the albuminoids become coagulated and the protoplasm structure is permanently changed. In both cases the power of imbibing water and of rendering the cell turgid is lost, and in ordinary temperatures chemical changes in the free solutions soon set in, resulting in their rapid disintegration.

Light.—Directly or indirectly all plants are dependent upon the light. Although many parasites and saprophytes grow in complete darkness, they do so by using material which developed in the light. We have seen (*supra*) that carbon assimilation is possible in the light only in cells whose protoplasm is stained with chlorophyll. All the carbon of vegetation came originally from chlorophyll-bearing cells, made active by the light. Just how the light affects the green protoplasm in carbon assimilation is not known, nor do we know how light brings about the formation of chlorophyll by the protoplasm. We can only regard light as a force which, acting upon the complex compound protoplasm, produces molecular changes resulting in the secretion first of chlorophyll, and second of a carbon compound. Here it must be remarked that not all cells secrete chlorophyll in the light, although many which are normally colorless become green under its influence; thus while many roots and underground stems become green on exposure to the light, the petals of many flowers, the stems of the dodders, and the cells of fungi when so exposed develop no chlorophyll. It is a fact, however, that some kind of coloring-matter is produced in nearly all cells on exposure to the light, as is well shown by the familiar experiment of growing flowers, fruits, and various fungi in complete darkness, when they are usually much paler or wholly wanting in color. The color of some flowers appears to be independent of the direct action of light, as shown by Prof. Sachs, who obtained perfectly normal flowers of the tulip, iris, squash, and morning-glory when grown in the darkness, although the leaves were completely etiolated.

It has been shown by experiment that light somewhat retards the growth of certain cells. A shoot grown in darkness or deficient light is always longer than one grown in strong light. Even in the daily growth of plants the rate during the day is less than during the night. This has been called by Prof. Vines, of England, the "tonic influence of light." Here we must note that while the stem grows more rapidly in darkness, the leaves grow less rapidly, and in complete darkness remain very small.

Gravitation.—Many cells always grow in a particular direction with respect to the earth's mass (gravitation). Thus the principal roots usually grow toward the earth, while most stems grow away from it. When a seed germinates its roots invariably take a downward and its stems an upward direction, and it does this regardless of its immediate surroundings. This is well illustrated in the experiment shown in Fig. 1, in which seeds are planted half an inch deep in a flower-pot, which is then covered with coarse netting and inverted upon a ring-stand. Below it is placed a mirror, standing at a proper angle to reflect light upon the under surface of the flower-pot. A tall bell-jar is put over the apparatus and water is kept in the dish so as to preserve a moist atmosphere. The whole is now placed in a light room of the proper temperature. Upon germination the stems invariably grow upward, deeper and deeper into the ground and darkness, while the roots grow down, out of the ground, and into the light. If, now, we make another experiment we may understand the matter better. Two small flasks containing a little water are slipped over opposite ends of a wooden rod and retained in place by a coil of wire, as shown in Fig. 2. A sprouted seed is previously fastened to each end of the rod by a stout pin, and the whole is rotated rapidly upon the steel rod *s* by a water or electric motor. As the roots develop they grow outward in the direction of the centrifugal force, and the stems grow inward, or in opposition to that force. Upon slower rotation both roots and stems grow diagonally, the angle depending upon the rate of revolution.

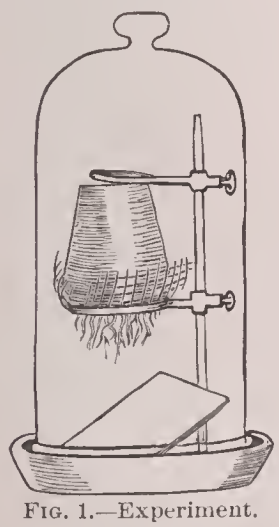


FIG. 1.—Experiment.

In considering the mode of action of gravitation upon parts of plants we can not suppose that the root-cells are more subject to it than the cells of the stem. Perhaps the best statement which we can now make of this matter is that each cell exhibits what we may call "polarity" with respect to the lines of constant force (gravitation, or centrifugal force). When these lines are vertical, as in gravitation, the cells exhibit vertical polarity; when the lines of force are horizontal, the cells exhibit horizontal polarity; and when, as in the experiment above, there are two lines of force acting at right angles to each other, the axis of polarity is diagonal. This general statement, while incomplete, and here applied only to the principal roots and stems, is capable of a far wider application, and doubtless may be useful as a working hypothesis.

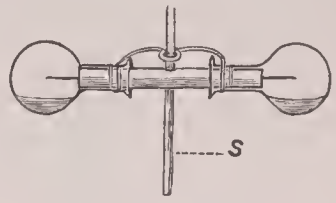


FIG. 2.—Rotating apparatus.

Electricity.—While plants exhibit electrical conditions in common with other material objects, they seem at present to possess no physiological significance. Every chemical change in the cell probably produces some disturbance of its electrical conditions and of those of its neighboring cells. So, too, the considerable amount of evaporation of water from leaves and other aërial parts probably produces electrical disturbances. Various observers have noticed weak electrical currents between different tissues upon making tranverse sections of stems or leaves. None of these appear to be of any importance physiologically, at least as now understood. Strong electrical currents, especially when interrupted, quickly disorganize the protoplasm; weak currents retard or arrest protoplasmic movements, and very weak currents produce no perceptible effect.

Humidity of the Air.—Since the walls of living plant-cells are usually permeable to water it follows that when exposed to relatively dry air they lose a portion of their watery contents by evaporation and soon cease their activity. In many-celled plants this loss is repaired by the absorption of water from contiguous cells not so exposed, and the latter in turn repair their loss by absorption from the surrounding moisture (water or moist earth). The condition of the atmosphere may thus set up many disturbances in the plant, but it must not be forgotten that the loss of water by the plant is a purely physical process.

Supply of Energy to the Plant.—The work done by a plant involves the expenditure of energy. In hysterophytes the decomposition of the chemical compounds absorbed by them affords a supply of energy fully, or nearly, adequate for all their needs. In holophytes the case is far different; they absorb compounds of simple chemical constitution supplying relatively little available energy, but in their chlorophyll-stained cells they are able to arrest the energy of the sunbeam, and divert it to the work of the plant. Doubtless green plants derive some energy from the decomposition of the compounds absorbed by them and perhaps more from the heat to which they are exposed, and possibly to a slight extent from other sources, but the great supply of energy is the light of the sun. It has been shown experimentally that any other bright light, whether produced by lamps of various kinds or by the electric arc, when of sufficient intensity may be a source of energy for green plants.

PLANT MOVEMENTS.—It is one of the essential characteristics of living things that they move, although "motility" and "life" are not synonymous. A complete examination of the motility of plants would include the many kinds of movements exhibited by protoplasm, whether naked (as in zoöspores) or inclosed within walls of greater or less rigidity, and in addition the very slow movements connected with growth and nutrition.

Nutation.—Under this term are gathered those cases in which terminal parts of plants move spontaneously and somewhat regularly in definite directions. It has been observed that the growing ends of climbing plants perform circular nutations; thus in the hop and honeysuckle the free ends of the stems rotate in the direction of the hands of a watch (Fig. 3, *a*), while in the yam, bean, and morning-glory the rotation is the reverse (Fig. 3, *b*). In other cases the nutation is a simple swaying back and forth, as Darwin has observed, in many leaves and growing shoots.

Geotropism.—This term includes all those movements of plants or their parts due directly or indirectly to gravitation, discussed above. In many works the movement toward the earth is termed geotropism, and organs exhibiting it are

said to be geotropic. Organs which move away from the earth, then, exhibit negative geotropism, and are said to be negatively geotropic.

Heliotropism.—In like manner the movements of plants or their parts due to the light are included under the term

FIG. 3.—Twining stem of hop (*a*) and yam (*b*), showing opposite nutations.

heliotropism. Organs which turn toward the light are heliotropic (or sometimes positively heliotropic), while those which turn away from it are said to be negatively heliotropic, and the phenomenon is negative heliotropism. The upper surface of most leaves is positively and the lower negatively heliotropic; yet some leaves have both surfaces positively heliotropic, and their blades are therefore approximately vertical and parallel with the meridian, as is notably the case in the compass-plant (*Silphium laciniatum*) of the prairies of the U. S. The tendrils of many plants are negatively heliotropic, as are also the runners of some others.

The movements of plants with the decrease in the amount of light, as at nightfall, often called the "sleep of plants," are heliotropic in their nature. Some of these are quite marked, as in many of the clovers, beans, peas, and their allies. The species of *Oxalis* are notable for their nyctitropic movements.

FIG. 4.—Ordinary (*a*) and "sleeping" (*b*) positions of leaves of white clover.

Irritability.—Many parts of plants exhibit movements as a result of physieal contact with some object. For this sensitiveness to contact the term irritability has been used. One of the best examples of this is the well-known "sensitive-plant" (*Mimosa pudica*), whose leaflets quickly assume a particular position when rudely touched. A more remarkable example is the Venus's fly-trap (*Dionœa muscipula*), in whieh each lobe of the leaf has three sensitive hairs upon its upper surface; and when these are touched the two halves of the leaf close together quickly. (See INSECTIVOROUS PLANTS.) Many stamens are sensitive to touch, as in the barberry, portulaca, and purslane.

The tendrils of many plants exhibit irritability, and when touched by an object bend toward and eventually coil around it. If after contact and some bending the tendril be freed once more, it will soon straighten out as before, and may be made to bend in the opposite direction by another contact; and this may be repeated a number of times. See, further, BOTANY, PROTOPLASM, and HISTOLOGY, VEGETABLE.

LITERATURE.—The most important of the recent general works on plant physiology are the following, in which may be found full references to books and papers on special topics: Charles Darwin, *The Movements and Habits of Climbing Plants* (2d ed. 1875), and *The Power of Movement in Plants* (1880); W. Pfeffer, *Pflanzenphysiologie* (1881); W. Detmer, *System der Pflanzenphysiologie* (1882); G. L. Goodale, *Physiological Botany* (1885); S. H. Vines, *Lectures on the Physiology of Plants* (1886); J. Sachs, *Lectures on the Physiology of Plants* (Eng. ed. 1887); A. Zimmerman, *Die Morphologie und Physiologie der Pflanzenzelle* (1887); W. Detmer, *Das Pflanzenphysiologische Praktikum* (1888); J. Wiesner, *Elemente der Wissenschaftlichen Botanik* (3 vols., 1889–91); J. Sachs, *Gesammelte Abhandlungen über Pflanzenphysiologie* (1892–93); W. Oels, *Pflanzenphysiologische Versuche* (1893), English translation by D. T. MacDougal under the title of *Experimental Plant Physiology* (1894).

CHARLES E. BESSEY.

Physitheism: See INDIANS OF NORTH AMERICA.

Physopoda: See ENTOMOLOGY.

Physos'tomi [Mod. Lat.; Gr. φῦσα, bellows (i. e. air-bladder) + στόμα, mouth]: those teleostean fishes which are provided with a duct connecting the air-bladder with the intestine as by a mouth, in allusion to which the name has been given. The name has been used with varying limits by different authors.

Phytoph'thires [from Gr. φυτόν, plant + φθείρ, louse]: that group of Hemipterous insects which contains the leaf-fleas (*Psyllidæ*), plant-lice (APHIDES, *q. v.*), and scale-insects (*Coccidæ*), characterized by having usually wingless females, wings when present with few veins and uniform texture, and the body frequently concealed by a waxy or powdery secretion from certain dermal glands. All are parasitic on plants, and cause no little damage to agricultural and horticultural interests. Exceptions to this rule are to be found in the cochineal insect (*Coccus cacti*) the lac-insect (*Coccus lacca*), and the manna-insect (*C. manniparus*), which produce directly or indirectly products of value to man. Among the most injurious forms is the grape PHYLLOXERA (*q. v.*), though many of the scale-insects are serious pests.

J. S. KINGSLEY.

Phytozo'ön, pl. **Phytozo'a** [Mod. Lat., from Gr. φυτόν, plant + ζῷον, animal]: a term sometimes applied to the antherozoids, or male sexual cells of certain cryptogamous plants.

Piacenza, pĕĕ-ăă-chen'zăă (anc. *Placentia*): chief town of the province of Piacenza, Italy; on the right bank of the Po, a little below its junction with the Trebbia; 43 miles S. E. of Milan (see map of Italy, ref. 3–C). Formerly a fortress of considerable strength, it is still surrounded by ramparts and trenches forming a circuit of 4 miles. The streets are broad, the Stradone Farnese being the finest, and the principal square, the Piazza de' Cavalli, in which are equestrian statues in bronze of Alessandro Farnese, governor of the Netherlands, and his son Ranuccio, has a busy aspect. The city in general, however, has a decayed and somber look, owing partly to the mediæval character of many of the buildings. The cathedral, begun in 1122 on the foundations of a much earlier church, is Lombardo-Gothic in style, and in its interior contains numerous frescoes mostly by Guercino and L. Caracci. Among other noticeable churches are Sant' Antonio, once the cathedral, built in 324 (on the spot, it is said, where St. Barnabas first preached to the people), but much altered by restorations, and San Sisto, which is known as giving its name to Raphael's famous Madonna, now in Dresden. The Palazzo Farnese, called La Cittadella, was a splendid structure, but is now a barrack. The Palazzo Comunale (1281), in the main front of the lower story, constructed of marble, presents fine open-pointed arcades. The municipal library contains 120,000 volumes. This town, of Gallic origin, served the Romans as a strong point of defense against Hannibal, and the construction of the great military road of M. Æmilius Lepidus and various large canals raised it to great prosperity. Under the Goths it was allowed to govern itself, and under the Lombards and Franks it had a fendal lord. In 1545 it was united with PARMA (*q. v.*) to form a duchy for Pierluigi Farnese, son of Paul III. In 1859 it was united to the kingdom of Italy. The trade of Piacenza is chiefly in the products of the rich neighboring country—grain, wine, cheese, etc.; the manufactures are silk, cotton and woolen goods, and pottery. Pop. (1892) 37,000. The province has an area of 954 sq. miles. Pop. (1892) 229,039.

Revised by R. A. ROBERTS.

Piacenza, DUKE OF: See LEBRUN, CHARLES FRANÇOIS.

Pi'a Ma'ter [Mod. Lat., fancifully taken from Lat. *pi'a mater*, pious or gentle mother; see DURA MATER]: the innermost of the meninges or membranes covering the brain and spinal cord. It is so named because it serves in nourishing the nerve-centers. It is a fine plexus of blood-vessels covering the brain, dipping down into its convolutions, forming the velum interpositum in the third and the choroid plexus in the fourth ventricle. A small part, over the crura

and pons, is not very vascular, but tough and fibrous. It is abundantly supplied with nerves and lymphatics. The pia mater is liable to inflammatory diseases which are collectively designated meningitis. The pia mater of the spinal cord is less vascular than that of the brain, with which it is continuous. It is partly composed of longitudinal fibrous bundles. It is intimately connected with the cord, of which it is the neurilemma. The tunica vasculosa of the testes is also called pia mater.

Revised by WILLIAM PEPPER.

Pianoforte [= Ital.; *pia'no*, soft (< Lat. *pla'nus*, smooth, whence Eng. plane, plain) + *for'te*, strong, loud]: a musical instrument played by a double row of keys upon a fingerboard, each key being connected with a hammer which strikes a steel string. The principle of the keyboard was applied to a musical instrument, the clavichord, as early as the fourth century, and other instruments of the same class, as the cithara, the harpsichord, and the spinet, were popular down to the eighteenth century. The invention of the pianoforte has been claimed for Germany, Italy, France, and England. The best evidence seems to assign it to Bartolommeo Cristofori, a harpsichord-maker at Padua, Italy, about the year 1710. Marius claimed a similar invention in Paris in 1716, and Christoph Gottlieb Schröter in Germany in 1717. It was not until 1760 that the instrument was manufactured in England by German mechanics; and it was first practically introduced into France by Sébastien Érard. (See ÉRARD.) The firm of Broadwood & Stodart soon took a leading position as English manufacturers, and improvements were rapidly made, the instrument speedily attaining popularity. The grand piano seems to have been first made in 1781, the upright in 1795. Few pianos had been exported to the U. S. when, in 1822, Jonas Chickering began their manufacture at Boston, being thus the pioneer of an important industry. In the form of the instrument called the grand piano the strings are placed horizontally and parallel to the keys. In the "upright" piano they run perpendicularly. The manufacture of the so-called "square" piano has practically ceased, owing to the more convenient form of the "upright," especially where little space is available. The former objection to the "upright" piano—viz., that it soon got out of tune—has been remedied. The piano is essentially the musical instrument of modern times. It has become a household requisite, and as a consequence its manufacturing industry has become a colossal one, extending over the whole civilized world. Outside its own characteristics and powers as a solo instrument, no other can so well represent the orchestra or successions of complex harmonies perhaps originally written for voices. In fact, it is the musician's indispensable assistant in every way. Its own literature, both singly and in combination with other instruments, is the richest, the great composers from Bach and Scarlatti down to the present day having bequeathed to the piano a wealth of their best thought and inspiration. Revised by DUDLEY BUCK.

Pi'arists, called also the **Pauline Congregation**, and popularly known as **Scolopins** [*Piarists* is from Lat. *pi'us*, pious; *Scolopins* is from Lat. *scho'la pia*, religious (liter., pious) school]: a congregation of regular clerks of the Roman Catholic Church, founded in 1599, for the purpose of spreading education, by St. Joseph Calasanctius, who was born at Calasanz, in Aragon, Sept. 11, 1556; studied law at Lerida and theology at Alcala; was ordained a priest in 1582, and settled in 1592 in Rome, where he died Aug. 25, 1648. His remarkable success as a teacher induced him to form an association, which in 1612 had over 1,200 pupils in Rome. The Piarists were confirmed by Paul V. (1617) and by Gregory XV. (1622), when they received the official title of Regular Clerks of the Pious Schools. The congregation was allowed by Gregory XV. to take solemn vows. Alexander VII. brought them back to their original condition, while Clement IX. (1669) re-established them in the state of regulars. They are found chiefly in Europe. See *History of Religious Orders*, by C. W. Currier (1894).

Piassava, or **Piassaba, Fiber** [*piassava* is viâ Portug., from the Braz. name]: a coarse substance used for making brushes and brooms for street-sweeping. It is exported from Brazil, and is produced chiefly from the palm-trees, *Leopoldinia piassaba* and *Attalea funifera*. See CHIQUICHIQUI PALM.

Piatt, JOHN JAMES: poet; b. at Milton, Ind., Mar. 1, 1835; was educated at the Columbus (O.) High School and Kenyon College; removed to Illinois in 1856, and soon after became a contributor to the Louisville *Journal* and confidential secretary to its editor, George D. Prentice. From 1861 to 1867 he was clerk in the Treasury Department at Washington. In 1867–70 he was engaged upon newspaper work at Cincinnati, O. In 1870 he became clerk to the U. S. House of Representatives, and librarian to the House in 1871. He was consul at Cork, Ireland (1882–94); joint author, with W. D. Howells, of *Poems by Two Friends* (1860); with his wife, wrote *Nests at Washington* (1863); sole author of *Poems in Sunshine and Firelight* (1866); *Western Windows* (1868); *Landmarks*, etc. (1871); *Poems of House and Home* (1879); *Idyls and Lyrics of the Ohio Valley* (1884 and 1888), etc.—His wife, SARAH MORGAN (*Bryan*) PIATT, b. at Lexington, Ky., Aug. 11, 1836, and married in 1861, is also distinguished as a writer of verse. She has published *A Woman's Poems* (1871); *A Voyage to the Fortunate Isles* (1874); *That New World* (1876); *Dramatic Persons and Moods* (1880); *The Witch in the Glass* (1889), etc. Revised by H. A. BEERS.

Piauhy, pĕe-ow-ee' (also written *Piauhí*): a northeastern state of Brazil; between Ceará, Pernambuco, Bahia, Maranhão, and the Atlantic. Area, 116,506 sq. miles. It lies entirely in the basin of the PARNAHYBA (*q. v.*), E. of that river; the coast is very short, and the mouth of the river forms the only seaport. The interior consists of table-lands, divided by numerous tracts of lower lands; there is little true forest, the land being open or varied with dry *catinga* woods. The climate resembles that of Ceará in its long dry seasons and occasional severe droughts; the vegetation withers and most of the streams disappear in the dry months. Piauhy is one of the poorest as well as least populous of the Brazilian states. The only important industry is cattle-raising. The exports are hides, cotton, vegetable wax, and a few drugs. Small steamers ascend the Parnahyba. The capital, Theresina, is a small place on that river. Pop. (1894) estimated, 300,609. HERBERT H. SMITH.

Piazza Armerina, pĕe-aat'săă-ăăr-mā-ree'năă: city; in the province of Caltanissetta, Sicily; 39 miles E. S. E. of the town of Caltanissetta (see map of Italy, ref. 10–F). It is situated on a hill surrounded by an undulating country of great fertility. It has a cathedral, built in the eighteenth century, an episcopal palace, and a communal library. Piazza Armerina is a very ancient town, settled, tradition says, by a colony of Greeks from Platææ. Under the Normans it rose to importance: it was destroyed in 1160, but rebuilt three years later. Its prosperity depends on the abundance of grain, wine, oil, chestnuts, and walnuts produced in the vicinity. Pop. of city about 17,040; of commune, 19,600.

Piazzi, pĕe-aat'sĕe, GIUSEPPE: astronomer; b. at Ponte, in the Valtelline, Italy, July 16, 1746. His master was the mathematician Father Giambattista Beccaria, and he himself joined the order of the Theatines. After being professor of philosophy in several of the large Italian universities, he was appointed in 1780 Professor of Mathematics at Palermo, where he promoted the establishment of an observatory, and finally went to France and England to obtain instruments for it. This observatory was opened in 1791, and there Piazzi compiled his famous *Catalogue of the Stars*. On Jan. 1, 1801, he discovered the planet or asteroid Ceres, which opened the way for the discovery of so many others. Piazzi revised the plan of the new observatory at Naples, of which he was afterward for some time the director. D. July 22, 1826. On occasion of the erection of a monument to Piazzi at Ponte, B. E. Maineri published his biography.

Pi-Beseth [Egypt. *Pa-Bast*, dwelling of Bast, the cat-headed deity; Gr. **Βούβαστος**; Mod. *Tell Basta*]: the Hebrew (Ezek. xxx. 17) name of Bubastis, a very ancient city of Egypt; situated on the Tanitic branch of the Nile, about midway between Heliopolis and Tanis. Manetho has preserved a legend which mentions the place as existing as early as the second dynasty, and monumental remains have been discovered which date from the fourth, sixth, twelfth, and succeeding dynasties, as well as others which indicate that it had a continuous history down to Roman times. Specially noteworthy are the remains left by Ramses II. and Osorkon II. It was also a stronghold of the Hyksos, and the name of one of these foreign sovereigns was discovered there by Naville, who reads the hieroglyphics as *Ianra*, corresponding to the Ianias or Annas of Josephus. It may have been the royal residence at the time of Joseph, and in that case it corresponds well with the Biblical narrative in being near to the land of GOSHEN (*q. v.*). See Herod-

otus, ii., 59. 67, 137, 166; Naville, *Bubastis* (London, 1891) and *Festival Hall of Osorkon II.* (London, 1892), being the eighth and tenth *Memoirs* of the Egypt Exploration Fund.
CHARLES R. GILLETT.

Pibroch [from Gael. *piobai-reachd*, pipe music, deriv. of *piobair*, piper, deriv. of *pioba*, pipe, bagpipe, from Eng. *pipe*]: the war-notes of the Highland bagpipe. There are numerous compositions of this kind, scarcely distinguishable from each other by the untrained ear. The use of this pipe in Scottish warfare has been traced back no farther than 1594.

Pic'amar [Lat. *pix, pi'cis*, pitch + *ama'rus*, bitter]: an oily body found in wood-tar.

Picard, pĕĕ'kaar', ALFRED: civil engineer; b. in Paris, France, Dec. 21, 1844; studied at the École de Ponts et Chaussées, graduating in 1864; engineer in chief in 1880; inspector-general of first class in 1891; honorary director-general of the commissions of bridges and roads, of mines, and of railways; president of section of the council of state; president of the consulting commission on railways, and of many other Government commissions; editor of the official reports of the Exposition of 1889; commissioner-general of the Universal Exposition to be held at Paris in 1900; grand officer of the Legion of Honor; vice-president of the international railway congress of St. Petersburg in 1892.

Picard, JEAN: astronomer; b. at La Flèche, department of Sarthe, France, July 21, 1620; accomplished the first exact measurement of a degree of the meridian, between Amiens and Malvoisin; made a number of valuable improvements in the instruments of observation and methods of calculation; was the real founder and constructor of the Observatory of Paris; founded the *Connaissance des Temps*, the French astronomical ephemeris, the publication of which has continued annually for more than two centuries; is noted for the noble disinterestedness with which he aided other astronomers, such as Ole Römer the Dane, Cassini the Italian, etc., and wrote, among other works, *La Mesure de la Terre* (1671), and *Voyage d'Uranibourg, ou Observations astronomiques faites en Danemark* (1680). D. in Paris, Oct. 12, 1682. Revised by S. NEWCOMB.

Picard, LOUIS BENOIT: dramatist; b. in Paris, France, July 29, 1769. At the age of eighteen he became an actor, and in 1789 he produced his first play; thereafter he continued in the double *rôle* of actor and author. He entered the Théâtre Français in 1792; about 1800 became director of the Théâtre Louvois, afterward the Odéon; in 1807 was called to direct the Opera, and returned in 1816 to the Odéon. D. Dec. 31, 1828. He wrote a large number of popular comedies, marked by naturalness, gayety, and fertility of invention. They are partly contained in his *Théâtre* (8 vols., Paris, 1821) and *Théâtre républicain* (1832).

Picards: See BRETHREN AND SISTERS OF THE FREE SPIRIT.

Pic'ardy: an old province of France; bordering on the English Channel. It is now divided into the departments of Somme and Pas-de-Calais; parts of it belong to the departments of Aisne, Oise, and Yonne.

Piccini, pi-chee'nĕe, or **Piccinni**, NICOLO: composer; b. at Bari, Italy, in 1728; received his musical education in the conservatory of Naples; made in 1754 his *début* as a composer with the opera *Le Donne dispettose*; achieved in 1760 an almost unprecedented success by his opera, *Cecchina, ossia la buona figliuola*; went in 1776 to Paris, and engaged in a musical contest with Gluck, brought about by the directors of the Grand Opéra. He composed during this period *Roland, Phaon, Atys, Iphigénie en Tauride*, etc., in all fifteen operas; but, although most of them were received with great enthusiasm, Gluck was victorious, and, other troubles being added to the defeat, Piccini left Paris for Naples in 1791. In Italy he composed several successful operas, *Griselda, Il Servo Padrone*, etc., but the Government suspected him of sympathizing with the French Revolution, and in 1798 he returned to Paris, where Bonaparte gave him a position as inspector of music at the National Conservatory. D. at Passy, May 7, 1800. He was a talented representative of the Italian music of that period, and his productivity was enormous; from 1754 to 1775 he composed 133 operas, besides many pieces of church music, etc.

Piccolom'ini: a celebrated Italian family which flourished in Siena and Amalfi. Its most noted members were ÆNEAS SYLVIUS PICCOLOMINI, afterward Pope Pius II. (1458–64), his nephew, FRANCESCO TODESCHINI, who also became pope, under the name of Pius III., but died in the year of his election, and the general OCTAVIO PICCOLOMINI (1599–1656), who fought in the Thirty Years' war on the Imperial side, joining the army of Wallenstein in 1627, and winning distinction in the battle of Lützen in 1632. Though promoted to a high command by Wallenstein, he turned against and was one of those who conspired to overthrow him, receiving for this service a part of Wallenstein's estates. After this he fought with some success against the Swedes and in the Netherlands; entered the Spanish service in 1643, was recalled by the emperor in 1648, and made marshal.

Pi'cea [Mod. Lat., from Lat. *pix, picis*, pitch]: a genus of coniferous trees including about a dozen species, known as spruces, all natives of the cooler portions of the northern hemisphere. They have four-sided needle-shaped leaves, scattered singly over the surfaces of the twigs, which after the fall of the leaves are covered with the elevated leaf bases. The cones are composed of persistent scales, and hence do not fall away from the axis, as they do in the firs (*Abies*). Six species are natives of North America, the best known being *P. alba*, the white spruce, *P. nigra*, the black spruce, *P. pungens*, Rocky Mountain spruce, and *P. engelmanni*, Engelmann's spruce. The European *P. excelsa*, Norway spruce, is commonly planted in North America as an ornamental tree. CHARLES E. BESSEY.

Pichegru, pĕĕsh'grü', CHARLES: general; b. at Arbois, department of Jura, France, Feb. 16, 1761; was a teacher of mathematics at the military school of Brienne while Bonaparte was a pupil there; entered the artillery service of the Revolutionary army, and rose rapidly; was commander-in-chief of the army of the Rhine in 1793, of the army of the North in 1794; conquered Holland and organized the Batavian republic in 1795; resumed the command of the army of the Rhine, but entered into negotiations with the Bourbons, and falling under suspicion on account of his inactivity and the reverses that his army sustained, he was deprived of his command in 1796. In 1797 he was a member of the Council of Five Hundred, and chosen its president, but, his plottings with the *émigrés* and the Royalist party being discovered, he was arrested, Sept. 4, 1797, and transported to Cayenne. In 1798 he escaped to England, where he formed a conspiracy with Cadoudal, the Polignacs, and others against Napoleon's life. He repaired secretly to Paris, but the conspiracy had in the meantime become known to the police; he was captured, imprisoned, and found strangled in his cell Apr. 5, 1804. See *Lives* by Gassier (1814), Pierret (1826), and Bouziers (1870). F. M. COLBY.

Pichiciago: a name for the little armadillos of the genus CHLAMYDOPHORUS (*q. v.*).

Pichin'cha, La: a volcano of Ecuador; immediately N. of the city of Quito and almost under the equator. It has several peaks and craters; the highest, called the Guagua Pichincha, is 15,916 feet above the sea, and appears to be gradually rising. The crater of Guagua Pichincha, which can be visited without great difficulty, is 2,500 feet deep, or one of the deepest in the world; there have been no violent eruptions since 1660, but vapor issues continually. On the side of this volcano was fought, May 24, 1822, the battle of Pichincha, in which the patriots, under Sucre, defeated the Spaniards and secured the independence of Ecuador. The province of Pichincha (named in honor of this victory) includes the city of Quito and the surrounding plateau. Area, 6,218 sq. miles. Pop. (1890) about 205,000. H. H. S.

Pichler, JOHANN: gem-engraver; b. at Naples, Jan., 1734. He was the pupil of his father, Anton Pichler (1697–1779), and began to cut intaglio-gems while still a boy. He copied many antique gems, and, as he seems to have sold them at low prices and to have done such work to order, it is probable that a great number of supposed antiques are by his hand. At a later time he signed his gems, using commonly his surname in Greek capitals, ΠΙΧΛΕΡ. In 1763 he went to Rome. A head of the Emperor Joseph II. caused him to be ennobled and added greatly to his fame. He was recognized as the first gem-engraver of his time, and undertook the most difficult tasks in the line of his art. Among other subjects he took up the representation of Græco-Roman statues and busts. Besides his intaglio-gems he produced a few cameos. He also painted some pictures and began the engraving of a set of plates after the Raphael frescoes in the Vatican. D. at Rome, Jan. 25, 1791.
RUSSELL STURGIS.

Pichuric Acid: See Lauric Acid.

Pich'urim Beans, or **Sassafras Nuts**: a name given to the seed-lobes of *Nectandra puchury* (properly *Ocotea pichurim*), a South American lauraceous tree. They are used by chocolate-makers and others for flavoring. They have a strong taste, resembling nutmeg as well as sassafras.

Pici [from Lat. *picus*, a woodpecker]: an order of birds containing the woodpeckers and wrynecks. The characteristics are a peculiar modification of the schizognathous palate, no basipterygoid processes, a Y-shaped manubrium, no cæca, and a tufted oil-gland. The fourth toe is turned backward, the first in one genus lacking. Huxley placed the woodpeckers in a group called *Celeomorphæ*, and Dr. Parker, from certain peculiarities in the palate, made them a distinct order, to which he gave the name *Saurognathæ*. Other authors have extended the limits of the group, though not always recognizing it as an order. Thus Fürbringer includes the barbets (*Capitonidæ*), toucans (*Rhamphastidæ*), and indicators (*Indicatoridæ*), and Sharpe—in his *Piciformes*—includes the puff-birds (*Bucconidæ*) and jacamars (*Galbulidæ*). F. A. Lucas.

Pic'idæ [Mod. Lat., named from *Pi'cus*, the typical genus or group, from Lat. *pi'cus*, woodpecker, whence Eng. *pie*, a bird]: a family of birds containing the woodpeckers (see Woodpecker) and wrynecks, although these last are sometimes placed in a separate family (*Iungidæ*).

Pick, Arnold, M. D., Ph. D.: alienist; b. at Gross-Meseritsch, Moravia, July 20, 1851; educated at Iglau, Moravia; became medical assistant in the Asylum for the Insane at Oldenburg in 1875, at Prague in 1877; privat docent at the University of Prague in 1880, and Professor of Psychiatry at the same university in 1886. His works are mainly monographs in psychiatry, neurology, physiological psychology, etc., besides his *Beiträge zur Pathologie u. Pathol. Anatomie des Centralnervensystems* (1879–80), written in collaboration with Otto Kohler. J. M. B.

Pick, Bernhard, Ph. D.: author; b. at Kempen, Prussia, Dec. 19, 1842; educated at Breslau, Berlin, and Union Seminary, New York. After filling pastorates in the Presbyterian Church, entered the Lutheran ministry in 1884, serving a congregation in Allegheny, Pa. He is a contributor to many important publications (McClintock and Strong's *Cyclopædia*, Schaff-Herzog *Encyclopædia*, etc.); has indexed Lange's *Commentaries* and the Ante-Nicene Fathers, and has published a number of translations. H. E. J.

Pickens, Andrew: soldier; b. at Paxton, Bucks co., Pa., Sept. 13, 1739, of Huguenot descent; went with his parents to the Waxhaw Settlement, S. C., in 1752; was a volunteer in Grant's expedition against the Cherokees 1761; was a captain of militia at the beginning of the Revolution; soon rose to the rank of brigadier-general, and shared with Marion and Sumter the honor of the heroic resistance made in South Carolina to the overwhelming numbers of the British and Tory forces. In Feb., 1779, with 400 men, he defeated Col. Boyd with 700 Tories at Kettle Creek, and at the battle of the Cowpens, Jan. 17, 1781, he commanded the militia, which he rallied and brought a second time into action after they had been broken and compelled to retreat; for this service Congress voted him a sword. After the war he was for many years a member of the Legislature; served in Congress 1793–95; was frequently commissioned to make treaties with the Indians; settled at Hopewell in the Pendleton district, which he had purchased from the Indians by the Hopewell treaty. D. there Aug. 17, 1817.

Pickens, Francis Wilkinson: Governor of South Carolina; son of Gen. Andrew Pickens; b. at Togadoo, S. C., Apr. 7, 1805; was educated at South Carolina College, and in 1829 became a lawyer of Edgefield district; was prominent as a nullifier in the State Legislature in 1832; was in Congress 1834–43; opposed the Bluffton secession movement of 1844; U. S. minister to Russia 1858–60; Governor of South Carolina 1860–62, and as such had important connection with the early secession movements of his State. D. at Edgefield, S. C., Jan. 25, 1869.

Pickerel [Mod. Eng. *pikerel*, dimin. of *pike*, pike]: in England the young of the pike (*Esox lucius*); in the U. S. any one of various fishes; thus in many localities the name is given to the small Esocidæ (*q.v.*), and in some places (e. g. the interior lakes of the Northwestern States) to the *Esox lucius*, the word being used as a synonym for pike, although sometimes incorrectly applied to other fishes of similar form. At the beginning of spring the pickerel leaves the larger rivers and ascends the creeks and narrow ditches in order to deposit its spawn. The growth of the young pickerel is extremely rapid, and from its birth it exhibits remarkable voracity. See Pike. Revised by D. S. Jordan.

Pickering, Edward Charles: astronomer; great grandson of Col. Timothy Pickering; b. in Boston, Mass., July 19, 1846; graduated at the Lawrence Scientific School 1865; taught mathematics at Cambridge 1865–67; was shortly afterward elected Thayer Professor of Physics at the Massachusetts Institute of Technology; was a member of the *Nautical Almanac* party which observed the total eclipse of Aug. 7, 1869, in Iowa, and of the Coast Survey party sent to Spain with a similar object in 1870; has conducted extended observations in optics, and especially in regard to the polarization of glass and of the sky, on which subjects he has contributed papers to several scientific journals; and has successfully carried out the laboratory method of teaching physics upon a system exhibited in his work entitled *Physical Manipulation* (1874). His system has been largely adopted in other institutions. In 1873 he was elected a fellow of the National Academy of Sciences. He afterward became director of the Harvard Observatory at Cambridge, Mass., which he raised to be one of the most active in the world in the lines of spectroscopy and celestial photography. He received the gold medal of the Royal Astronomical Society of England in 1886. Revised by S. Newcomb.

Pickering, John, LL. D.: philologist and archæologist; son of Col. Timothy Pickering; b. at Salem, Mass., Feb. 7, 1777; accompanied his father in his visits to the Six Nations of Central New York, deriving from that circumstance his fondness for American philology; graduated at Harvard 1796; studied law in Philadelphia; was attached to the U. S. legations in Lisbon and London 1797–1801; a lawyer of Salem, Mass., 1801–27; city solicitor of Boston 1829–46; was much in the State Legislature, and assisted in revising the statutes; was a laborious philological student and familiar with many languages; president of the American Academy of Arts and Sciences; founder and first president of the American Oriental Society; maintained a correspondence for many years on philological topics with P. S. Duponceau and Wilhelm von Humboldt; author of valuable legal, archæological, and philological papers, including an *Essay on a Uniform Orthography for the Indian Languages of North America* (1820), in which he proposed the alphabet adopted by American missionaries in reducing to writing not only Indian but Polynesian languages; *Remarks on the Indian Languages of North America* (Philadelphia, 1836); *Vocabulary or Collection of Words and Phrases supposed to be peculiar to the United States* (1816); *Greek and English Lexicon* (1826; 3d ed. revised and enlarged, 1846). D. at Boston, Mass., May 5, 1846. Revised by B. I. Wheeler.

Pickering, Timothy, LL. D.: statesman; b. at Salem, Mass., July 6, 1745; graduated at Harvard 1763; was commissioned lieutenant of militia 1766; studied law while acting as selectman, assessor, and town clerk of Salem; admitted to the bar 1768; was prominent in resistance to British aggressions; in 1775 became judge of the maritime and common pleas courts, was elected colonel of militia, and published *An Easy Plan of Discipline for a Militia*, which was made the official text-book in Massachusetts and in the Continental army; joined the Continental army at Morristown, N. J., in 1776 at the head of a regiment raised in Essex County, Mass.; served through the Revolution as colonel with valor and disinterestedness; became in 1777 Washington's adjutant-general, serving as such at Brandywine and Germantown, and member of the board of war in the same year; quartermaster-general 1780–85; became a commission merchant at Philadelphia at the close of the war; was sent in 1786 by the Federal Government to settle the dispute between Pennsylvania and Connecticut over land titles in the valley of Wyoming, Pa.; acquired a large tract of land in that region, settled at Wilkesbarre, and strove with much wisdom to harmonize the conflicting elements, but was seized and imprisoned for twenty days; was a delegate from Luzerne County to the Pennsylvania constitutional conventions of 1787 and 1790; negotiated treaties with the Six Nations of New York in 1790, 1791, and 1794, and with the Ohio Indians in 1793; Postmaster-General 1791–95; appointed Secretary of War 1795, and was instrumental in founding West Point Academy; became U. S. Secretary of State 1795, and was retained by President Adams until 1800, when he was dismissed with the rest of the cabinet; returned to the forests of Pennsylvania and

built a log house for his family, when by sale of a portion of his lands to friends in Massachusetts, he was set free from heavy debts and returned to Massachusetts to settle at Danvers; was made a judge of common pleas 1802; was U. S. Senator 1803–11; made himself unpopular by opposing the Louisiana purchase and the embargo of 1807; also was opposed to the war of 1812, but served as commissioner for the defense of the Massachusetts coast; in Congress 1815–17; declined a re-election to the Senate 1816; was author of able political pamphlets; devoted much attention to agriculture, being president of the Essex Agricultural Society; was an ardent Federalist. (See Essex Junto, The.) He published several occasional addresses and pamphlets: *Letter to Governor Sullivan on the Embargo*, *Addresses to the People*, *Political Essays*, and a severe *Review of the Correspondence between John Adams and W. Cunningham* (1824), etc. D. at Salem, Mass., Jan. 29, 1829. See his *Life*, begun by his son Octavius, and completed by Rev. Charles W. Upham (4 vols., 1867–73); Adams, *Documents Relating to New England Federalism* (Boston, 1877); and the article on Pickering by Lodge, *Atlantic Monthly*, vol. xli.

Pickett, George Edward: soldier; b. in Richmond, Va., Jan. 25, 1825; graduated at the U. S. Military Academy, and entered the army as brevet second lieutenant of infantry July, 1846; engaged in the war with Mexico from Vera Cruz to the capture of the city of Mexico; brevet first lieutenant and captain for gallantry at Contreras, Churubusco, and Chapultepec; on frontier duty 1848–61, becoming captain of Ninth Infantry Mar. 3, 1855. He resigned June 25, 1861, and in September was appointed colonel in the Confederate army, and brigadier and major general in 1862. In the Virginia Peninsular campaign of 1862 he led a brigade, and was severely wounded at Gaines's Mill. Continuing thereafter with the army of Northern Virginia, he participated in the battles of that army, and was conspicuous for his bravery and intelligence. At Gettysburg his division led the assaulting column which suffered so severely July 3, 1863; he also commanded in North Carolina, at the capture of Plymouth. In the campaign of 1864–65 he made the final stand at Five Forks, where his division was broken up after a desperate resistance. D. in Norfolk, Va., July 30, 1875.

Picking, Henry Forry: See the Appendix.

Pickling and Pickles: See Preservation of Food.

Picknell, William Lamb: landscape-painter; b. in Boston, Mass., in 1853; pupil of George Inness in Rome, of Gérôme in Paris, and of Robert Wylie in Brittany; member of the Society of American Artists 1880; member of the Society of British Artists; honorable mention, Paris Salon, 1880. His pictures of sunlight effects are remarkably luminous. *The Concarneau Road* (1880) is in the collection of T. B. Clarke, New York, and works by him are in the Metropolitan Museum, New York; Pennsylvania Academy, Philadelphia; Museum of Fine Arts, Boston; and the collection of the corporation of Liverpool, England. D. in Marblehead, Mass., Aug. 8, 1897.

Pico, pee'kō: one of the Azores Islands (*q. v.*); belonging to the central group; comprises an area of 143 sq. miles, and includes the volcanic mass of Pico Alto, 7,613 feet high, the highest mountain in the group. The island is fertile and well wooded, and produces an excellent wine, of which about 25,000 pipes are annually exported. Pop. 29,000.

Pico della Mirandola, Giovanni, Count of Mirandola and Prince of Concordia: philosopher and mystic; b. Feb. 24, 1463; studied at Bologna, and visited several schools in Italy and France; went to Florence 1484, and there became intimate with the group of Platonizing thinkers known as the "Academy." Seeking to reconcile the Platonic and the Aristotelian systems of philosophy, and, at the same time, to harmonize religion and philosophy, he fell into a vague and mystical method of interpretation. The wide range of his knowledge is illustrated by his offer in 1486 to defend against all comers 900 propositions *de omni re scibili*. They are drawn from theology, dialectics, ethics, physics, mathematics, natural magic, the Cabbalah. As preparatory to the great debate, he prepared a discourse, *De hominis dignitate*, a splendid affirmation of man's capacity to take all wisdom and all truth for his promise. Influenced by Pico's enemies, Pope Innocent VIII. forbade the reading of the propositions, as in part heretical. Pico retired to France, but Alexander VI. in 1493 absolved him from all taint of heresy. D. in Florence, Nov. 17, 1494. By the great scholars of the time he was regarded as the wonder of the world, but posterity has not confirmed their judgment. It is only too clear that his command of the twenty-two languages he was reputed to know (among them Greek, Arabic, and Chaldee) was very superficial; and that in philosophy he was one of those ardent but ineffectual spirits whose supposed discovery of the secret of the universe is but an affirmation of their own lack of clearness. The works of Pico that have come down to us are almost exclusively in Latin. In his extreme youth he had written verses in Italian, but later he foreswore such trifles and destroyed most of those he had already composed. His *Opera* have been printed in folio at Bologna (1496), Venice (1498), Strassburg (1504), Basel (1557, and often after that date). The most important are *Conclusiones philosophicæ, cabbalisticæ et theologicæ* (1486), containing the 900 propositions mentioned above; *Apologia G. Pici Mirand., Concordiæ Comitis* (1489); *Disputationes adversus astrologiam divinatricem libri XII.* (1495); *Heptaplus, id est de Dei creatoris opere sex dierum libri VII.* (already in the hands of friends in 1489); *Aureæ ad familiares epistolæ* (1499). Of his great projected *Concordia Platonis et Aristotelis*, he had completed only the treatise *De ente et uno*, when death interrupted his labors. See Dreydorff, *Das System des Johannes Pico della Mirandola* (Marburg, 1888).

A. R. Marsh.

Picot, pēē'kō', François Édouard: historical and genre painter; b. in Paris, France, Oct. 17, 1786; d. there Mar. 15, 1868; pupil of Vincent; Grand Prix de Rome 1813; member of the Institute 1836; first-class medal, Salon, 1819; Legion of Honor 1852. He was the master of a large number of celebrated painters, including Pils, Cabanel, Bouguereau, and Henner. Among his works are *Meeting of Venus and Æneas* (1819), Brussels Museum; *Cephalus and Procris* (1824), Amiens Museum; several portraits in the Museum at Versailles, and ceilings in the Louvre. W. A. C.

Picotees: See Carnation (the flower).

Picric Acid, **Trinitrocarbol'ic Acid**, **Trinitrophenol**, **Trinitrophenic Acid**, or **Carbazotic Acid**: the acid whose symbol is $C_6H_3(NO_2)_3O$. It is produced by the action of hot nitric acid on phenol, salicylic acid, indigo, aloes, silk, etc.; it is usually prepared from pure crystallized phenol. It crystallizes in beautiful pale-yellow, scaly crystals, or needles; dissolves in eighty-six parts of water at 60° F., and in much less at 212° F.; and is soluble in alcohol, ether, and benzol, and in sulphuric and nitric acids. When heated it melts, and on cooling solidifies to a crystalline mass; at a higher temperature it sublimes; when quickly heated, it explodes. Its taste is very bitter. Its solution in water is yellow, and it imparts a yellow color to the skin and to silk and wool; hence it is used as a yellow dye. By mordanting with argol or alum before dyeing, the color is rendered more stable. It has been common to supply for this purpose the picrate of soda, which is very explosive, and has given rise to serious accidents. A beautiful green dye is made by mixing the picric acid with indigo carmine. The Victoria yellow is trinitro-cresol, not picric acid. Leather is dyed with picric acid, particularly alum-tawed leather for belt lacings. Goods dyed with picric acid resist light well, but are liable to suffer on washing with soap. As vegetable fibers do not take picric acid, it affords a ready method for detecting cotton and flax when mixed with silk or wool. It is said to be used as a substitute for hops in making beer. Many of the salts of picric acid are explosive. A mixture of fifty-four parts of ammonium picrate and forty-six of potassium nitrate has been used as a substitute for gunpowder. Other mixtures for gunpowder are formed of potassium picrate, niter, and carbon. For explosive powder for torpedoes the carbon is omitted. Melinite, one of the most powerful explosives, is said to consist only of compressed picric acid. See Explosives.

Revised by Ira Remsen.

Picrite: See Peridotite.

Picrotoxine [Gr. πικρός, bitter + τοξικόν, arrow-poison, poison]: a poisonous bitter principle found in the *cocculus indicus* of commerce, the berries of the *Anamirta cocculus*. An infusion of the berries has been used against lice, and the alkaloid has been employed to prevent night sweats.

Pictet, Raoul: See the Appendix.

Picton: a port of entry; capital of Prince Edward co., Ontario, Canada; on the Bay of Quinté, 40 miles S. S. W. from Kingston; terminus of the Cent. Ont. Railway (see map of Ontario, ref. 4–G). It is the seat of Ontario College, has fruit-canning factories and a manufactory of fence-wire, and two weekly newspapers. Pop. (1891) 3,287.

Pictou: port of entry; capital of Pictou County, Nova Scotia; on a safe and commodious harbor at the terminus of a branch of the Intercolonial Railway; 114 miles by rail N. N. E. of Halifax (see map of Quebec, ref. 2–C). Steamers ply to Charlottetown, Quebec, and the ports of the Gulf of St. Lawrence. Bituminous coal is mined near by. There are considerable manufactures, also an academy, court-house, and a weekly newspaper. Pop. (1891) 2,998.

Picts: a Celtic tribe, the Caledonians of the Roman writers, inhabiting the lowlands and the eastern part of Scotland; are first mentioned under the name of the *Picti* in a speech addressed by the rhetorician Eumenius to the Emperor Constantius Chlorus on his return in 296 A. D. after the victory over Allectus. They were divided into the Southern and Northern Picts by the Grampian Mountains. The Southern Picts were converted to Christianity early in the fifth century by St. Ninian; the Northern by St. Columba, who began the work of conversion in 563. Their history is obscure, and its details have been the subject of much controversy. Nor are authorities agreed upon what languages they spoke. In the ninth century they were subdued by the Scots, a kindred tribe which invaded the country from Ireland. Kenneth II. conquered the whole of Scotland, made it one kingdom, and took up his residence in the old Pictish capital, Forteviot, in Stratherne. Subsequently attacked on both sides—from the N. by the Scandinavian invaders, and from the S. by the Teutonic inhabitants of England—the Pictish language and nationality gradually disappeared. See Innes, *Civil and Ecclesiastical History of Scotland*; Pinkerton, *Inquiry into the History of Scotland*; Stokes, *On the Linguistic Value of the Irish Annals*; and Rhys, *Celtic Scotland* (1884).

F. M. Colby.

Picture-gallery: a room especially prepared for the exhibition of pictures, the word *gallery* expressing the comparative length and narrowness of most of such rooms. (See Gallery.) Many of the public museums of Europe are housed in ancient palaces whose long rooms are not very skillfully altered to suit the new purposes. New galleries also are often defective in respect to the light-openings. It is required to throw the light more upon the walls than upon the floor, and to have this light come at such an angle that there shall be no flash on the surface of the picture at any ordinary position of the spectator. Sunshine and even the reflection and glow of sunshine upon the glass of the light-openings are to be avoided. It is found in practice that the section of gallery and the position of the light which suits a room of certain dimensions is not suitable to galleries much wider or narrower; not only the height has to be changed, but the relative positions of the light-openings and the wall. See the *Handbuch der Architektur*, published at Darmstadt (part iv., sixth half-volume, fourth number).

Russell Sturgis.

Pidgin- (or **Pigeon-**) **English**: an artificial dialect employed in Hongkong and the treaty-ports of China by foreigners of all nationalities who do not speak Chinese, in their dealings with native servants, merchants, coolies, etc. Its base is corrupted English, with a mixture of Chinese, Portuguese, and Malay words, arranged according to Chinese idiom. Owing to the difficulty the Chinese have in pronouncing consonantal terminations, vowel terminations *-o* and *-ee* abound, as *olo* for old, *wifo* for wife, *talkee* for talk, *catchee* for catch, *muchee* for much, etc. *Belong* takes the place of the verb to *be*: *my* = I, me, mine; *plenty* = very; *topside* = above, upstairs; *that side* = there; *this side* = here; *how fashion* = why; *savey* = know; *man-man* = slow, gently, quietly; *chop-chop* = quick; *maskee* = no matter, never mind; *chow-chow* = food, eat, etc. The word *pidgin* is itself a Chinese corruption of the English word "business."

R. Lilley.

Pied'mont (Ital. *Piemonte*): territory of Northern Italy; bounded S. by the Maritime Alps, W. by the Graian and Cottian, N. by the Pennine Alps, and E. by the river Ticino; area, 11,340 sq. miles. In the twelfth century it became a possession of the house of Savoy, and now it forms, with slightly altered boundaries, a large division of the kingdom of Italy, being subdivided into the four provinces of Turin, Cuneo, Alessandria, and Novara. The greater part of this country is mountainous, covered with spurs of the Alps, between which the numerous affluents of the Po, the Tanaro, Bormida, Clusone, Dora, Sesia, etc., form beautiful and fertile valleys; but toward the E. the country gradually opens into the plain of the Po. Rice, wheat, maize, wine, olive oil, and many varieties of fruits are produced, and extensive dairy-farming and manufacturing industries are carried on. The method of the Piedmontese silk-culture is celebrated and very successful. Pop. (1892) 3,270,988. See Italy, and Sardinia, Kingdom of.

Piedmont Plain or **Plateau**: a term applied by geographers to that portion of the North American continent which lies W. of the Coastal Plain (*q. v.*) and E. of the Appalachian Mountains. These portions are quite strongly contrasted. The dividing line between the two, known as the *fall line*, marks the localities where the streams from the W. leave the region of hard rocks adjacent to the Appalachians and enter the newer and more easily eroded terranes forming the coastal plain. In most instances the fall line also indicates where the streams lose their current and merge with the estuaries formed by the submergence of the lower portions of their channels. In New England the Piedmont plateau is broad but less clearly defined than in the Middle and Southern Atlantic States, where it is a broken, hilly country, composed principally of crystalline rocks, and deeply trenched by the rivers flowing across it. It broadens from New York southward, and reaches its greatest width in North Carolina, where it extends eastward some 300 miles from the Appalachians.

Israel C. Russell.

Pie'per, Franz Augustus Otto: theologian; b. in Pomerania, June 27, 1852; educated at Watertown, Wis., and St. Louis, Mo. After a pastorate at Manitowoc, Wis., 1875–78, he became professor in Concordia Theological Seminary, first as the colleague and afterward as the successor of Dr. C. F. W. Walther. Besides numerous articles in the German language, Prof. Pieper has contributed in English to *The Distinctive Doctrines and Usages of the General Bodies of the Evangelical Lutheran Church* and to *The Presbyterian and Reformed Review*. He is the leader of the Missouri Lutherans.

H. E. Jacobs.

Pierce, Franklin: the fourteenth President of the U. S.; b. at Hillsborough, N. H., Nov. 23, 1804; graduated in 1824 at Bowdoin College, where he was the intimate associate of Nathaniel Hawthorne, his lifelong friend; was the law-pupil of Levi Woodbury; admitted to the bar in 1827, and practiced law with success in Hillsborough and Concord, N. H.; represented the former town in the State Legislature 1827–33; was in Congress 1833–37; in the U. S. Senate 1837–42; was heartily in favor of the union of Texas with the U. S.; twice declined positions in the cabinet of Mr. Polk; served with distinction in the Mexican war, commanding a brigade; was president of the New Hampshire constitutional convention 1850–51; was chosen President of the U. S. in 1852 by 254 electoral votes to 42 for Gen. Scott, the Whig candidate. Mr. Pierce's administration was a period of great political excitement. In his inaugural address, Mar. 4, 1853, he strongly denounced the agitation of the slavery question then going on, and maintained that slavery was recognized by the Constitution, and that the Fugitive Slave law was constitutional and ought to be strictly enforced. Prominent among the events of his administration were the Gadsden Purchase, the repeal of the Missouri Compromise, and the beginning of the troubles in Kansas, during which the President opposed by every means in his power the organization of a Free-State government. He sought to justify the Kansas and Nebraska Act, and in his special message of Jan. 24, 1856, represented the formation of a Free-State government as an act of rebellion. Other important events of his administration were the negotiation of a treaty with Japan by Commodore Perry, the publication of the Ostend Manifesto, the settlement of the dispute over the boundary between the U. S. and Mexico, and Walker's filibustering expedition to Nicaragua. He was an ardent advocate of the State rights doctrine, and during the war of 1861–65 sympathized with the Southern States. D. at Concord, N. H., Oct. 8, 1869. His *Life*, down to his nomination, was written by Nathaniel Hawthorne (Boston, 1852).

Revised by F. M. Colby.

Pierce, George Foster, D. D.: bishop; son of Lovick Pierce, D. D.; b. in Greene co., Ga., Feb. 3, 1811; studied law with his uncle, Hon. George Foster; in 1831 joined the Georgia conference of the Methodist Episcopal Church; performed important pastoral work in Georgia and South Carolina, and presided over literary institutions (Emory College for six years) till 1854, when he was made bishop; was a member of the General Conferences of 1844, 1846, 1850, and 1854; published *Incidents of Western Travel* (Nashville, 1857) and several sermons, addresses, etc. D. near Sparta, Ga., Sept. 3, 1884.

Revised by A. Osborn.

Piero'la, Nicolas, de: politician; b. at Camaná, Arequipa, Peru, Jan. 5, 1839; son of the director of the Lima museum; studied and practiced law in that city, and was a well-known journalist. Under President Balta (1868–72) he was Minister of the Treasury, and consequently was directly connected with the enormous outlays of that period. He led abortive revolts against Pardo 1872 and 1874, and Prado 1877. After the first reverses of the Chilian war, President Prado went to Europe; Pierola then headed another revolt, deposed the vice-president, and was declared supreme chief at Lima Dec. 23, 1879. Owing to the urgent need for a responsible head the republic generally accepted him. He showed great activity, especially in defending Lima; when that city was taken (Jan. 17, 1881) he fled into the interior, convoking a congress at Arequipa, but in the following November he resigned and went to Europe. He tried to seize the presidency again in 1885. Owing to his restless and revolutionary spirit he has several times been banished, but he has a considerable political following in Peru. He was a presidential candidate in 1894. Herbert H. Smith.

Pierre: city; capital of South Dakota and of Hughes County (for location, see map of South Dakota, ref. 6–D); on the Missouri river and the C. and N. W. Railway; 158 miles W. of Huron. It is the principal trading-point for the Black Hills section. Natural gas has been discovered here, and is used in large quantities for power and lighting. It is the seat of Pierre University (Presbyterian, chartered in 1883), and of an Indian industrial school established by the U. S. Government, and contains 3 national banks, with combined capital of $200,000, a State bank with a capital of $50,000, and a daily, 4 weekly, and 3 monthly periodicals. Pop. (1890) 3,236; (1900) 2,306. S. A. Travis.

Pierrepont, Edwards, LL. D., D. C. L.: jurist; b. in North Haven, Conn., Mar. 4, 1817; graduated at Yale College in 1837, and a year later was admitted to the bar; practiced law at Columbus, O., till 1845, when he removed to New York city; in 1857 was elected a judge of the superior court of New York, but resigned that position in 1860, and returned to the practice of law; was engaged by the National Government in 1867 to conduct its case against John H. Surratt, indicted for complicity in the murder of President Lincoln; in 1869 was appointed by President Grant U. S. district attorney for the southern district of New York, but resigned that office in May, 1870; was appointed minister to Russia but declined in 1873; was appointed attorney-general of the U. S. in 1875, minister to England in 1876, resigned in 1877. He received the degree of LL. D. from Columbian College, Washington, and from Yale College, and that of D. C. L. from Oxford University. D. in New York, Mar. 6, 1892.

Piers: See Harbors.

Pierson, Arthur Tappan, D. D.: minister; b. in New York city, Mar. 6, 1837; educated at Hamilton College and Union Theological Seminary; was pastor of the Congregational churches, West Winsted, Conn., 1859–60; Binghamton, N. Y., 1860–63; Norwalk, Conn., 1863; of the Presbyterian churches, Waterford, N. Y., 1863–69; Fort Street, Detroit, Mich., 1869–82; Second, Indianapolis, Ind., 1882–83; Bethany, Philadelphia, 1883–91; supplied the Metropolitan Tabernacle, London, England, 1891–93; and was incumbent of the Duff lectureship in 1892. Besides frequent contributions to periodicals, Dr. Pierson has edited *The Missionary Review of the World* since its inception, 1888 (New York), and has published many evangelistic and missionary works, such as *Many Infallible Proofs* (1886; 2d ed. 1889); *The Crisis of Missions* (New York, 1886); *Evangelistic Work in Principle and Practice* (1887; 2d ed. 1888); *The Divine Enterprise of Missions* (1891); *The Miracles of Missions* (1891); *The Heart of the Gospel* (Sermons, 1891); *The Divine Art of Preaching* (New York and London, 1892); and *The New Acts of the Apostles* (1894). C. K. H.

Piers Plowman: See English Literature.

Pietermaritzburg, or **Maritzburg**: capital of Natal (*q. v.*); at an altitude of over 2,000 feet above the sea; on a fertile plain watered by a tributary of the Umgeni; 73 miles by the main line of the Natal Government Railway System N. of Durban (see map of Africa, ref. 9–F). It is also connected by rail with the Orange Free State and the Transvaal. The chief buildings are the government-house and the office of the colonial secretary; and there is a military camp here which is occupied by the principal division of troops stationed in the colony. The town takes its name from its Boer founders, Pieter Retief and Gert Maritz. Pop. (1891) 17,500, of whom two-thirds are whites, the rest being natives and coolies.

Pietists [from Lat. *pi'etas*, piety, deriv. of *pi'us*, observing what is proper toward parents or God, pious (often implying merely formal or outward observance)]: in Germany, Christians who never formed a sect nor professed distinctive doctrines, but were noted for their preference of practical religion. The movement took place wholly within the Lutheran Church, and may be characterized as an attempt to make even the least important every-day doings expressive of the religious spirit, and eliminate from human life anything—such as dancing, visiting the theater, etc.—which proves hostile to such a modification. The first writers of importance who assumed this ground were Johann Arndt (*Vom wahren Christenthum*, 1605) and Johann V. Andreæ (*Invitatio Fraternitatis Christi*, 1617). The term was first applied in derision to a number of teachers at Leipzig in 1689, chief among whom was A. H. Francke, and was soon afterward employed chiefly as a designation of the followers of Philipp Jakob Spener (*q. v.*). The combined influence of Spener and Francke led to the foundation of the University of Halle, which became a center of the pietistic movement. The rationalism of the close of the eighteenth and beginning of the nineteenth century operated adversely to pietism, but since the overthrow of rationalism it has largely revived in Germany, especially in Berlin, Silesia, and Würtemberg. The general history of Pietism has been written by H. Schmid (Nördlingen, 1863), H. Heppe (Leyden, 1879), and A. Ritschl (Bonn, 1880–86, 3 vols.). Revised by S. M. Jackson.

Pie'tra Du'ra [Ital., liter., hard stone]: a name applied to the better kinds of cameo and mosaic work. See Mosaic.

Piëzom'eter [Gr. πιέζειν, press + μέτρον, a measure]: an instrument for measuring the compression of water and of other fluids under pressure. The first successful piëzometer was that of Oersted, in which the pressure was gauged by the manometer, and the amount of compression of the water was indicated by the use of mercury in a glass tube. Regnault's piëzometer is in principle the same, but it also takes into account the expansion of the tubes under pressure, and consequently gives more accurate results. Where the pressures to be used are beyond the crushing point for glass steel tubes are used and the encroachment of the mercury upon the manometer tube is recorded by gold plating the inner surface of the latter previous to the test, and afterward noting to what height the gold has been amalgamated.
Revised by E. L. Nichols.

Pig: See Swine.

Pigafet'ta, Antonio: traveler; b. at Vicenza, Italy, in 1491. In 1510 he went to Spain in the suite of the papal nuncio; by special permission he accompanied the expedition of Magalhães in 1519, and was one of those who returned in the Victoria 1522, after the first circumnavigation of the globe. A letter which he wrote to Charles V., describing the voyage, was quickly published in several languages. He prepared a longer account, which was discovered and published at Milan in 1800 as *Primo Viaggio intorno al globo terracqueo*. Pigafetta is the principal authority on this important voyage. D., probably at Vicenza, about 1534. Herbert H. Smith.

Pigeon [= Fr. < Lat. *pi'pio*, a young piping or chirping bird, deriv. of *pipi're*, pipe, peep, chirp]: any member of the order *Columbæ*, a group of birds typified by the familiar domestic pigeon. The characters of the order are given under Columbæ, and although the members of the group present great variations in regard to size and color, yet, with one or two exceptions, they are all readily recognizable. There is popularly supposed to be a difference between doves and pigeons, but it has no existence in nature. Something like 500 species have been described, widely distributed throughout the temperate and warm parts of the globe, but most abundant in the Malay Archipelago, which has about 120 species. Wallace accounts for this abundance by the absence in this region of fruit-eating animals, like monkeys and squirrels. The most aberrant number of the order is the Samoan tooth-billed pigeon (*Didunculus strigirostris*), so named from the notches in the lower mandible. It is the nearest living relative of the extinct Dodo (*q. v.*), but the affinity between the two is not very close. The specific name is in allusion to the hooked upper mandible, which suggests that of a bird of prey. This bird is about a foot long; the head and greater portion of the un-

BLACK CARRIER COCK.

BLACK PIED POUTER COCK.

ALMOND TUMBLER.

HOMING PIGEON.

RED TURBIT.

YELLOW JACOBIN.

SCOTCH FANTAIL.

TRUMPETER.

SWIFT.

FANCY PIGEONS.

der parts are glossy greenish black; the larger share of the upper part of the body, including the tail, is chestnut brown, the feathers on the upper part of the mantle tipped with greenish black. It formerly nested on the ground, a fact which threatened to lead to its extermination, owing to the attacks of dogs, cats, and rats, but changed its habits and took to nesting in trees and thus prolonged its days.

The Nicobar pigeon (*Calœnas nicobarica*), from New Guinea and some of the adjacent islands, is another peculiar form, having a remarkable horn-like lining to its gizzard. The plumage, except the tail (which is white), is of various shades of green with metallic reflections, and the lower part of the neck is adorned with pointed feathers much like the hackles of a cock. The brilliantly colored fruit-pigeons, of the genus *Carpophaga* and allied genera, come from Australia, the Malay Archipelago, and the islands of the Pacific. Green is perhaps their predominant color, but some are almost as gay in plumage as any of the parrots. Some of the fruit-pigeons of the genus *Treron*, owing to the spicy fruits on which they feed, are said to surpass all other birds in flavor, and some present very interesting modifications of the gizzard.

The giants of the order are the crowned pigeons, Goura (*q. v.*); the pygmies are found among the little ground-doves (*Columbigallina*, *Geopelia*, etc.), some of which are little larger than a sparrow. Finally we come to *the* pigeon (*Columba livia*) or rock-pigeon, which is found in a wild state over a great part of Europe, breeding upon rocky precipices, especially near the sea. The wings are black at their outer margin, and have a black bar on the secondaries, and a second on the great coverts; the rump is ashy; the tail bluish ash, black for the terminal third, with the lateral feathers white externally for their basal third. This plumage may be seen almost feather for feather in some of the common domesticated pigeons. The blue rock-pigeon is by most authorities considered to be the parent stock of *all* breeds of domestic pigeons, of which there are at least 250 varieties, but other authorities consider that some of the eastern breeds sprang from *Columba intermedia*, a very similar bird. The domestic birds differ not only in color, markings, and size, but even in the number of their vertebræ and ribs, as well as in the shape and proportions of their skulls. Darwin, who made an extensive study of pigeons, divides them into four principal groups, Pouters, Carriers, Tumblers, and Trumpeters, with eleven sub-groups or races. There are at least 150 distinct breeds recognized by fanciers. For a full discussion of the question see Darwin's *Animals and Plants under Domestication*, vol. ii.

The carrier-pigeon is perhaps the best known by name of all domestic breeds, but it is *not* the bird used for carrying messages. Whatever may have been the case formerly, the modern carrier is a mere fancy breed distinguished by a large fleshy caruncle about the base of the bill and a smaller one around each eye. The bird used for carrying messages and for long-distance flying is the homer, which is not bred for "points" and is not essentially different from an ordinary dove-cote pigeon in appearance. By careful selection the pigeon's natural fondness for its own loft has been intensified, while by selection and training birds have been raised which will return home from distances of from 200 to 500 miles, and, very rarely, from 1,000 miles.

The fantail belongs to the short-billed tumbler group, and is characterized by the great number of tail feathers, which should be at least twenty-four, and may be as many as forty, and by having the tail carried more or less erect and open. The head should also be carried well over the back, toward the root of the tail, and breeding has gone so far in this direction that these birds are hollow-backed and some have great difficulty in picking up their food.

For domestic breeds, see Fulton's *Illustrated Book of Pigeons*. There is no modern monographic work on pigeons save the British Museum *Catalogue of Game Birds*, by Ogilvie Grant. See also Evolution, Dodo, Goura, Passenger-pigeon, Jacobin, Pouter, and Trumpeter.

F. A. Lucas.

Pigeon-English: See Pidgin-English.

Pigeon-pea: the pea-like pulse grown upon the leguminous shrubs *Cajanus flavus* and *bicolor*, which are extensively cultivated in many tropical countries, where they are highly valued. The better sorts are very palatable substitutes for the pea.

Pigmentation [from Lat. *pigmentum*, paint, color, deriv. of *pingere*, to paint, to decorate]: in physiology, a discoloration produced by the deposition, especially to excess, of a pigment in the tissues. A certain amount of pigment is one of the normal constituents of the body. The great source of pigment is found in the coloring matter of the red blood-corpuscles, and it is probable that all of the pigments found in the tissues represent various modifications of this. Under normal circumstances the greatest amount of pigmentation is found in the epidermal appendages, especially in the hair. The varying color of this is due to the different amounts and possibly different physical relations to the tissue of the same pigment. The same is true of the eyes, which owe their color to the pigment contained in the iris. A varying amount of pigment is found in the skin. In a section of the Negro skin there is found a line of pigment in and between the cells of the deepest layer of epidermis. The formation of the pigment does not seem to be a function of the epidermic cells, but it is formed by certain cells of the connective tissue, and when formed is taken up by the epidermic cells. The color of different organs of the body is due to the presence of essentially the same pigment. An increased formation of the pigment plays an essential part in various pathological conditions of the body, and a diseased condition of the adrenal glands is associated with an increased formation of pigment. In the skin the greatest formation of pigment under pathological conditions is seen in the pigmented tumors. All these tumors spring from the mesoderm and usually originate in tissues where there is normally a formation of pigment, as in the choroid coat of the eye and in the skin. Another source of pigment is also given when organs are subjected to long-standing congestion, or when hæmorrhage takes place in organs. A number of red blood-corpuseles are then destroyed and their pigment is taken up in the tissues. The pigmentation of the skin which follows a bruise or an injury is due to changes following on a hæmorrhage. W. T. Councilman.

Pigments: coloring matters which when mixed with oil, water, or gum, form paint. They are either mineral or extracted from organic matter. See Paint.

Pigmy: See Pygmy Tribes.

Pigmy Ape: See Barbary Ape.

Pig-nut: See Hickory.

Pigres (in Gr. Πίγρης: Greek poet of the fifth century B. C., brother of Artemisia (*q. v.*), and reputed author of the mock-heroic poem, *The Battle of the Frogs and Mice* (Βατραχομυομαχία), once attributed to Homer. (See editions by Baumeister, 1852, and Brandt, 1888.) To him was ascribed also the *Mœrgites* (Μαργίτης), the hero of which was a blundering Jack-of-all-trades and master-of-none, a phrase which goes back to the Greek original: πόλλ' ἠπίστατο ἔργα, κακῶς δ' ἠπίστατο πάντα. B. L. G.

Pigweed: See Chenopodium.

Pike [M. Eng. *pike*, appar. deriv. of *pike*, a sharp point, etc. Cf. Fr. *brochet*, pike, deriv. of *broche*, spit]: any one of various species of fishes. The English pike (*Esox lucius*) has been supposed to have been "so called either from the likeness of its nose to a pike or spear, or because it moves itself in the water like a spear thrown" (*Richardson*); or with greater probability because of the pointed or pike-like teeth. In the U. S. the name is applied to the same species, and in some places to the smaller species of the same genus —e. g. *Esox reticulatus*, *Esox niger*, etc. These are, however, generally called pickerel. The *Esox mashinongy* is in most sections distinguished under the name muskellunge. All the species agree in the form familiar to most persons from personal acquaintance with some one or other of the species, or from the illustrations in angling books, and differ chiefly in the comparative length of the snout, the

The pike.

extension of scales on the cheeks and opercula, the number of rays in the dorsal and anal fins, and color. The name "pike," either alone or in combination, is also perverted to

species very different from those just considered. In some parts of the U. S., e. g. the species of *Stizostedion* (a genus closely related to *Perca* or the perches) are called walled-eyed pike, or simply pike. See Esocidæ and Fishes.

Revised by F. A. Lucas.

Pike: a spear with wooden handle and metal head, carried by foot soldiers. In the fifteenth century it was from 15 to 20 feet in length, but was gradually reduced to from 10 to 14 feet. It was designed for use as a thrusting, not as a missile weapon. Before the introduction of the musket, about 1525 A. D., the mass of the infantry was armed with the pike. Concurrently with the more general use of the musket the number of pikemen was reduced; but in the latter part of the sixteenth century they still constituted half of each battalion, being massed ten deep in the center, with the musketeers on the flanks. With the introduction of the bayonet in the seventeenth century the use of the pike was gradually given up, although, owing to lack of other arms, it has been used in comparatively recent times, as during the French Revolution. James Mercur.

Pike, Albert: author; b. at Boston, Mass., Dec. 29, 1809; studied at Harvard University; went in 1831 to Santa Fé, N. M., by way of St. Louis, much of the way on foot; reached Fort Smith, Ark., in 1832 in a destitute state; was a journalist at Little Rock 1834–36, after which he became a successful lawyer and a prominent States-rights politician; served as a captain of Arkansas cavalry in the Mexican war; was brigadier-general in the Confederate service during the civil war; editor of Memphis *Appeal*, 1867–68; author of *Prose Sketches and Poems* (1834); 5 vols. of *Law Reports* (1840–45); *The Arkansas Form-book* (1845); *Nugæ* (poems, 1854); a romance (1835); a volume of Masonic statutes and regulations (1859); *Morals and Dogma of Freemasonry* (1870). His *Hymns to the Gods* were originally contributed to *Blackwood's Magazine* in 1839. Privately printed collections of his poems were issued in 1873 and 1881. He was the grand commander of Scottish Rite Masonry of the southern jurisdiction and the chief of the Royal Order of Scotland in the U. S. D. at Washington, D. C., Apr. 2, 1891. Revised by H. A. Beers.

Pike, Zebulon Montgomery: soldier; b. at Lamberton, N. J., Jan. 5, 1779; son of a captain in the U. S. army; became a cadet in his father's regiment 1799; was soon promoted to captain; headed an expedition which penetrated to the head-waters of the Mississippi in the autumn of 1805; in the following year was charged with an exploration of the interior of Louisiana territory, in the course of which he discovered Pike's Peak in the Rocky Mountains and reached the Rio Grande; was detained by Spanish authorities, taken to Santa Fé for examination, and his papers seized. Being ultimately released, he arrived at Natchitoches July 1, 1807, received the thanks of the Government for his services, was rapidly promoted, published in 1810 an account of his two expeditions, became brigadier-general 1813, and commanded the expedition sent against York (now Toronto), Canada, in the assault of which place he was killed Apr. 27, 1813. See his *Life*, by H. Whiting, in Sparks's *American Biography* (2d series, vol. v.).

Pike's Peak: a summit of the Rocky Mountains, named in honor of Gen. Zebulon M. Pike, who discovered it in 1806. Its altitude is 14,147 feet, and as it stands in the Front range it is visible from a wide area of the plains. From 1842 to 1888 it was occupied as a meteorological station by the U. S. Signal Service, and observations were resumed by the Weather Bureau in 1892. In 1890 it was connected by a cog railway with Manitou, and it is a popular resort for tourists. Its lower slopes are covered by a forest of pine and fir, the upper limit being at 11,500 feet, above which the rocks are bare. G. K. Gilbert.

Pilas'ter [from Lat. *pila*, pillar]: a square pillar, attached to a wall, from which it projects but little. It sometimes has the taper of a column, and is sometimes of equal breadth from top to bottom. Its base and capital usually conform to those of the pillars or columns, though this was not the custom among the Greeks. The name pilaster is also given to a projecting pier of rough brick or stone standing on the inside of a wall, and designed to sustain the end of a sleeper for the floor above.

Pi'late, Pontius: the fifth Roman procurator of Judæa and Samaria; entered his office in 26 A. D., residing partly in Cæsarea and partly in Jerusalem, where he inhabited the magnificent palace built by Herod the Great. In 36 he was arraigned by the Samaritans before the Syrian proconsul, Vitellius, on account of his unjust and cruel government, and Vitellius sent him to Rome to answer the accusations before the emperor. The issue is not known with certainty. According to Eusebius, he was banished to Vienne in Gaul, and committed suicide soon after. According to a widely spread tradition, he was beheaded under Nero. A great number of legends, more or less fanciful, clustered naturally around his name. His singular behavior during the trial of Christ, as we read it in the Bible, excited from the earliest time a most vivid interest, and occasioned very different explanations. Tertullian calls him *jam pro sua conscientia Christianum*, and the Æthiopian Church declared him a martyr and a saint. Modern scholars, however, agree generally in considering him one of those frivolous characters which were the natural offspring of the Roman civilization in the Augustan period—capable of receiving a strong impression of the sublime, but utterly unable to act on such an impression. The cruel massacre of the Samaritans at Gerizim, the immediate cause of his downfall, is consistent with that kind of weakness of character which rises from moral indifference. The so-called *Acta Pilati* (of which an English translation is found in the Ante-Nicene Library) give an account of the trial of Jesus, but of course they are spurious, as are also numerous other works either attributed to him, as the *Epistola Pilati*, a letter purporting to be Pilate's description to Tiberius of the resurrection, or describing his subsequent life and punishment. His wife is generally called Procla or Claudia Procula by the Pilate legends, and represented as a proselyte of the gate. Origen, Chrysostom, and Hilary assert that she became a Christian. The Greek Church has made her a saint, and observes Oct. 27 as her day.

Revised by G. L. Hendrickson.

Pilat'ka, Fla.: See Palatka, Fla.

Pilchard: See Clupeidæ.

Pilcomayo, pĕĕl-kō-mī'yō: a river of South America; rises in Bolivia, N. W. of Potosí; flows S. E. through the Gran Chaco, where it separates the Argentine Republic from Paraguay, and joins the Paraguay by several mouths just below Asuncion. Length probably over 1,100 miles. Though most of its course is through a plain, it is so shallow and so much obstructed that it is nearly useless for navigation, at least in the dry season; in some places the channel is almost lost in marshes. H. H. S.

Pile-driver: an apparatus for driving piles into the ground. The common pile-driver consists of a frame having two vertical timbers or guides between which an iron ram is drawn up by a rope passing over a pulley at the top, and then allowed to drop on the head of the pile; the ram weighs from 1,000 to 2,000 lb., its fall is from 10 to 20 feet, and the number of blows per minute is five or more. The steam pile-driver, invented by Nasmyth, has a steam cylinder which can be set at different elevations between vertical guides. The piston in this cylinder is lifted up by steam pressure, and thus the ram, which is attached to the lower end of the piston rod, is raised; the ram weighs from 2,000 to 4,000 lb., falls about 3 feet, and the number of blows per minute is about sixty. In the gunpowder pile-driver, invented by Shaw, a cartridge of powder is placed upon the head of the pile and exploded by the impact of the falling ram; the force of the explosion drives down the pile and throws up the ram, which is caught and held by an automatic device at its highest elevation. In soft soils piles should be driven until the penetration under a single blow of the ram is only 1 or 2 inches. Mansfield Merriman.

Piles (in engineering): See Foundation.

Piles, or **Hæmorrhoids** [*piles* is from Mod. Lat. *pi'læ*, piles, liter., plur. of Lat. *pi'la*, ball]: vascular and fibro-vascular tumors of the lower bowel or rectum—termed *external* piles when below the sphincter muscle and upon the verge of the anus; *internal* piles when above the sphincter. In structure they are due to congestion or dilatation of the hæmorrhoidal veins, which are connected with the portal venous circulation, returning blood from the intestines through the portal vein and liver to the vena cava and the heart. Piles when chronic are dilated veins of the anus and rectum, with fibrous thickening of the tissues and mucous membrane investing them. Hæmorrhoids are caused in the first place by anything which obstructs the outflow of blood from the rectal veins, and in the second place by any local irritation tending to cause congestions or inflammatory processes. They seldom afflict persons who are robust, ab-

stemious, frugal, and engaged in active exercise. They result from excessive eating and drinking, congestion or cirrhosis of the liver, alcoholic excesses, and constipation. Sedentary occupation favors their development. Cavalry officers and railway travelers suffer from piles—in part from constipation, in part from the influence of incessant jarring and hypostatic congestion of the lower bowel. The abuse of harsh and powerful catharties, drinking water impregnated with mineral substances, and too fine, non-laxative diet may develop piles. Pregnant women have piles from pressure of the gravid uterus upon the veins. Internal piles may increase in size, and in efforts of evacuation be protruded from the bowel. By this stretching the hæmorrhoidal tumors in time become pedunculated, and are forced out with every act of defecation. They require to be constantly returned; failure to do this may result in their strangulation, ulceration, bleeding, and even removal by gangrene. External piles when inflamed may also ulcerate and bleed. Hæmorrhoids when inflamed render evacuations of the bowels very painful, and cause suffering in sitting and walking. Patients with hæmorrhoids usually discharge mucus from the anus, and sometimes shreds and patches of organized lymph. Piles are to be prevented, and also treated in their milder forms and stages, by regulated, laxative diet, active exercise, and mild saline catharties. When pedunculated they may be removed by the knife, ligature, or galvano-cautery. When they are strangulated they must be reduced in size by ice or cold water, oiled, and returned. Ulcerated and inflamed piles are treated by cold applications, astringent and anodyne ointments, and free evacuation of watery stools by use of saline catharties. Revised by W. Pepper.

Pileus: See Head-dress.

Pilgrim Fathers: the name commonly applied to the earliest settlers in Massachusetts (*q. v.*). They had separated from the Church of England and sought refuge in Holland, whence they emigrated to Massachusetts in 1620, founding the Plymouth colony. In religion they were Independents, while the Massachusetts Bay colonists were Puritans (*q. v.*).

Pillar: See Column.

Pillar Saints or **Stylites**: in the Eastern Church, chiefly in Syria, a class of ascetics who dwelt each on the top of a lofty pillar, after the example of St. Simeon Stylites (*q. v.*). The practice began to prevail in the fourth century, and in the twelfth was not yet extinct. It never penetrated into the West.

Pillars of Hercules: See Gibraltar.

Pilling, James Constantine: ethnologist; b. in Washington, D. C., Nov. 16, 1846. He attended the public schools and Gonzaga College. At the age of twenty was employed as stenographer in court work, in committee work in Congress, and in the various commissions established by Congress for the settlement of claims resulting from the civil war. In 1875 he joined the survey of the Rocky Mountain region under Maj. J. W. Powell; in 1880 was made chief clerk of the U. S. Geological Survey; in 1891 became ethnologist in the Bureau of Ethnology of the Smithsonian Institution. D. at Olney, Md., July 26, 1895. His publications, which are chiefly bibliographical, range from 1881 to the time of his death, and relate to the languages and literatures of the Eskimo (1887), Siouan (1887), Iroquoian (1888), Muskhogean (1889), Algonquian (1891), Athapascan (1892), Chinookan (1893), Salishan (1893), Wakashan (1894), and other linguistic stocks of North American Indians. Among his earliest works was a *Catalogue of Linguistic Manuscripts in the Bureau of Ethnology* in Washington (1881). This was followed in 1885 by a general work on Indian bibliography entitled *Proof-sheets of a Bibliography of the Languages of the North American Indians*. His latest work, as yet unpublished, was a bibliography of the ancient Mexican language.

Pillory [from O. Fr. *pilori*, pillory; cf. Portug. *pelourinho*, Provenç. *espitlori* < Lat. **specula'rium*, deriv. of *speculum*, mirror. Fr. *pilori* has been influenced in form by *pilier*, pillar]: an instrument of punishment, consisting of a wooden frame in which the offender's head and arms were inserted, he standing, thus confined in a stooping posture, exposed to public ridicule. Something of the kind existed in England previous to the Norman Conquest, and was known as the *halsfang*, or catch-neck. From the reign of Henry III., and especially during the sixteenth, seventeenth, and eighteenth centuries, the pillory was a statute punishment for perjurers, forgers, users of false weights, etc. Its use was abolished by 56 Geo. III., c. 138 (1816), except for perjury and subornation, and was altogether abolished by 7 Wm. IV. and 1 Vict., c. 23 (1837). In France a similar implement, called the *carcan*, was in use until 1832. The pillory was in use in the American colonies, and provision for its use existed on the statute-books of the U. S. until 1839, but it seems not to have been employed after the Revolution. See Stephen's *Commentaries*, Andrews's *Punishment in the Olden Times*, *The Reliquary* for Apr., 1861, and *The Penny Magazine* (ii., 108.) Revised by F. Sturges Allen.

Pillow, Gideon Johnson: soldier; b. in Williamson co., Tenn., June 8, 1806; graduated at the University of Nashville 1827; studied law; practiced successfully at Columbia; was a delegate to the national Democratic convention of 1844, where he was influential in securing the nomination of James K. Polk for the presidency; was appointed brigadier-general of Tennessee volunteers July 11, 1846, during the war with Mexico; took a prominent part in the siege of Vera Cruz; commanded the right wing at the battle of Cerro Gordo, where he was wounded; was made major-general Apr. 13, 1847; took part in the battles of Churubusco, Molino del Rey, and Chapultepec, being severely wounded in the latter; came into collision with Gen. Scott in regard to the convention of Tacubaya, which he disapproved, and at his own request was tried by a military court upon charges of insubordination preferred by Gen. Scott, but was honorably acquitted. He was honorably discharged July 20, 1848, and resumed the practice of law in Tennessee; was a member of the Nashville convention of 1850, where he opposed extreme measures; raised a large force of Tennessee volunteers for the Confederate service in 1861; was appointed brigadier-general; commanded at the battle of Belmont Nov. 7, 1861; was second in command at Fort Donelson in February; escaped before the surrender, and afterward served under Gen. Beauregard in the Southwest. D. in Lee co., Ark., Oct. 8, 1878. Revised by James Mercur.

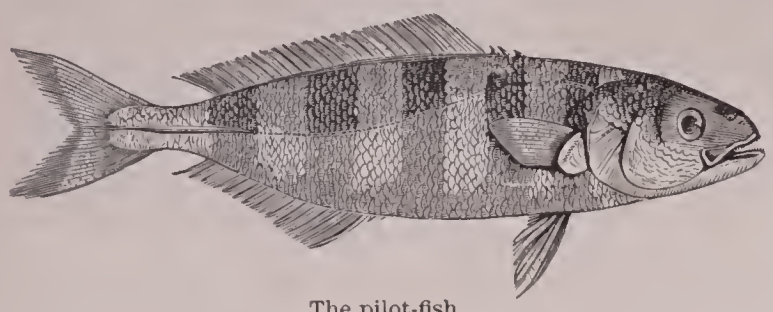
Pilot [from Fr. *pilote*: Ital., *pedoto*, *piloto*: Span. *piloto*, from a deriv. of Gr. πηδόν, oar, πηδάλιον, rudder. The Dutch words *pijloot*, etc., are probably borrowed from Romanic sources]: the steersman of a ship; the officer or person on board ship who has charge of the helm and of the ship's course; in the specific and more usual sense, the person appointed and authorized by law to conduct or steer a vessel through a river, road, channel, etc., or into or out of a harbor or port. *Pilotage* is the service rendered by a pilot; also the compensation received by a pilot.

Pilots of the description last mentioned are rendered necessary by the exigencies of modern commerce by water. In Great Britain the appointment and much of the regulation of pilots is placed in the hands of societies or corporations, either holding ancient charters or existing under statutory authority, and called Pilotage Authorities. The most important of these corporations is that of the Trinity House of Deptford Strand, which has the control of the pilots of the Cinque Ports (*q. v.*). The jurisdiction of pilotage authorities in Great Britain now depends for most purposes, independently of local statutes, upon the Merchant Shipping Act of 1854. In the U. S. the States and the Federal Government have concurrent jurisdiction to pass pilotage laws, the power of Congress being superior to that of the States, and exclusive when exercised (by virtue of Art. I., § 8, of the Federal Constitution). Pilots are licensed in the U. S. either by the Governor of a State, or by a commission, or under federal laws.

Vessels are required by statute to take a licensed pilot, and must pay pilotage to the first pilot offering himself. In Great Britain the Merchant Shipping Act of 1854 provides that no owner or master of any ship shall be answerable to any person whatever for any loss or damage occasioned by the fault or incapacity of any qualified pilot acting in charge of the ship where the employment of the pilot is compulsory by law. In the U. S. the owner is not exonerated from liability for damages resulting from gross mismanagement by the pilot by reason of the employment of the pilot being compulsory. The pilot's fees are regulated by statute, or in Great Britain by the pilotage authorities, or by custom. See Maude and Pollock's *Law of Merchant Shipping*, Abbott's *Law Relative to Merchant Ships and Seamen*, and Parson's *Maritime Law*. F. Sturges Allen.

Pilot-fish, or **Pilot** [so called because it was formerly supposed to act as a pilot to the mariner, and is still sup-

posed to act as such to sharks]: a carangoid fish (*Naucrates ductor*), rarely much more than a foot long, which is found in almost all tropical and temperate seas. These fishes often



The pilot-fish.

follow in the wake of vessels, associating with sharks, and taking the refuse thrown from the ships. They are elongated, symmetrical, fusiform fishes, of graceful form and with seven cross-bands of black, which, however, in part disappear in after-life. They are remarkable for the changes which they undergo with age, which have led to the idea that the young pilot-fish was a species distinct from the adult. Revised by D. S. JORDAN.

Pilot Mountain: See ARARAT.

Pilot-snake: a harmless snake (*Coluber obsoletus*) common in the Eastern and Southern U. S. It is dark brown or black above, mottled or clouded below, and is more heavily built and less active than the true black snake (*Bascanium constrictor*). F. A. L.

Piloty, pēē'lō'tēē, KARL, von: historical painter; b. in Munich, Oct. 1, 1826; d. there July 21, 1886; son of a lithographer, Ferdinand Piloty, from whom he received his first instruction; afterward pupil in Munich Academy. He visited Venice in 1847, painted portraits in Leipzig in 1849, went to Paris and Antwerp in 1852, and thereafter devoted himself to painting pictures of historical subjects. He was appointed a professor in the Munich Academy in 1856 and director in 1874, and had numerous Americans among his pupils. His style is academic. One of his most celebrated works, *Nero on the Ruins of Rome* (1861), is in the National Museum at Pesth; his *Galileo in Prison* is in the Cologne Museum; *The Entry of Godfrey de Bouillon into Jerusalem* (1862) is in the Maximilianeum, Munich; *Columbus Discovering Land* (1866) in the Shack Gallery, Munich; the *Triumph of Germanicus* (1873) in the New Pinakothek, Munich; and the *Death of Alexander the Great* (1886) in the National Gallery, Berlin. His *Wise and Foolish Virgins* (1881) was exhibited in the principal cities of the U. S. in 1887–88. WILLIAM A. COFFIN.

Pilpay, Pilpai, or **Bidpai**: Oriental fabulist; lived several centuries B. C.; the reputed author of a collection of fables not now extant, but contained partially in the PANCHATANTRA (*q. v.*) and to a less extent in the MAHÂ-BHÂRATA (*q. v.*) and the *Hitopadesa*.

Pils, peelz, ISIDORE ALEXANDRE AUGUSTE: historical and military painter; b. in Paris, Nov. 17, 1815; pupil of Picot; awarded Grand Prix de Rome 1838; medals Salons 1846, 1855, and 1857; first-class medal, Paris Exposition, 1867; medal of honor Salon 1861; became officer Legion of Honor 1867; member of the Institute 1868; d. at Douarnenez, France, Sept. 3, 1875. He first attracted attention in 1849 by the exhibition of his picture *Rouget de l'Isle Singing the Marseillaise*, and his battle pictures made his works very popular. They are open to criticism for technical faults, however. He was a Professor of Painting in the École des Beaux-Arts for a number of years. WILLIAM A. COFFIN.

Pil'sen: town of Bohemia, Austria; at the confluence of the Mies and the Beraun; 67 miles by rail S. W. of Prague (see map of Austria-Hungary, ref. 3–D). It lies in a fertile valley, and is surrounded by promenades on the site of the old walls. Among the buildings are the Gothic church of St. Bartholomew (1292) and the Renaissance town-hall. There are large breweries producing annually 9,000,000 gal. of the beer known as Pilsener, and manufactures of leather, pottery, machinery, etc. In the neighborhood are mines of iron, coal, and alum, During the Hussite wars Pilsen was besieged several times, and was stormed by Count Mansfeld at the beginning of the Thirty Years' war. The first printing-press in Bohemia was set up here in 1468. Pop. (1891) 50,693, about equally divided between Germans and Czechs.

Piman Indians: a linguistic stock of North American Indians. The term Pima, which as a tribal name was first used by Father Eusebio Kino as early as 1692, is said to mean "no," and was employed, as now used, through a misunderstanding. The aboriginal name of the Pima proper is *A'kemorl-Oohtam*, signifying river people. According to some authorities, the Piman Indians, as here recognized, form but part of a linguistic group embracing the Shoshonean, Piman, and Aztec or Nahuatl tribes. The relationship of these peoples, however, has yet to be demonstrated.

TRIBES.—With the exception of the Pima Alta or Pima proper, and part of the Papago, the tribes composing this stock inhabit a vast area in Northwestern Mexico, including the greater portions of the states of Sonora, Chihuahua, Sinaloa, and Durango, as well as parts of Jalisco and Zacatecas. Beside the tribes mentioned, the stock embraces the Pima Baja or Nevome, Opata, Tarahumar, Cahita, Cora, and Tepehuan, with their numerous ramifications.

Pima Alta.—According to tradition, the Pima Alta formerly lived in the Salado valley, Southern Arizona, whence they extended their settlements into the valley of the Gila. According to their mythology, a deluge came and left but a single survivor, a chief named Ci-ho, or So-ho, the progenitor of the present Pima tribe. One of his descendants, Sivano, erected as his residence the now ruined adobe structure called CASAS GRANDES (*q. v.*), and constructed numerous other pueblos in the Gila and Salado valleys. The Sobaipuri, an extinct branch of the Pima, attributed these now ruined pueblos to people who had come from Tusayan, or from the north, and this is strengthened by recent research, which tends to show that the culture of the inhabitants was quite similar to that of the ancient Pueblos of the north. Sivano's tribe became so populous that many of its members were forced to emigrate to the Salado valley, where they followed the example of their ancestors of the Gila by constructing extensive irrigating canals and reservoirs, and by building large defensive villages of adobe.

The Pima attribute their downfall to the destruction wrought by foreign tribes from the east. Prior to this, however, a part of the tribe seceded from the main body and settled in the valleys of Northern Sonora, where they became known as Pima Baja, or Nevome, and Opata. When the other natives descended from the mountains and resettled the valley of the Salado, they never rebuilt the substantial adobe dwellings, but constructed dome-shaped lodges of poles covered with thatch and earth, and in such habitations they have since dwelt. In early historic times the Pima were joined by the Maricopa, a Yuman tribe who left the Lower Gila owing to constant oppression by the Cuchan or Yuma. Although speaking distinct languages, the Maricopa and Pima intermarry, and their general habits and customs are similar.

It is probable that the teachings of Father Eusebio Kino and his followers, in the seventeenth and eighteenth centuries, influenced the primitive beliefs of the Pima Alta. They now believe in the existence of a supreme being, known as the "Prophet of the Earth," and also in a malevolent deity. Sickness, misfortune, and death are attributed to sorcery, and medicine-men are employed to overcome the evil influence of the sorcerers.

Marriage among the Pima is entered into with little ceremony, and is never considered binding, and the number of a man's wives is only a question of the husband's ability to support more than one wife. The women perform much of the labor, save the hunting, plowing, and sowing.

The agriculture of the Pima Alta is conducted by irrigation, and antedates the Columbian epoch. Each village possesses an irrigating canal, frequently several miles in length. They cultivate wheat, corn, barley, beans, pumpkins, squashes, melons, onions, and a small supply of inferior short cotton. One of the principal food products of their country is the bean of the mesquite, which is prepared and made into loaves. The fruit of the zaguara cactus (*Cereus giganteus*) is also gathered by the women and made into an intoxicating beverage. The Pima women are expert makers of water-tight basketry, prettily decorated. They also manufacture a coarse pottery, some of which also is decorated.

The Pima Alta, who numbered 4,464 in 1890, are confined, with the Maricopa, to reservations in the Salado and Gila valleys, Arizona.

Pap'ago.—This tribe inhabits the territory S. and S. E. of the Gila river, on Gila Bend reservation, especially S. of Tucson, Ariz., and extending across the desert waste known as the Papagueria into Sonora, Mexico. Like the Pima, the Papago subsist by agriculture, and are frugal and peaceable. An extensive trade in salt, taken from the great in-

land salt-lakes, is conducted by this tribe, and they also manufacture and sell a sirup extracted from the pitahaya. They are tall and dark-complexioned; their dialect differs but little from that of the Pima, and their habits and customs, as well as their traditions, are quite similar. The tribe suffered much from the hostility of the Apache prior to the subjugation of the latter. Within the limits of the U. S. the Papago number about 5,000. There are possibly as many more in Sonora.

Sobaipu'ri.—Allied to the Pima and Papago were the Sobaipuri, a tribe now unknown by that name, but in the eighteenth century occupying the Santa Cruz and San Pedro valleys, and the valley of the Gila between the confluences of those intermittent streams. Probably this tribe was forced from its settlements by the depredating Apache, and compelled to join its nearest kindred, the Papago, by whom they have been absorbed.

Nevo'me.—This term is applied to the Lower Pima, or Pima Baja, and their subdivisions inhabiting the region of South Central Sonora. The social organization and religious system of beliefs and practices of the Nevome, prior to the teachings of Catholic missionaries, were analogous to those of the Yaqui, their southern neighbors, although the dialects of the two branches were so differentiated that intercourse was possible only through a sign-language. The Nevome were agriculturists; they dressed better than most of their kindred, and lived in flat-roofed adobe houses. The Nevome were divided geographically into a northern and a southern branch. These were autonomous, often at enmity with each other, and inhabited a number of independently governed villages. The population is estimated at about 8,000.

O'pata.—Adjoining the Papago and Pima Alta on the S. E. is a large body of Indians whose tribal name is Joyl-ra-wa, and who were formerly at enmity with their northern neighbors, hence the appellation Opata, a Pima term derived from *oop*, enemy, and *ootam*, people, folk.

Physically the Opata are fine specimens of the Indian race. They are generally below the medium size, but are well-proportioned; their complexion is not so dark as that of the Yaqui; their features are regular and agreeable, and their hair is unusually soft. They number about 5,500.

Prior to the advent of the Spanish missionaries the habits and customs of the Opata were akin to those of the Pima and Papago N. and W.; now, however, they have become so thoroughly transformed as almost to have forgotten their native tongue. They are described as of a submissive disposition, with much regard for honesty and morality.

Tarahumár.—The name of this division is derived from *huma*, to run; *tala*, or *tara*, foot = foot-racers, in allusion to the custom of running and driving a wooden ball before them with their feet. Their habitat embraces the headwaters of the principal southern Sonora and Chihuahua streams in the Sierra Madre. They are still very primitive, living in hovels or in caves in the mountain fastnesses and barrancas, and subsisting by hunting deer and smaller game, and by the cultivation of maize, beans, pepper, and potatoes. They are robust, of medium height, and have swarthy complexions and scanty beards, but long, thick, black hair. They formerly tattooed the forehead, lips, and cheeks in various patterns. Their docile character contributed to their reduction by the Spanish settlers, notwithstanding their large number, which is said to reach about 15,000, and by some is even estimated at 40,000. The names of the settlements of the Tarahumar almost invariably terminate in the locative form *chic*.

Cahi'ta.—This division inhabits the southwestern coast of Sonora and the northwestern coast of Sinaloa, extending from lat. 28° to 25° 30′. The Yaqui and Mayo tribes form the most important part of the Cahita division. The men are robust, but well formed; their complexion is dark bronze and their features, though somewhat coarse, are not unpleasant. The women are small and rather thick-set. Owing to the semi-tropical climate their dwellings are unsubstantially constructed of canes and boughs covered with palm-leaves. In the fertile valleys about the mouths of streams they engage in raising corn, cotton, calabashes, beans, and tobacco, and also in cultivating the mescal-producing agave.

The Mayo and the Yaqui have a tribal chief; both are divided into a number of autonomous villages, which combine only in case of warfare. In both groups a system of clans is found, and esoteric orders similar to those of the Pueblos exist. Their religious beliefs are characterized by fetichism, and they recognize no supreme being.

In the first half of the seventeenth century the Mayo and Yaqui probably numbered together about 60,000. There are now about 13,500 Yaqui and half as many Mayo. Like most of the southern tribes of the Piman stock these have largely become Hispanized, except in language. The Yaqui are described as naturally industrious, and are employed as cattlemen, teamsters, farmers, sailors, etc. They are also good miners, and are expert in pearl-diving. They exhibit an unusual talent for music.

Co'ra.—This division, which embraces the Cora, Nayarita, Tecualme, Muntzizti, Teacuacitzisti, Ateacari, and Colotlan, with their sub-tribes, inhabits mainly the territory contiguous to the Rio de San Pedro. Their country, therefore, lies chiefly within the state of Jalisco. They were warlike, living independently in the mountain glens and ravines until 1721–22, when they were subjugated by the Spanish and compelled to follow more civilized ways. The Cora language does not exist in its native purity, having been influenced by contact with civilization. Although hostile, they were agriculturists and manufacturers of coarse woolen blankets. The population is about 20,000.

Tepehuán.—The native name of this tribal division is derived from *tepehuani*, conqueror, victor. They inhabited mainly the state of Durango, but their domain extended also into Southern and Western Chihuahua, Northeastern and Southeastern Sinaloa, Northeastern Jalisco, Northern Zacatecas, and Southwestern Coahuila. Now, however, the tribe is confined to the eastern slope of the Sierra Madre, between lat. 25° and 26°. Their primitive condition resembled that of the Cahita tribes, locally varied through environment. While strictly an agricultural people (cotton and corn being their principal products), they were ever ready to defend the log and stone habitations they had constructed on almost inaccessible crags. In valor they were regarded as foremost among the tribes of Mexico, and chastity they held in high esteem. They wove their cotton into articles of clothing, which they dyed and bartered with neighboring tribes. The population is less than 1,000.

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See INDIANS OF NORTH AMERICA. J. W. POWELL.

Pimen'ta, or **Pimento** [from Span. *pimien'ta* and *pimiento* < Lat. *pigmen'tum*, paint, pigment, juice of plants]: a name given to the unripe berries of a handsome evergreen tree (*Pimenta officinalis*, family *Myrtaceæ*), growing throughout the West Indies and in Mexico and South America. The fruit is a small globular berry, rather less than a third of an inch in diameter; it is two-celled, each cell containing a single black kidney-shaped seed. The active principles are a volatile oil, contained in the proportion of from 3 to 4 per cent., and a green fixed oil. Both of these occur in largest proportion in the cortical portion of the fruit. Pimenta has a warm, pungent, aromatic taste, and may be used in medicine for the general purposes of the aromatic spices—namely, as stomachics, to improve digestive power, to allay nausea, and correct the nauseating and griping effects of other medicines. It is largely used as a spice in cookery, called allspice or Jamaica pepper. It is obtained in commerce from Jamaica.

Pimpernel, or **Poor Man's Weather-glass**: a common herb of Europe (*Anagallis arvensis*), naturalized in North America, having rather handsome flowers, most commonly scarlet, but often white or blue. It is remarkable that it always closes upon the approach of bad weather. The water-pimpernel is *Samolus valerandi*, found in the U. S. and most other countries. *S. floribundus* and *S. ebracteatus* are found in the Gulf States. The above plants all belong to the *Primulaceæ*. The first-mentioned was thought to have active medicinal powers, and the second was once looked upon as having magical qualities.

Pinar del Rio: See the Appendix.

Pinchback, PINCKNEY B. S.: See the Appendix.

Pinchbeck: a kind of brass formerly much used for making cheap watch-cases, and now used as a substitute for the more costly bronze. It contains over 80 per cent. of copper (the rest is zinc), and has when new a look quite like that of gold.

Pinckney, CHARLES, LL. D.: statesman; b. at Charleston, S. C., 1758; was bred a lawyer, and during a part of the Revolution was held a prisoner by the British, and after the peace represented South Carolina in Congress. He was a prominent member of the convention of 1787 which framed the U. S. Constitution, and one of the drafts submitted to that body was made by him. In 1788 he was president of the convention in which South Carolina ratified the U. S. Constitution, and in 1790 he presided over the convention which adopted the State constitution. He was Governor of the State 1789–92, 1796–98, 1806–08; U. S. Senator 1798–1801; minister to Spain 1802–05: and was again in Congress 1819–21; an ardent and eloquent anti-Federalist. D. at Charleston, Oct. 29, 1824.

Pinckney, CHARLES COTESWORTH, LL. D.: statesman; b. at Charleston, S. C., Feb. 25, 1746; was educated at Westminster, at Christ Church, Oxford, and the Middle Temple, London; studied military science at Caen, France; became a barrister at Charleston 1769; served as captain, and afterward as colonel of South Carolina troops in the Revolution; was aid to Washington in 1777; displayed great valor and skill in the Southern campaigns 1778–80; suffered much as a prisoner of war 1780–82; became a brigadier-general 1783, and later a major-general of the State, and still later of U. S. troops (1797); declined many important offices; assisted in framing the U. S. Constitution; was one of the special ministers to France 1796–97, when he was ordered to leave that country; was the author of the famous sentiment, "Millions for defense, but not one cent for tribute"; Federalist candidate for Vice-President 1800, and one of the ablest lawyers of his time. D. at Charleston, S. C., Aug. 16, 1825.

Pinckney, THOMAS: statesman; brother of C. C. Pinckney; b. at Charleston Oct. 23, 1750; graduated at Oxford, and was called to the bar at the Temple, London, 1770; entered the Revolutionary army, in which he served with much distinction, receiving a bad wound at Camden; Governor of South Carolina 1787–89; U. S. minister to London 1792–94, and to Madrid 1794–96, when he negotiated the important treaty of San Ildefonso; was in Congress 1799–1801; appointed major-general 1812, and served against the Creeks and Seminoles with success. D. at Charleston, Nov. 2, 1828.

Pindar (in Gr. Πίνδαρος): the greatest of Greek lyric poets; b. about 522 B. C. of an ancient family of Cynoscephalæ near Thebes; was carefully trained in musical arts by the best masters; began his career at an early age, and before the Persian war (490 B. C.) had gained a national reputation. During the Persian war, however, he did not and could not espouse the national cause, for Thebes was on the side of the invader, and being a Theban and an aristocrat, he went with his state and his caste. Still he showed that he was too good a Greek not to sympathize with the great achievements of the war of liberation, and his praise of Athens is said to have brought on him a fine from his "Mother Thebes" and a rich reward from the "violet-wreath'd city." Pindar traveled far and wide in the exercise of his profession as a lyric poet whose office it was to adorn the great occasions of life, and he was everywhere honored and reverenced by the princes of earth. His character was as lofty as his verse. He was a priest as well as a poet, a favored guest of the Delphic god, and the last prophet of the old Doric creed. The date of his death is uncertain, but he can not have lived much beyond 450 B. C. His poetry covered the whole field of Greek lyric, and the fragments that remain show his poetical faculty in various ranges of composition, in banquet songs and in choruses for virgins, in dithyrambs and in dirges, but the height of his art reveals itself in the only poems that we have entire, his *Hymns of Victory* (Ἐπινίκια), odes written in honor of victors in the four great national games of Greece, Olympian, Pythian, Nemean, and Isthmian. The opulence of these poems, their brilliancy of imagination and of diction, the swing of their movement, their elevation and their force, have been recognized by all critics and have excited the emulation of lyrists from the poet's day to this; but the springs of Pindar's art seem to have been hidden from critics and imitators alike for many generations. A "Pindaric ode" has been too often synonymous with rant and bombast, and it was not until the nineteenth century that a diligent study of Pindar showed that there is profound art in the plan, as well as in the details, and that everything works together to produce a total effect. The myths which constitute so important a part of these *epinicia* are not mere idle or incidental adornments, but grow up out of the theme and form an organic part of the structure; they serve to idealize victory and victor and to make what might have been a mere occasional poem into an eternal type. The meters are not lawless, as they were once thought to be, but obey the rule of a refined and exacting system, and it is through the symmetry of the meters that scholars learned first to divine and then to prove the symmetry of the thought. Much that would have aided in the appreciation of Pindar has been lost, but though music and dance have perished, the rhythm that regulated both survives in the language and has proved itself a key to the inner life of the Pindaric poems. Renewed study only confirms the judgment that Pindar combines, in almost unique perfection, largeness of manner and elaborateness of detail.

His poems were edited by Böckh (Berlin, 1811–21) in three parts, still the great edition; Dissen-Schneidewin (1847); Mommsen (1864); Bergk in his *Poetæ Lyrici Græci* (4 ed. 1878). Text edition by Christ in the Teubner Library (1879); with English notes by Fennell (1879–83, new ed. of *Olympians and Pythians*, 1893); by Gildersleeve, *Olympians and Pythians* (New York, 1885); by Bury, *Nemeans and Isthmians* (1890–92). Translated into English prose by Ernest Myers (2 ed. 1884). The best book on Pindar and his art is by Alfred Croiset, *Pindare et les lois du lyrisme grec* (2 ed. Paris, 1886). See also the chapter on Pindar, in Jebb's *Classical Greek Poetry* (1893), and Fracearoli's elaborate work, *Le Odi di Pindaro* (1894). B. L. GILDERSLEEVE.

Pindar, PETER: See WOLCOT, JOHN.

Pindemonte, IPPOLITO: poet; b. at Verona, Italy, Nov. 13, 1753. Of noble birth, he was entered by his family, as soon as he had completed his studies at Modena, among the Knights of the Order of Malta. After some years of service in Malta and Sicily his health gave out, and he was obliged to retire from active life. He settled at his country estate, Avesa, near Verona, and gave himself to letters. He tried his hand at tragedy, but with poor success. In 1785, however, he brought out *Poesie Campestri*, which had immediate recognition. These were delicate and tender praises of the country life, after the manner of the English poets of the eighteenth century. He had already begun to be intimate with the best Italian poets of his time, among them Monti and Foscolo, of whom the latter had dedicated to him his *Sepolcri*. In 1788 he went to Paris, where he remained for two years, becoming intimate with Alfieri, who deferred to his critical judgment. The French Revolution caused him to return to Italy in 1791. In 1795 he published a new edition of the *Poesie Campestri*, with the addition of *Prose Campestri*—essays of a contemplative and philosophic kind. In 1804 he published his tragedy *Arminio*—suitable for reading rather than for representation, and accompanied by three dissertations on the dramatic art. In 1805 appeared a volume of *Sermoni*—satires in the manner of Horace, and gay rather than angry castigations of the follies of his time. In 1809 he printed the first books of his delicate and graceful translation in blank verse of Homer's *Odyssey*, and in 1822 the remainder. His *Epistole in versi* (1819) are filled with sadness at the sufferings of Italy. His last work, a series of *Elogi di letterati* (1825–26), contains sympathetic notices of contemporary scholars and poets. D. at Verona, Italy, Nov. 18, 1828. See B. Montanari, *Della vita e delle opere d'Ippolito Pindemonte* (Venice, 1834) and *Le Poesie originali di Ipp. Pindemonte*, ed. by A. Torri, with *discorso* by P. Dal Ris (Florence, 1858).—His brother, Marquis GIOVANNI PINDEMONTE (b. at Verona in 1751; d. there Jan. 23, 1812) wrote a number of interesting plays, collected under the title *Componimenti teatrali* (4 vols., Milan, 1804).

A. R. MARSH.

Pine [O. Eng. *pīn*, from Lat. *pī'nus*, pine]: gymnospermous trees belonging to the genus *Pinus* of the family *Pinaceæ* and order *Coniferæ*. (See CONIFERS.) They are described as follows by Dr. George Engelmann:

"Their angular, two or three edged leaves (almost always serrulate or rough on the edges), in bunches of two to five, are inclosed in a sheath of membranaceous scales; one (Western American) species has a single rounded leaf in this sheath. Their sterile flowers develop abundantly at the base of the shoots of the same spring; the fertile clusters appear singly, or a few together higher up or near the top of such shoots. The young fruit remains almost sta-

tionary for a whole year, and only in the second summer the cone enlarges, maturing in the autumn. We distinguish two sections of true pines. The white pines have five mostly slender leaves in a bunch; scales of the cones rather thin; wood whiter, lighter, softer, and less resinous, and therefore highly prized for carpenter-work. Of these, the white pine of the Eastern and Northern U. S. (*P. strobus*) is the fairest representative, a tree of magnificent proportions and universal application, and highly prized as an ornamental tree. Similar, still more ornamental, but also more slender, is the Himalaya or Butan white pine. In the Western U. S. this group of pines is represented by the colossal sugar-pine (*P. lambertiana*), with its immense cones and large edible seeds, and by the mountain white pine (*P. monticola*) of the Pacific mountains; another species, with large squarrose cones (*P. ayacahuite*), is spread over the Mexican mountains. Similar to these, but distinguished by more rigid leaves, shorter, thicker cones, with thicker scales and large, edible, almost wingless seeds, is the small group of the Cembra pines, the principal species of which grows on the European and Siberian Alps, the similar *P. albicaulis* on the Pacific alps, and *P. flexilis* on the Rocky Mountains. *P. cembra* furnishes the red wood with the white sap from which particolored Swiss carvings are made.

"The second and by far the largest section of true pines comprises those with knobby scales, leaves from one to five in a bundle. The small group of the four Mexican and Western American nut-pines closely approaches to the last; they are small and scraggy trees that make excellent firewood, with globose cones, the scales thick with very prominent knobs, bearing large, edible, wingless seeds, like those of Cembra, and with leaves varying in the different species from a single one (*P. monophyllos*) to five in number.

"Next to these range the large-fruited nut-pines, with thick or hook-knobbed scales, and large short-winged seeds, of which *P. pinea* is the Mediterranean and *P. sabiniana*, *coulteri*, and *torreyana* the Western American representatives. Of the large number of pines remaining, some bear their cones just below the terminal bud of the same year's shoot; their scales are usually thinner, with less prominent prickles, and their wood whiter and less resinous. The Scotch and the Austrian pine of Europe, and the red pine of the Northern U. S., all of them with leaves in pairs, belong here, as also the long and five-leaved, large-coned, and variable Mexican pines of the alliance of *P. montezumæ*. Those pines that bear lateral cones have usually very knobby and prickly scales, and heavy, resinous, yellowish wood—the real *yellow* or *pitch pines*. Here range the seaside pine (*P. pinaster* of the Mediterranean regions), the Eastern pitch-pine, the Jersey pine, prickly pine, loblolly pine, the yellow pine, Elliott's pine, and, above all, that most important and magnificent of all pitch-pines in the U. S., the long-leaved pine of the South (*P. australis*), which furnishes a most highly prized naval timber and nearly all the resinous products of the country. To the yellow pines belong also a number of Western pines, the most important and widest spread of which is the heavy pine (*P. ponderosa*), *P. contorta*, the interesting but very local Monterey pine (*P. insignis*), and a few others."

In all, seventy species of pines are known, extending from the Arctic regions southward in both hemispheres to subtropical or tropical countries (Central America and the East Indies); and somewhat more than one-half of these occur in North America. CHARLES E. BESSEY.

Pin'eal Gland or **Body**: See PARIETAL EYE and BRAIN.

Pineapple: the compound conical fruit of a plant of the family *Bromeliaceæ* (*Ananassa sativa*); a native of tropical America, naturalized in many hot countries, and cultivated also in hothouses. It is one of the best of fruits. The Bahamas and South Florida are finely adapted to pineapple culture. From the fibers of the leaves of this and allied plants a beautiful fabric called pina muslin is made.

Pine Bluff: city (settled in 1819, plotted in 1836); capital of Jefferson co., Ark. (for location, see map of Arkansas, ref. 4–D); on the Arkansas river at the head of low-water navigation, and on the St. L., Iron Mount. and South., and the St. L. S. West. railways; 42 miles S. S. E. of Little Rock. It is built on a bluff 228 feet above sea-level; is in the cotton-producing region of the State; has a large cotton-compress, extensive railway-car factory, the general shops of the St. Louis S. Western Railroad, flour-mill and grain-elevator, cottonseed-oil mill, 2 planing-mills, and ice-factory, and contains a branch of the State Normal College, 3 State banks with combined capital of $350,000, and 2 daily and 4 weekly papers. A large amount of cotton and lumber is handled annually. Pop. (1880) 3,203; (1890) 9,952; (1900) 11,496. EDITOR OF "COMMERCIAL."

Pine, Cape: See CAPE PINE.

Pine-chafer: any one of various coleopterous insects whose larvæ commit great ravages in pine forests, eating away the new material between the bark and the wood. These insects are *Pissodes strobi*, *Tomicus pini*, *T. xylographus*, and several species of *Hylurgus*.

Pine Family: See CONIFERS.

Pine-finch, or **Goldfinch**: a bird of the family *Fringillidæ*, the *Spinus pinus* of recent authors. It is a near relative of the common goldfinch of the U. S. (*Spinus tristis*), and occurs more or less abundantly throughout North America. It attains a length of about 4¾ inches, is brownish olive above, and beneath whitish, streaked with dusky. It feeds chiefly on the seeds of hemlock and other trees, as well as those of grasses, etc. Revised by F. A. LUCAS.

Pine-grosbeak: a bird of the family *Fringillidæ*, the *Pinicola enucleator* (Linn.), Cab. It is found throughout the northern regions of the Old as well as New World. Its average length is about 8½ inches; the bill and legs are black; the male is rosy colored (tinged, except on the head, with brownish) above, ashy below; the female brownish above, ashy (tinged with greenish yellow) below. As indicated by the name, this bird frequents pine and other evergreen forests; it feeds on spruce-seeds, etc. It is rare in the U. S., except near the northern border, although occasionally abundant even so far S. as Philadelphia.
Revised by F. A. LUCAS.

Pinel', PHILIPPE, M. D.: alienist; b. at St.-Paul, Tarn, France, Apr. 20, 1745; studied medicine at Toulouse and Montpellier, graduating M. D. from the former in 1773; removed in 1778 to Paris; obtained a prize in 1791 for his *Traité médico-philosophique sur l'Aliénation mentale*, and was appointed physician of the Bicêtre in 1792, and in 1795 of the Salpêtrière. He substituted compassion, kindness, and justice for the chains and cells that confined the insane, and, recognizing insanity as a disease, he inaugurated its scientific study. He was Professor of Hygiene and subsequently of Pathology in the School of Medicine at Paris until 1822, when the faculty was reorganized, and, owing to jealousies, his name was omitted save as an honorary professor. He was author of *La Nosographie philosophique* (1798) and *La Médecine clinique* (1802). D. in Paris, Oct. 26, 1826.
Revised by S. T. ARMSTRONG.

Pine'lo, ANTONIO DE LEON: jurist and author; b. at Córdoba (now in the Argentine Republic) about 1590. He studied law at Lima, and subsequently went to Spain, where he was judge of the Casa de Contratación at Seville, and historical secretary of the Council of the Indies. He was employed to codify the laws relating to the Spanish colonies, laboring for many years and examining more than 500,000 *cédulas*. The work was published under the title *Recopilación general de las Leyes de las Indias*, in four volumes, in Madrid, 1680; it was made authoritative, was for over a century the organic law of the colonies, and is, besides, a mine of historical information. There are several revisions. Pinelo also published a life of Toribio, Archbishop of Lima, several valuable works on the American colonies and their laws, and the first bibliography of the Spanish colonies, entitled *Biblioteca oriental y occidental. náutica y geográfica* (Madrid, 1629; revised ed. by Gonzalez de Barcia, 3 vols., 1737–38). D. at Seville about 1675. HERBERT H. SMITH.

Pinero'lo (in Fr. *Pignerol*): town of Northern Italy, in the province of Turin, on a hill 1,200 feet above the sea; on the left bank of the torrent Chisone; 23 miles S. W. of the city of Turin (see map of Italy, ref. 3–A). The cathedral stands near an ancient tower, once a prison, but at present serving as a campanile or belfry. The old Piazza d'Armi is now shaded with American elms. From the early part of the eleventh century it was a strong fortress, held for the most part by the house of Savoy, though France frequently, and often successfully, disputed its possession. In 1696 the fortifications of Pinerolo were, in accordance with a treaty, mostly destroyed. Since 1748 it has been an episcopal see. It is a place of considerable industry; its manufactures are silks, woolens, cottons, liqueurs, etc. Pop. 12,000.

Pines, Isle of: an island of the West Indies; 35 miles S. of the western end of Cuba. The island is a dependency of

Cuba, contains 1,214 sq. miles of undulating or flat and marshy land, and has (1899) 3,199 inhabitants. Capital and prineipal village, Nueva Gerona. The island contains marble quarries, and is a favorite health resort for sufferers from lung diseases. H. H. S.

Pines, Isle of, or **Hunea**: an island in the southern Paeific Ocean, belonging to France; in lat. 22° 38′ S., lon. 167° 25′ E.; 30 miles from the southeastern extremity of New Caledonia. It was discovered in 1774 by Capt. Cook, and was selected in 1872 by the French Assembly for a penal station. The inhabitants belong to the same race as the population of New Caledonia. Exclusive of the convicts they number about 800.

Pine-snake: a large serpent (*Pituophis melanoleucus*), 6 feet long, 2 inches thick, of a shining white color with dark-brown spots. It receives its name from having its home in the pineries of Eastern North America, from New Jersey southward, though it is also sometimes called the "bull-snake," from the loud bellowing sound it produees. It emits a strong, disagreeable odor. It feeds on eggs and small birds and mammals, and is harmless to man.

Pingré, păn′grā′, Alexandre Gui: astronomer; b. in Paris, Franee, Sept. 4, 1711; studied theology, but adopted Jansenistic views, and devoted himself to astronomy; published 1754–57 a nautical almanac under the title of *État du Ciel*; greatly extended Lacaille's table of eclipses in the second edition of *L'Art de vérifier les Dates*; wrote in 1783 his *Cométographie, ou Traité historique des Comètes* (2 vols.), which is his principal work, and translated the poem by Manilius, *Astronomica* (1786). D. in Paris, May 1, 1796.

Pinguicula: See Butterwort.

Pini, pee′nĕe, Gaetano, M. D.: physician and hygienist; b. at Leghorn, Italy, Apr. 1, 1846; studied at the Universities of Pisa and Naples, graduating M. D. *summa cum laude* from the former in 1869. His medieal studies were interrupted in 1866 by service as a private in the war between Italy and Austria, and again in 1867 under Garibaldi. In 1870 he was on the staff of the *Enciclopedia Medica Italiana*. He originated and secured the funds for the erection of the hospital for rhachitic children in Milan in 1875. He originated and organized the Royal Italian Society of Hygiene in 1878. In 1876 he founded the Milan society for cremation, and was instrumental in originating a number of these soeieties in Italy. He was an earnest worker in philanthropy, originating the Brotherly Aid Society and the Night Asylums. He was a member of the Italian Pellagra commission. D. Sept. 25, 1886. S. T. Armstrong.

Pink [cf. *pink*, priek, make jagged]: the name of various plants of the genus *Dianthus*, all natives of Asia and Europe, for the wild pinks of the U. S. are of the genus *Silene*, and are properly called campions or catchflies; although *D. armeria*, *D. prolifer*, and one or two others are sparingly naturalized. The most eommon pinks are beautiful garden and window flowers, often delightfully fragrant. There are thousands of fine varieties—carnations (comprising flakes, bizarres, picotees), pheasant's-eyes, monthlies, Chinese pinks, maidens, Carthusian pinks, etc. (See Carnation.) They are somewhat doubtfully referred to some four or five original species (*D. plumarius*, *caryophyllus*, *chinensis*, *carthusianorum*, *superbus*, *deltoides*, etc.). The commonest pink of old gardens, once much used for borders, is *D. plumarius*. Revised by L. H. Bailey.

Pinkerton, Allan G.: founder of the Pinkerton detective agency; b. at Glasgow, Scotland, in 1819; took part in the Chartist outbreak in Birmingham, and to eseape imprisonment emigrated to the U. S. in 1842. He settled in Illinois, where he became a deputy-sheriff, and in 1850 founded his deteetive agency in Chicago. During the U. S. eivil war he was in eharge of the secret-serviee division of the army, and both at that time and later showed unusual skill and courage in detecting and bringing to justiee the authors of crime. He broke up several notorious gangs of thieves, recovered large amounts of stolen money, and did effective work against the Molly Maguires in Pennsylvania. Among his published writings are *The Molly Maguires and the Detective* (1877); *Criminal Reminiscences* (1878); *The Spy of the Rebellion* (1883); and *Thirty Years a Detective* (1884). D. in Chicago, 1884. F. M. Colby.

Pinkerton, John: author; b. at Edinburgh, Scotland, Feb. 13, 1758; passed an apprenticeship of five years to the law in his native city; settled in London 1780; devoted himself to literature under the patronage of Horace Walpole, and produced an immense number of works, chiefly historical, none of which, however, were marked by any great talent. The best known is his *General Collection of Voyages and Travels* (17 vols. 4to, 1808–14), with maps and engravings, which is still useful for reference. He wrote some poems of merit, but his *Ancient Scottish Poems* (2 vols., 1786), purporting to be from the MS. colleetions of Sir Richard Maitland, has been pronounced a literary forgery, probably executed by himself. In 1804 he settled in Paris, where he died Mar. 10, 1826. See his *Literary Correspondence*, edited by Dawson Turner, 1830.

Pinkeye, or **Influenza** (Epizoötic): an infectious disease of horses, charaeterized by high temperature, great prostration, redness, and swelling of the eyelids (whence its name), and other mucous membranes of the head, and swelling of the limbs. It is one of the oldest known diseases of horses, having been described by Rusius, an Italian writer, in 1301; sinee then numerous outbreaks have been recorded at varying intervals. In 1872 and 1873 the disease spread over all of North America, and so many horses were attacked that commeree was seriously interfered with. An outbreak oeeurred in Europe in 1882 and 1883, when large numbers of horses were affected.

This disease always results from direet or indirect exposure to diseased animals or to their exhalations. The infectious material is sometimes carried long distances by the wind or by fomites. In outbreaks it is noticed that the disease spreads most rapidly along channels of commerce, and requires a long time to reach remote and thinly settled districts. The cause of pinkeye has not been discovered, although it has been determined by Pfeiffer that a short bacillus is the etiological factor in a similar disease—influenza of man. The period of incubation is from four to seven days, at the end of which time the disease begins suddenly with high fever and great depression. The onslaught and progress are so rapid that the height of the disease may be reached in twenty-four hours. The temperature sometimes advanees from normal to 106° F. within a few hours. The pulse and respirations are quiekened. The animal evidenees depression by hanging the head, allowing the ears to droop, refusing food, refusing to move, but when forced to do so walking with an irregular, tottering gait. The eyelids are swollen, the legs and sheath become œdematous, and sometimes the substernal region as well. The visible mucous membranes of the digestive tract are injected and red, and there is some constipation. A diseharge from the nose and a cough indieate irritation of the respiratory mucous membrane. The eye is sometimes involved to the extent of an inflammation of the cornea and iris that may lead to blindness. Recovery usually takes plaee in from five to fourteen days, but complications, as exhaustion of the heart, eatarrhal pneumonia, diarrhœa, laminitis, or paralysis of the brain, may prolong the case or cause death. Mortality results in from 2 to 10 per cent., depending largely on the type and virulence of the special outbreak.

In treating pinkeye good care and properly selected foods are of the greatest importanee. The horse should be allowed a plentiful supply of pure air, an abundance of pure cold water, and soft laxative foods, as grass, green-corn fodder, roots, apples, bran mashes, steamed grain, etc. The skin should be kept brushed and the swollen parts moistened frequently with cooling, astringent washes. The eyes should be washed at short intervals with boraeie-acid solution, and, if painful, proteeted from the light. Constant stimulation of the heart is required. The bowels should be kept open with small doses of salts or with calomel. Clysters of cold water are useful to reduee the temperature. Antipyrine is frequently used with benefit, and nux vomiea and quinine are usually administered freely.

Leonard Pearson.

Pink Family, or **Pinkworts**: the *Caryophyllaceæ*, a group of (mostly) herbaceous dieotyledons, with opposite entire leaves, and stems with swollen joints; flowers usually dichlamydeous, the petals separate; ovary superior, compound, one- to five-celled, the ovules axial, or on a central column. There are about 1,100 known speeies, mostly natives of temperate and cold countries. Many species are cultivated for their beautiful flowers, as the pinks (species of *Dianthus*, especially *D. caryophyllus*, the carnation; *D. chinensis*, the Chinese pink; *D. barbatus*, the sweet-william; *D. superbus*, etc.), rose-campions (species of *Lychnis*), catchfly (*Silene*), soapwort (*Saponaria*), etc.

Charles E. Bessey.

Pinkney, Edward Coate: poet; son of William Pinkney, statesman: b. in London, England, Oct. 1, 1802; educated at St. Mary's College, Baltimore; was in the naval service 1816–24; practiced law at Baltimore with little success, but was appointed Professor of Rhetoric and Belles-Lettres in the University of Maryland; published *Rodolph and other Poems* (1825), and edited for a short time a political journal, *The Marylander* (1827). D. at Baltimore, Apr. 11, 1828. Some of his lyrics have much grace and spirit. The best known of them, *A Health*—"I fill this cup to one made up of loveliness alone," was enthusiastically praised by Edgar Allan Poe. Revised by H. A. Beers.

Pinkney, William, LL. D.: statesman; b. at Annapolis, Md., Mar. 17, 1764; was the son of an English loyalist; studied medicine and law; was admitted to the bar 1786, and rapidly rose to eminence. He was a member of the State convention that ratified the U. S. Constitution in 1788, and was elected in the same year to the State Legislature. He was a U. S. commissioner in England under the Jay Treaty 1796–1804; attorney-general of his native State 1805; minister extraordinary, with Monroe, to Great Britain 1806; minister resident there 1807–11; U. S. attorney-general 1811–14; served as a volunteer officer in the war of 1812, and was wounded at Bladensburg; was in Congress 1815–1816; was appointed minister to Russia, and special envoy to Naples in 1816, but resigned in 1818. He was U. S. Senator 1820–22. D. Feb. 25, 1822. See *Life*, by H. Wheaton (1826); by W. Pinkney, D. D. (1853).

Pinkroot: the root of a showy herb of the U. S. (*Spigelia marilandica*), found from New Jersey to Wisconsin and Texas. The infusion of this root is much used as an anthelmintic; it has also some narcotic qualities. In use it should be combined with a cathartic, such as senna. Four other species occur in the U. S. *S. anthelmia* is a similar plant of South America. They belong to the *Loganiaceæ*.

Pinkworts: See Pink Family.

Pin-money: in law, an annual sum of money, sometimes provided for in a marriage settlement, to be paid by the husband to the wife for the purpose of defraying her own personal expenses for dress and the like. When the wife dies, her representatives can not claim any arrears that may be unpaid at the time, nor can the husband ever be compelled to pay more than the arrears of a single year; for the allowance is intended to be fully expended in each current year, and is designed to keep up the family dignity and appearance, and not to furnish the wife a means of accumulation. Both the name and the provision for the wife which it designates are practically unknown in the U. S., being nearly confined to the English law and social customs, though the term sometimes occurs in Scotch marriage contracts. The origin of the term is uncertain; by some it is traced to an ancient tax in France for supplying the queen with pins. See Frazer on *Husband and Wife*.
Revised by F. Sturges Allen.

Pinnated Grouse: a name given to the prairie-hen (*Tympanuchus americanus*) on account of the pointed tufts of feathers on either side of the neck. See Prairie-hen.

Pin'nidæ [Mod. Lat., named from *Pin'na*, the typical genus, from Gr. πίννα, a kind of mussel]: a family of bivalve molluscs occurring in warm seas. They have an elongate triangular shell of delicate texture and moor themselves, like the mussels, by a silken "byssus." About fifty living species are known.

Pinnipedes [Lat. *pin'na*, feather, fin + *pes*, *pe'dis*, foot]: a sub-order of carnivorous mammals containing the seals, sea-lions, walruses, and their relatives; so called from the fact that the feet are so modified as to form paddles for swimming, the toes being united by a web or fold of skin. The group is differentiated into three well-defined families: (1) *Otariidæ*, or sea-lions and sea-bears; (2) *Phocidæ*, or typical seals, and (3) *Odobœnidæ*, or walruses, each of which is noticed under its own name. Revised by F. A. Lucas.

Pins [M. Eng. *pinne* < O. Eng. *pinn*, pin, peg, from Lat. *pin'na*, feather, fin, pen]: pieces of wire pointed at one end and provided with a head at the other, designed for fastening together various articles or for ornament. The pins which have been found in Egyptian, Etruscan, and old Scandinavian tombs, or in other ways have come down to us from antiquity, are mostly very elaborate and expensive instruments, made of iron, bronze, brass, silver, or gold, sometimes 12 inches long, with artistically executed heads of wood, bone, ivory, amber, metal, or precious stones; and it is evident that in many cases in which we now use pins the ancients used clasps, laces, and other contrivances. In England pins came into common use in the fifteenth century, but were at first imported from the Continent. Soon, however, the manufacture was introduced into England, and in the latter part of the seventeenth century Birmingham became the center of this branch of industry. In the U. S. it was attempted in 1820, and again in 1824, but not firmly established until the invention of the Howe machine in 1832. The original process of the manufacture by hand, from the straightening of the wire to the spinning and hammering of the head, was long and tedious, and required no less than fourteen distinctly different operations. At present, all these processes, from the cutting of the wire to the sticking of the pins into papers, are performed by machinery, which needs only to be fed by the proper materials at each stage of its operation. The manufacture of safety pins (in which the point rests in and is covered by a loop) has also reached large proportions both in Birmingham and the U. S.

Pinsk: town; in the government of Minsk, Russia; 172 miles S. W. of Minsk (see map of Russia, ref. 8–B). It has a considerable trade carried on by means of the navigable river Pina, which connects it with the fertile regions on the Dnieper. Pop. (1890) 32,480, mostly Jews.

Pint: a measure of capacity, the eighth part of a gallon. See Weights and Measures.

Pinto: See Mendez-Pinto.

Pinto: See Serpa Pinto.

Pinto, Francisco Antonio: soldier and politician; b. at Santiago, Chili, 1785. He studied law at Santiago; supported the patriot cause in 1810, and represented the first republic in Buenos Ayres and England; returned in 1817, entered the patriot army, and served with distinction in Charcas and Peru. In 1824 he was foreign minister; was elected vice-president of Chili at the beginning of 1827, and soon after, by the resignation of Freire, became president, holding the post until July, 1829, when he resigned. Two months later he was again made president by election, but the republic was on the eve of a revolution, and he was forced to resign Nov. 2, 1829. He was the liberal candidate for president in 1841. D. at Santiago, July 18, 1858. —His son, Aníbal Pinto, was b. at Santiago in 1825; was Minister of War and Marine 1871–76 and president Sept. 18, 1876–Sept. 18, 1881; he was a moderate liberal in politics, and was the first of his party elected to the presidency after 1830. The war with Bolivia and Peru began in 1879 and continued through President Pinto's term. D. at Valparaiso, 1884. Herbert H. Smith.

Pinturicchio, pin-too-ree'kĕe-ō, Bernardino di Betto: painter; b. at Perugia, Italy, in 1454. Fiorenzo di Lorenzo was his first master. He afterward entered into partnership with Pietro Perugino. He is considered the greatest decorative artist of his time. He painted some frescoes in the Sistine chapel and the Borgia apartments in the Vatican, some frescoes in Castel St. Angelo, which have entirely been effaced, the library of the Duomo of Siena, the vault of the choir of Santa Maria del Popolo in Rome, and the Buffalini chapel in the Church of Aracoeli in Rome. At Spello there is much of his work, but it is sadly decayed. His altar-pieces are numerous. Pinturicchio always painted in tempera. D. at Siena, 1513. W. J. Stillman.

Pin-worm: a name given to a parasitic nematode worm, *Oxyuris vermicularis*, in allusion to the pricking sensation it produces in the perianal region of infected persons. It is thread-like, rarely more than half an inch in length, and occurs, often in numbers, in the rectum of human beings, especially children. It comes to the exterior to lay its eggs in the region around the vent. The eggs or young must be again taken into the alimentary canal before going through their development, and infection takes place through the mouth. The trouble usually disappears in a short time spontaneously, but medical treatment, and, above all, cleanliness, will mitigate the attacks. J. S. Kingsley.

Pinzon': the name of three brothers, ship-builders and navigators, of Palos, Spain, who were connected with some of the first voyages to America. The eldest, Martin Alonso, aided Columbus in preparing for his first voyage in 1492. He sailed with the expedition, in command of the Pinta; parted company with Columbus on the coast of Cuba Nov., 1492; was the first to discover Haiti, where he rejoined the admiral Jan. 6, 1493; and during the return voyage was again sepa-

rated by a storm, Feb. 14, reaching Bayona, a port of Galicia. Thence he sent an account of the discovery to the Spanish sovereigns, but they paid little attention to it, giving all the honor to Columbus. Pinzon returned to Palos, where he died shortly after of chagrin, as was asserted. Columbus and his friends charged Pinzon with willful desertion on the coast of Cuba, and with attempting to appropriate the honor of the discovery. On the other hand, it was asserted later that Columbus had been incited to the voyage by information received from Pinzon, and there is a generally discredited story that Pinzon had already been on the coast of Brazil in a French ship.—Another brother, VICENTE YAÑEZ, commanded the Niña under Columbus in 1492, but he is better known for his voyage of 1500, when he crossed the equator, reached the coast of Brazil near Cape St. Augustine, coasted northwestward, discovered the mouth of the Amazon, passed between Trinidad and the mainland, and returned to Spain by way of Española. This was the first discovery of the Brazilian coast, but as the country was in the hemisphere assigned to Portugal by the convention of Tordesillas, Spain derived no benefit from it. Pinzon was associated with Juan Diaz de Solis in two voyages—an exploration of the Gulf of Honduras in 1506, and one of the eastern coast of South America, probably to lat. 40° S., in 1508. D. at Palos about 1524.—A third brother, FRANCISCO MARTIN, was pilot of the Pinta in 1492–93, but is not otherwise known. The family was ennobled by Charles V., and has had some distinguished modern representatives. HERBERT H. SMITH.

Piombo, pĕe-om'bō, Fra SEBASTIANO, del (his real name was Luciani, but he signed himself *Sebastiano Veneziano*, that is, the Venetian): painter; b. at Venice in 1485. He was a pupil of Giovanni Bellini at first, and afterward of Giorgione, whose style he adopted in his great altar-piece in the Church of San Giovanni Crisostomo. In 1512 he went to Rome to paint some frescoes in the Farnesina, at the invitation of Agostino Chigi. Michelangelo then became his friend, and employed him in some of his important work. He became second to none as a painter of altar-pieces, and was also very successful in portraiture. Clement VII. appointed him Frate del Piombo (that is, the monk, keeper of the seal) in 1531, and he held this office also under Paul III. till his death at Rome in 1547. The National Gallery in London possesses Sebastiano's masterpiece. *The Raising of Lazarus.* At Viterbo there is a *Pietà* of great beauty. The *Scourging of our Lord*, in San Pietro in Montorio, Rome, is also a great work. His portrait of Andrea Doria in the Doria Palace, Rome, and his portrait of a lady in the Uffizi Gallery, Florence, are excellent examples of his skill.

W. J. STILLMAN.

Piorry, pĕe'ō'ree', PIERRE ADOLPHE, M. D.: clinician; b. at Poitiers, France, Dec. 31, 1794; studied medicine; took his degree in 1816; became professor of pathology at Paris in 1840, changing this for the chair of clinical medicine in 1850, and retired into private life in 1866. He invented the pleximeter, described in his *Traité sur la Percussion médiate*, for which he received the Montyon prize in 1828. He also wrote *De l'Hérédité dans les Maladies* (1840); *Traité de Médecine pratique et de Pathologie iatrique ou médicale* (9 vols., 1841–51); *Traité de Plessimétrisme et d'Organographisme* (1866). D. in Paris, May 29, 1879.

Revised by S. T. ARMSTRONG.

Piozzi, pĕe-ot'sĕe, Mrs. HESTER LYNCH SALUSBURY: author; b. at Bodvel, Carnarvonshire, Wales, Jan. 16, 1740; married, in 1763, Henry Thrale, a wealthy brewer, subsequently a member of Parliament; made in 1764 the acquaintance of Dr. Samuel Johnson, who became in 1766 an inmate of her family at Southwark, and remained such until Mr. Thrale's death in 1781; contributed several poems to Mrs. Anna Williams's volume of *Miscellanies* (1766), among which was the celebrated *Three Warnings*, often supposed to be the composition of Dr. Johnson; married, in 1784, Gabriel Piozzi, a native of Florence, then a music-teacher at Bath; resided a year or two at Florence, where she edited a volume entitled *The Florence Miscellany* (1785) under the signature of "Anna Matilda," thereby attracting the relentless criticism of Gifford against the Della Crusca school; published *Anecdotes of Dr. Johnson* (1786); *Letters to and from Dr. Johnson* (1788); a book of travels on the Continent (1789); *British Synonymy* (1794); and *Retrospection* (1801). D. at Clifton, near Bristol, May 2, 1821. See her *Autobiography, Letters, and Literary Remains* (2 vols., 1861), edited by Abraham Hayward.

Pipefish: a name given to various fishes with a tubular or pipe-like snout, chiefly belonging to the order *Lophobranchiata* and family SYNGNATHIDÆ (*q. v.*).

Pipe-line: See PETROLEUM.

Piperaceæ: the pepper family; dicotyledonous herbs, shrubs, or rarely trees, with naked, usually small, and often imperfect flowers which are commonly spicate; stamens usually two to six; ovary superior, simple, or compound; ovules one or few in each carpel; seeds with small endosperm and large perisperm; embryo very small. There are 1,025 known species, nearly all tropical. Many possess acrid, astringent, or narcotic properties, which have given them economic value, as *Piper nigrum*, a climbing shrubby species of the East Indies, whose dried fruits constitute the well-known black pepper of commerce. Other products are cubebs, obtained from *P. cubeba* of the East Indies, and betel-leaves used from *P. betle*. Species of *Peperomia* are cultivated, and many are known as pepper-elders. CHARLES E. BESSEY.

Piper'no: town of Italy, province of Rome; about 50 miles S. E. of the city of Rome (see map of Italy, ref. 6–E). It stands on an elevation in the midst of an amphitheater of lofty hills near the site of the ancient Volscian town of *Privernum*, from which it takes its name. It is almost entirely surrounded by castellated walls with towers, and stones and inscriptions, taken from the ruined temples and palaces of the ancient city just below it, serve to adorn the more modern town. Here Thomas Aquinas died in 1272. Piperno is very unhealthful, owing to its nearness to the Pontine marshes. Pop. about 4,500.

Pipette [= Fr., dimin. of *pipe*, pipe]: a chemical laboratory instrument of glass which is used for sucking up quantities of liquids by the application of mouth-suction. The pipette has therefore a long stem with a contracted orifice for introduction into deep or narrow-mouthed vessels, with a bulbous or elongated expanded portion above to contain the liquid. Sometimes pipettes are graduated, so that known quantities of liquids may be taken up.

Pipit: See TITLARK.

Pippi: See GIULIO ROMANO.

Piqua: city; Miami co., O.; on the Miami river, the Miami and Erie Canal, and the Cin., Hamil. and Dayton, Pitts., Cin., Chi. and St. L., and the Miami Valley railways; 28 miles N. by W. of Dayton, 73 miles W. by N. of Columbus (for location, see map of Ohio, ref. 5–C). It is the second largest linseed-oil center in the U. S., and contains linseed-oil works, straw-board mills, bent-wood works, rolling-mills, tin-plate works, stove-foundry, corrugated iron-works, woolen-mills, hosiery and wagon works, and school-desk and furniture factories. There are 7 public-school buildings, public-school property valued at over $300,000, the Schmidlapp Free School, public library, 3 national banks with combined capital of $500,000, and 3 daily and 4 weekly newspapers. Pop. (1880) 6,031; (1890) 9,090; (1900) 12,172.

J. W. MORRIS, EDITOR OF "DAILY CALL."

Piquet [Fr.]: a game of cards in which the ace, king, queen, knave, ten, nine, eight, and seven of each suit are employed, ranking in the order given. After shuffling and dealing, two by two, to each of the two players, until each holds twelve cards, the rest are laid on the table, and constitute a talon of eight cards. Next, the non-dealer discards from one to five of his poorest cards, and draws as many more from the talon. The opponent next discards. The first player now reckons points, as follows: For *carte blanche* (twelve plain cards), 10 points; for *point* (the hand fullest of any one suit, or, if both hands are alike, the best hand of the two high suits, calling aces eleven, face-cards each ten, and counting pips on the plain cards) the highest hand scores the number of cards in his fullest suit; for *sequence* (the greatest number of consecutive cards in any suit, or, if both hands are alike in this respect, the one whose highest sequence begins with the higher card; but no two cards make a sequence) the better hand scores as follows: If the best sequence is three cards, count 3; for four cards, 4; for five, 15; for six, 16; for seven, 17, etc. Sometimes all sequences are scored. For the *quatorze*, of four equal honor-cards, the highest scores 14, or if there are no sets of four, the highest set of three equal honor-cards counts 3, etc. The first player now plays a card. The opponent now scores his *carte blanche* if he has any, adds what other points he has, and then follows suit. Each player counts 1 for each lead; and if the second player takes a trick, he counts 1 for that. The one who takes the larger number of

tricks counts 10 for *cards*; if he takes all, he counts 40 more for *capot*. If the first hand makes 29 by preliminary scores, and 1 by first lead, he counts 30 more by *pique*; but if his first score comes up to 30 before his lead, he scores 60 more by *repique*: 100 or 101 points make the game, but there are several ways of scoring besides the above.

Piracicaba, pĕe-raă-sĕe-kaa'baă, or **Constituição**, kŏnstĕe-twĕe-sowñ': a city of the state of São Paulo, Brazil; on a river of the same name, a branch of the Tieté; 97 miles N. W. of São Paulo, with which it is connected by rail. It is the center of a rich coffee and sugar district, and has a thriving trade; a water-fall on the river is utilized for several mills. Pop. (1894) about 15,000. H. H. S.

Piracy [from Gr. πειρατεία, deriv. of Gr. πειρατής, pirate, liter., one who makes attacks, deriv. of πεῖρα, trial, attempt, attack, deriv. of πειρᾶν, try]: robbery on the high seas; depredations committed by persons without the commission or authority of any state. In the law of nations the essential element of the crime is the intention of preying indiscriminately on the human race, rather than a desire to inflict damage upon some particular nationality. As the high seas are not under the jurisdiction of any state, piracy is justiciable in any court. A pirate is a sea-rover who preys on the vessels and goods of any nation that he falls in with, or makes descents on the land for a similar purpose of plunder. A privateer exceeding its commission might not be accounted as a piratical vessel, but one with a commission from *two opposite* belligerents would be piratical, since the only motive for such a double commission is plunder of both parties and of vessels bound to the ports of either. The vessel of a part of a state, organized for rebellion and independence, has been held to be piratical, because, although it may have received a commission from the rebel government, it carries a flag unknown to international law, and offers no guaranty of legal belligerent behavior; but the better opinion is that as such a vessel does not scour the sea for the purpose of plunder, and wages war with but one nation, it wants two important characteristics of piracy. Piracy, in the international sense of the word, is a crime against all nations, but each nation in its own criminal code may class other crimes under this head; thus the U. S. made the slave-trade to be piracy for all its citizens on any ship, and for persons not citizens on its vessels; yet, for all that, the slave-trade, though it might be made criminal by the laws of all civilized nations, is not piratical in an international sense. A slave-trading vessel from the U. S. could not be captured by the cruisers of any other country without special treaty to that effect; but an act of strict piracy could be tried everywhere, for a piratical ship, as being at war with the world, could be captured by the vessel of any nation. As a rule, the search of one vessel by a public ship of another state is a war right only, but search on suspicion of piracy exists in time of peace. The usual penalty for piracy is the confiscation of the piratical ship and hanging of its crew. This shows the wide difference between piracy and privateering, since the penalty for the latter is at most imprisonment. Revised by T. S. Woolsey.

Piræ'us [= Lat. = Gr. Πειραιεύς]: a town situated about the chief harbor of Athens (*q. v.*), and connected with Athens by the celebrated long walls (see map of Greece, ref. 17–L). It is a town of great commercial importance. Pop. (1896) 42,169.

Piranesi, pĕe-raă-naa'sĕe, Giambattista: etcher and line-engraver and architect: b. at Venice in 1720. He first studied drawing with his mother's brother, but perfected himself in this art in Rome under Giuseppe Vasi, who taught him engraving also. He became an excellent architect. Clement XIII. employed him to restore the Church of the Knights of Malta on the Aventine. He is best known for his engravings of the monuments of Rome, ancient and modern, a work in sixteen volumes.—His son Francesco, b. in 1748, was also an engraver, and continued this series after his father's death. Their works are scarcely distinguishable.

Pirbright, Henry de Worms: See the Appendix.

Piro: See Pueblo Indians and Tañoan Indians.

Piron, pĕe'rōñ', Alexis: author; b. at Dijon, France, July 9, 1689; studied law, but did not practice; left his native town chiefly on account of an improper ode he wrote; lived in Paris for a long time in obscurity; began to write for the minor theaters, and obtained admission to literary and elegant society by his brilliant sarcasm and ready wit; entered into rather ludicrous rivalry with Voltaire as a tragedian, but wrote an excellent comedy, *La Métromanie* (1738). When proposed as a member of the Academy he was rejected on account of his ode, not by the Academy, but by Louis XV. D. in Paris, Jan. 21, 1773. There is a collected edition of his works by Rigoley de Juvigny (7 vols., Paris, 1776).

Pisa, pee'zaă, or pee'saă: capital of the province of Pisa, Italy; on the Arno; 49 miles W. by rail of Florence (see map of Italy, ref. 4–C). It is still a walled town, and is entered by six gates. The bridges are very fine, especially the Ponte del Mezzo, which spans the center of the semicircle formed by the Arno within the town. An aqueduct 4 miles in length supplies the town with water. The Duomo (or cathedral), founded probably in 1063, on the site of a palace of Hadrian, has a fine dome, and possesses several paintings by Cimabue, Andrea del Sarto, and others. The Baptistery (1154) and the Leaning Tower (1174) are both circular structures, the former 180 feet in height and 160 in diameter; the latter, 179 feet in height and 50 in diameter, with an inclination of 13 ft. 8 in. (the cornices being included), from the perpendicular. This position, it seems probable, was not due to the design of the architects, but was assumed during the progress of the work. The Campo Santo is adorned with frescoes by Benozzo Gozzoli, Orcagna, and others. The University of Pisa (1338) counts Galileo among its former pupils and professors. It has a natural history museum, a library of 120,000 volumes, and (1891) 64 teachers and 728 students. The town possesses an academy of fine arts and a botanical garden. Pisa is of very remote and uncertain origin. Under the first Roman emperors it rose to great prosperity, which lasted till the middle of the fifth century, after which time it shared in the common calamities of barbarian invasion. In 1003 the pope invited Pisa, then an independent republic, to assist in expelling the Saracens from the Roman territory. After wresting Sardinia, Corsica, and other places from the infidels, Pisa gave herself to commerce and the arts of peace, but her rapidly increasing power and wealth excited the jealousy of Genoa and of the other neighboring republics. Several Guelphic cities, instigated by Ugolino Gherardesca, a traitor noble of Pisa, united in a league against this Ghibelline commonwealth. The Pisans finally suffered a great naval defeat at Meloria in 1284. Henceforth, rival families and rival parties disputed the government of the city, but the commonwealth sustained itself, both against France and its own sister republics, until 1509, when it was forced to submit to Florence. From this time the history of Pisa is one with that of Tuscany. It was formerly a seaport, but, owing to the accumulation of deposits at the mouth of the Arno, is now about 6 miles distant from the sea, and its once important commerce has been transferred to Leghorn. There are manufactures of cottons and silks and coral and alabaster ornaments. Pop. (1893), with the suburbs, 61,500. Revised by R. A. Roberts.

Pisa, Council of: a council called to heal the schism which had distracted the Church since 1378. It was considered œcumenical by Gallican theologians, but not by the Roman Catholic Church. Bellarmine says it was "neither clearly approved nor clearly rejected." It was summoned neither by pope nor emperor, but by fourteen cardinals (seven in each obedience) of the two rival popes. It met in the cathedral of Pisa, Mar. 25, 1409, and held its twenty-third and last session Aug. 7, 1409. It was composed of 24 cardinals, 4 patriarchs, 80 bishops in person and 102 by proxy, 87 abbots in person and 200 by proxy, the ambassadors of several governments, the representatives of 13 universities, and more than 300 professors and doctors of canon law. On June 5, 1409, the council deposed Gregory XII. of the Roman line and Benedict XIII. of the Avignon line, declaring them both to be schismatics, heretics, perjurers, and vow-breakers. On June 26, the 24 (some say only 22) cardinals elected Peter Philargi, who took the name of Alexander V. The reforms talked of were then adjourned for the consideration of a general council to meet in Apr., 1412. The Church now had three rival popes instead of two. F. M. Colby.

Pisa'gua: a town and port of the province of Tarapacá, Chili (formerly in Peru); 45 miles N. of Iquique; lat. 19° 36′ 30″ S. (see map of South America, ref. 6–C). A partial shelter is here afforded to ships by a projecting point. The town is built on a narrow space between the shore and a line of high cliffs; the whole surrounding country is a desert. Next to Iquique, it is the principal center of the

nitrate-trade; the product is brought down from the interior by rail. At the breaking out of the Chilian war this was a point of great importance; it was bombarded Apr. 18, 1879, and taken by the Chilians Nov. 2. During the civil war of 1891 it was the scene of severe fighting, changing hands several times. Pop. 8,000. H. H. S.

Pisan, Christine, de: poet; b. in Venice in 1364; d. about 1431. Her father, Thomas de Pisan (or Pezano), famous in his time for his knowledge of the speculative sciences and especially astrology, held a public position of influence. Hence he was drawn, soon after the daughter's birth, by a tempting offer of King Charles V. of France. Four years later, probably in 1368, he removed his family also to Paris, where they were received into the society of the court. In 1379 Christine was married to a Picard gentleman, by name Estienne du Castel, who died in 1389. Left with three children to a life of care and pecuniary difficulties, and tormented with lawsuits by unscrupulous persons, who had had business relations with her husband, she seems to have turned to writing almost of necessity. The example and care of her father had made her an excellent scholar, perhaps the best Latinist of her period in France. Her opinions were original, and she was able to estimate critically the ideas and tendencies she saw about her. Her acquaintance with great people enabled her to obtain an income from her works by dedications and similar means, and speedily her fame spread even beyond the borders of France. Her poetical manner seems to owe much to Guillaume de Machault and to Eustache Deschamps; but her prose, perhaps owing to her reading of classic models, has an amplitude and power all its own. In her earlier years she seems to have composed many of those light but gracious verses so popular at the time—ballades, lais, virelais, rondeaux, jeux à vendre, etc. Later she wrote a number of longer and more serious poems, including *Épître au Dieu d'Amours* (1399) and *Les sept Seaumes* (1410). Her prose works fall into several groups. The first deals with the dignity of woman, which had been maligned in the famous *Roman de la Rose* and other works. Here belong *La Cité des Dames* (1405?); *Le Livre des trois Vertus* (1406?); *Épîtres sur le Roman de la Rose* (1407). Another group contains works of a moral or didactic character designed primarily for men: *Épître d'Othéa à Hector* (1386?, in mingled verse and prose); *Le Corps de Policie* (1407?); *Faits d'armes et de Chevalerie* (1404–07?), based largely on Vegetius. Finally we have works of an historical or patriotic kind: *La Vie et les bonnes Meurs du sage Roy Charles V.* (1404); *Lamentations sur les maux de la guerre civile* (1410); *Le Livre de la Paix* (1412–13). Besides the above works, we have a quaint biographical piece, *La Vision de Christine* (1405), and two versions from the Latin, which show Christine's love of moralizing. These are the *Dits Moraux*, in verse, based on the distiches of the so-called Dionysius Cato, and the *Livre de Prudence et l'Enseignement de bien vivre*, in prose, based on the treatise *De quattuor virtutibus*, attributed to Martin of Braga. In 1418 the poet entered a convent, and her voice was stilled until 1429, when the appearance of Jeanne d'Arc as the savior of France elicited from her the last and most beautiful of her poems. She seems not to have been living when her heroine met her sad fate.

There is no complete edition of the works of Christine de Pisan. The earlier poems are edited by M. Roy, 2 vols., Paris, 1886–91 (Soc. des anciens textes franç.); *Le Chemin du long Estude*, by R. Püschel (Berlin and Paris, 1881); *Le Dit de la Rose*, by F. Heuchenkamp (Halle, 1891). See also R. Thomassy, *Essai sur les écrits politiques de Christine de Pisan* (Paris, 1838); and F. Koch, *Leben u. Werke der Christine de Pizan* (Goslar, 1885), and *Ueber die Werke der Christine de Pizan* (in *Zeitsch. f. neufranz. Sprache u. Litt.*, 1886). A. R. Marsh.

Pisan'der (in Gr. Πείσανδρος) of Rhodes: Greek epic poet who flourished, according to Suidas, about the middle of the seventh century B. C., but probably much later. Pisander is noteworthy for having first endowed Hercules with the club and the lion's skin, suggestive of sun-worship. It has been conjectured that he too fixed the number of labors at twelve, corresponding to the signs of the zodiac.

B. L. G.

Pisano, Andrea: See Andrea Pisano.

Pisano, Giovanni: See Giovanni da Pisa.

Pisano, Giunta: painter; b. at Pisa, Italy, 1190. He was the first who attempted to free himself from the Byzantine traditions. One of his earliest works is in the Cathedral of Pisa, a *Crucifixion*. Examples of his art exist in Santa Maria degli Angeli at Assisi, as also in the upper church of St. Francis there. He may be considered to have prepared the way for Cimabue. D. in 1236. W. J. S.

Pisano, Vittore, known also as **Pisanello**: Italian painter and medalist; b. at San Vigilio, in Veronese territory, in 1380. He studied painting under Altichieri da Zevio, and painted both in tempera and fresco. He worked in Venice in 1421–22 together with Gentile da Fabriano. Most of his works in fresco at Verona and elsewhere have disappeared. Of his easel-pictures only three exist, one of which, *St. Anthony and St. George*, is in the National Gallery, London. It is as a medalist that he is best known. D. in 1455 or 1456. W. J. S.

Piscary: See Hereditaments.

Piscary, Common of: See Fishery Laws.

Piscat'aqua River: a river which is for a few miles the boundary between Maine and New Hampshire; formed by the junction of Salmon Falls and Cocheco rivers, both of which furnish extensive and well-utilized water-power. Its lower course is tidal, and constitutes the harbor of Portsmouth, N. H. Drainage area, 550 sq. miles.

Piscataquis River: a stream which rises in Somerset co., Me., flows E., and reaches the Penobscot at Howland. Length, 71 miles. Drainage area, 1,276 sq. miles.

Pisces: the twelfth sign of the zodiac, which the sun enters Feb. 20. It formerly corresponded to the constellation of that name. Owing to the precession of the equinoxes, the constellation Pisces is now mostly in the sign Aries. It contains no prominent stars.

Pis'ciculture [Lat. *piscis*, fish + *cultura*, culture, care]: the artificial cultivation of aquatic animals, as described under the synonymous term Fish-culture (*q. v.*). Resting upon the basis of scientific study and associated with adequate protective legislation, it is capable of maintaining the sources of supply utilized by the fishery industries. Pisciculturai operations are extensively carried on by private individuals for profit and by governments for the public benefit.

European Fish-culture.—In Europe Dr. Nicolas Borodine reported 416 fish-hatcheries in 1891, all of which except 82 were private establishments occupied chiefly with trout and salmon culture. Governmental aid was extended in Norway, Switzerland, France, Italy, Great Britain, Austria, and Russia, named in the order of the number of hatcheries supported by them. Norway entered upon the work in 1850 and now takes first rank in the number of its establishments, the amount of its annual grant for fish-culture, and the results accomplished, having produced 200,000,000 cod in 1891 at its station at Flodevigen. Germany supports the once famous but now unimportant hatchery at Hüningen; France subsidizes a small private shad-hatchery at St.-Pierre-les-Elbeuf on the Seine, and contemplates the establishment of a piscicultural school at Gremaz, where M. Lugrin invented a method of artificially propagating live food for young fish; Italy has hatching stations at Brescia and Rome; the Netherlands appropriates a small sum for planting salmon fry in the Rhine; Russia has a station principally for whitefish-culture at Nicholsk; and Scotland sustains a small marine hatchery at Dunbar. The Governments of New Zealand, Australia, and Japan also aid in restocking their public waters, their operations relating almost exclusively to the acclimatization of exotic salmon and trout.

Fish and Fishery Commissions.—Public fish-culture in many countries is conducted through the agency of scientific bureaus and associations. Thus in Norway operations are carried on by the Society for the Development of Norwegian Fisheries; the Netherlands has its commission for the sea fisheries, to which the Government refers all matters relating to fishery interests; in Germany the Deutscher Fischerei Verein (German Fishery Union) and the Commission for the Investigation of the German Seas are partly supported by public funds in their piscicultural work and scientific investigations; Scotland has a fishery board, chiefly for the inquiry into the proper basis of fishery legislation, but partly engaged in marine fish-culture at its Dunbar station. For the extent to which the Government promotes pisciculture in the U. S. see Fish-culture. Newfoundland also maintains a superintendent of the fisheries, and is especially active in the propagation of the cod and the lobster.

Artificial Propagation.—Modern pisciculture includes

artificial as well as natural propagation and rearing of useful and ornamental water-animals, and the acclimatization of species in waters to which they are not native. The necessity of artificial propagation has become most manifest in interior waters where fishing operations and artificial obstructions have interfered with natural reproduction; also in shallow seas to which the shoals of gravid fish resort for spawning, just as the need of regulation has become evident to protect the seals on their shore breeding-grounds and the approaches thereto, the oyster on its flats, and the whale in its arctic nursery shallows.

Artificial propagation forms the basis of successful pisciculture, and has arrived at such a point of development that it affords many advantages over natural reproduction. Under natural conditions only a small percentage of the eggs cast by the female are impregnated. A. N. Cheney found by actual counting of eggs in a Canadian salmon river that only 2 per cent. had been fertilized. By the artificial method nearly all the eggs can be impregnated and hatched; it is common to hatch 97 per cent. of them. In a state of nature eggs are devoured by insects, fishes, birds, mammals, and other enemies; they are destroyed by freshets, crushed by logs, or smothered in mud and mill refuse. The young fish escaping these dangers are attacked incessantly by hosts of predatory animals as well as by larger individuals of their own kind. In a hatchery or pond station both eggs and young are protected almost entirely from all these destructive agencies, the growing fish are assorted according to size, and are regularly and properly fed.

Classification of Eggs.—The fish egg, like that of other animals, consists of the germ-cell, the yolk, and the yolk-membrane, and varies greatly in size according to the amount of its yolk element. After leaving the yolk-membrane, or shell, the young fish is nourished by the yolk for a period varying from a few days, as in the case of the pike-perch, shad, and bass, to several weeks, as in the case of salmon and trout. The eggs differ greatly not only in size and toughness of the shell, but also in their specific gravity, and they have been classified with reference to the latter property into: 1, heavy eggs, like those of salmon, trout, pike-perch, yellow perch, black bass, sea-herring, and smelt; 2, semi-buoyant eggs, as in the shad, whitefish, and sucker; 3, buoyant eggs, as found in the cod, haddock, mackerel, tautog, and cunner. Heavy eggs are again divided into adhesive and non-adhesive, according to the presence or absence of a glutinous covering on the yolk-membrane.

Hatching Apparatus.—Salmon and trout eggs were first hatched on gravel in perforated boxes placed in running water. Next in order came the Coste parallel glass tubes or grilles as a substitute for the gravel. In 1873 Holton invented a box intended to utilize an upward current of water passing through a number of egg-trays placed one above another, and escaping at the top. The Clark hatching-trough, also intended to economize space, is divided by watertight partitions into ten or twenty compartments, each containing a series of egg-trays. Water is introduced into the top of the first compartment, escapes at the bottom, passes over the top of the partition into the next compartment, and so on. The Williamson box resembles Clark's, but utilizes an upward current of water produced by a double partition. Livingston Stone substituted wire-trays or baskets for the egg-trays used in the Williamson box, placing in each basket numerous layers of salmon eggs. This form of apparatus was among those successfully employed by the U. S. Fish Commission at the Columbian Exposition at Chicago.

Heavy eggs are developed also in cylindrical glass jars, either open or closed at the top, the water being admitted near the bottom, directly or by means of a tube, and escaping at the top. Types of such devices are the Chase, the Wilmot, the Ferguson, and the McDonald jars. The upward current not only buoys up the eggs, but also facilitates the removal of dead eggs and other injurious substances. As the embryos developed from heavy eggs are unable to swim when first hatched, they must be removed to rearing troughs, where they are usually kept on gravel.

Adhesive eggs were formerly, and to some extent still are, collected on grass roots, twigs, panes of glass, or other surfaces to which they adhere during the incubation period. The apparatus was placed in running water or in an alternating upward and downward current, the water passing over one partition, under the next, and so on. The box used by Christian Lund in 1761, the smelt-hatching box of James Ricardo, employed in 1876, and the box devised at Gloucester, Mass., by F. N. Clark in 1878, are among the early types. At the present time glutinous eggs—those of the pike-perch for example—are freed from their adhesive envelope by manipulation in a solution of starch or muck, and are afterward hatched like free heavy eggs.

Among semi-buoyant eggs those of the shad were formerly hatched successfully, but inconveniently, in a rectangular box invented by Seth Green. The box had a wire-cloth bottom, and was caused to float at a small angle to the current by means of long wooden cleats on the sides. This arrangement was intended to intensify the action of the current in buoying up the eggs. The boxes were placed in a stream, and required constant supervision to prevent injury to their contents. Variations of the Green box were made by Brackett, of Massachusetts, and by Stilwell and Atkins, of Maine. Semi-buoyant eggs are now developed in the jars used for heavy eggs with greater comfort and safety and an increased percentage of fry.

Buoyant eggs were first successfully hatched in large numbers in the U. S. by Capt. H. C. Chester in 1885 by means of the McDonald cod-hatching box modified by substituting large glass jars for the inner box of McDonald. That box was supplied with water through the center of the bottom, and had an intermittent siphon at each end, so arranged as to give a rise and fall of 5 inches, imitating tidal motion. The improved cod-hatching box of Marshall McDonald resembles the original pattern devised in 1880, but the inner wooden box has a slightly oval bottom covered with cheese-cloth, and a small additional current of water is introduced from the water-chamber through an opening near the bottom of the box, and this gives the eggs a rotary motion which is highly advantageous. The flow of water is from below upward.

Lobsters.—The hatching period of lobster eggs in 1892 varied from two days to thirty-five days, according to temperature of the water. The eggs did not begin to hatch until the water reached 54° F. The largest lobster brought to the Wood's Hole, Mass., station that year measured 12½ inches and had 24,300 eggs. The average number obtained was 12,000. The eggs are readily hatched in the cod boxes above referred to and in the jars used for heavy fish eggs.

Transportation of Eggs.—Fish eggs are usually shipped after the eye-spots are present between layers of damp moss or cotton, or on flannel or zinc bottom-trays lined with moss, and sometimes with a covering of clean snow. The temperature of the inside of the shipping-box is kept low by means of ice. Eggs are frequently sent before they have reached the eyed stage, notably pike-perch and whitefish eggs. The method of shipping shad eggs in bulk on flannel trays, introduced by U. S. Fish Commissioner McDonald, revolutionized the movement of such eggs from the field stations to distant hatching establishments.

Care of the Young.—No attempt is made to feed the young of marine fishes or of the fresh-water shad and pike-perch, the fry being released soon after hatching. Shad, however, have been successfully reared on natural food in ponds to the age of six months, when they are allowed to migrate seaward. The yolk-sac of salmon and trout sustains the fry during a period of thirty to fifty days after leaving the egg, but feeding usually begins a week or ten days before the absorption of the sac is completed. Raw liver ground very fine and passed through a sieve is used. This is diluted with water to the consistence of cream, and the fry are fed just enough to satisfy their hunger several times a day, care being taken to remove all refuse remaining on the bottom after feeding. The larvæ of gnats, mosquitoes, flies, and various small crustaceans, are employed at different stages of the growth of the young, and the flesh of domestic animals constitutes the principal food of older fish.

A series of rearing ponds is one of the most important adjuncts to a fish-hatchery. These should have an adequate supply of brook or river water, which for trout or salmon work should not exceed 70° in temperature in midsummer. The shape, size, and depths of ponds vary with the purpose for which they are intended, but each should have an independent supply and drainage to provide for complete isolation from the remainder of the series. A prime requisite is a bountiful supply of pure water under perfect control.

LITERATURE.—Among the numerous works upon pisciculture methods are the following: *Fischzucht*, by Max von dem Borne and others (Berlin, 1881); Hubrecht, *Oyster-culture and Oyster-fisheries in the Netherlands* (London, 1883); Haxo, *De la fécondation artificielle des œufs des poissons* (Épinal, 1853); Coste, *Instructions sur la pisciculture* (Paris,

1856); Koltz, *Multiplication artificielle des poissons* (Brussels, 1858); Buckland, *Fish-hatching* (London. 1863); Francis, *Fish-culture* (London, 1863); Bertram, *Harvest of the Sea* (London, 1865; New York, 1866); Day, *Fish-culture* (London, 1883); Home, *Salmon and Salmon-fisheries* (London, 1883); Marston, *Coarse Fish-culture* (London, 1883); Maitland, *On the Culture of Salmonidæ and the Acclimatization of Fish* (London, 1883); Maitland, *The History of Howietoun*; Kent, *Artificial Culture of Lobsters* (London, 1883); Day, *British and Irish Salmonidæ* (London, 1887); Fry, *A Complete Treatise on Artificial Fish-breeding* (New York, 1854); Garlick, *A Treatise on the Artificial Propagation of Certain Kinds of Fish* (Cleveland, 1857); Marsh, *Artificial Propagation of Fish* (Burlington, Vt., 1857); Norris, *American Fish-culture* (Philadelphia, 1868); Green, *Trout-culture* (Caledonia, N. Y., 1870); Slack, *Practical Trout-culture* (New York, 1872); Klippart, *An Essay on Fish-culture* (Columbus, O., 1873); Stone, *Domesticated Trout* (Boston, 1873); Green and Roosevelt, *Fish-hatching and Fish-catching* (Rochester, N. Y., 1879); Hessel, *Carp-culture*, U. S. Fish Comm. *Report*, part iv.; Logan, *Carp-culture* (Youngstown, O., 1888); Mulertt, *The Gold-fish and its Culture* (Cincinnati). Much varied information can also be obtained from the annual reports and bulletins of the U. S. Fish Commission, the reports of State fish commissions and of the Department of Marine and Fisheries of Canada, the journals of the Society of Acclimatization and the Society of Agriculture of France, the Transactions of the American Fisheries Society, the publications of the Dentscher Fischerei Verein, and of the fisheries departments of Norway and Finland, *The Field*, *Land and Water*, and *The Fishing Gazette* (London). TARLETON H. BEAN.

Piscidia erythria: a leguminous tree growing in the West Indies, popularly known as Jamaica dogwood. The wood of this tree is largely sold in commerce, and the bark has been employed for catching fish, as when placed in the water it stupefies them. It is supposed to possess considerable narcotic power, and to be a useful substitute for opium in some cases of insomnia due to pain. H. A. HARE.

Pi'semskiĭ, ALEKSEĬ TEOFILAKTOVICH: author; b. in the village of Ramene, in the government of Kostroma, Russia, Mar. 20, 1820; d. Jan., 1881. During his youth he became familiar with the life of the people, and also saw something of the Freemasons, whom he afterward described in a poor novel, *The Freemasons* (1881). After studying mathematics four years in the University of Moscow, he entered the Government service (1844) in the town of Kostroma, but resigned (1853) and moved to St. Petersburg in order to devote himself exclusively to literature. After 1862 he lived in Moscow. His first novel, *Trufiak* (The Jester) appeared in 1850, his second, *A Love Match*, in 1853. The same year witnessed his best drama, *Gorkaĭa Sudbĭna* (A Bitter Lot), a powerful and painful piece that is still played. His greatest novel, *A Thousand Souls*, came out in 1858. Among his later books, which were especially attacks on the liberal tendencies of the time, *The Stormy Sea* (1863), *The Men of 1840* (1868), and *In the Whirlpool* (1871) are noteworthy. Some of his short stories, sueh as *Leshiĭ* (The Wood Demon) and *Piterstchik*, are masterpieces. Most of his dramas (*Veteran and Recruit*, *Baal*, *The Hypochondriac*, etc.) were less successful. He was an unsparing realist who painted with great force and fidelity low and repulsive charaeters, or the miseries of everyday life. His weakness lay in his utter absence of ideals. A complete edition of the novels and tales he had then written appeared in 1861–65; of his plays in 1874. Most of his best work has been translated into French and German. A. C. COOLIDGE.

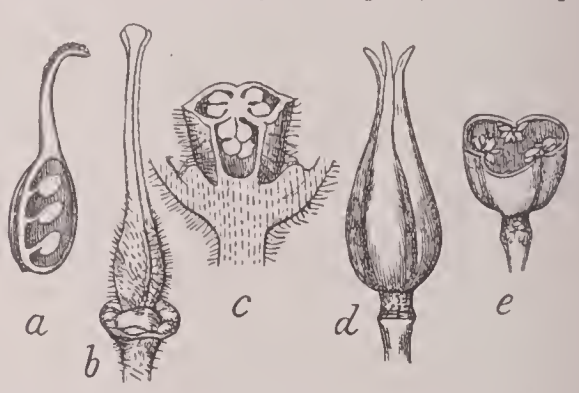
Pis'gah: a mountain of Palestine, E. of the Jordan, mentioned several times in the Pentatench. It was the summit from which Moses obtained his view of the Promised Land (Deut. xxxiv. 1). In 1873 it was identified by Prof. John A. Paine, of the American Palestine Exploration Society, with *Siâghah*, 2,360 feet above the sea. Though not the highest summit of the range, it reaches out toward the valley so as to command a very wide prospect.

Pisid'ia: an ancient territory of Asia Minor, with varying and ill-defined boundaries, situated between Phrygia, Isauria, Cilicia, Pamphylia, Lycia, and Caria. It was inhabited by wild and predatory tribes, ruled by petty chiefs. The Romans never wholly subdued Pisidia, though they held possession of its chief towns—Antioch, its capital, Salagassus, and Selge. It is now included in the Ottoman vilayet of Konieh. E. A. G.

Pisis'tratus [= Lat. = Gr. Πεισίστρατος]: a tyrant of Athens, a son of Hippocrates, and a kinsman of Solon. When in 571 B. C. Solon left Athens for ten years in order to test the working of his laws, Pisistratus entered politics as an advocate of the cause of the lower classes, whose confidence he won. By a ruse he persuaded the people to give him a body-guard, which he gradually increased, until in 560 B. C. he felt himself strong enough to assume the *rôle* of tyrant. Later he had to flee the country, and lived in exile for five years, when, with the help of Megacles, he was restored to power. A second time he was banished, and remained in exile eleven years. The dates of his exile are variously given by ehronologers. By the help of Thebans, Argives, and Naxians, he was again restored to power, and died on the throne in 527 B. C. Between 560 and 527 he was tyrant seventeen years and an exile sixteen years. As tyrant he was distinguished for his mildness and reverence for the laws of Solon, which in the main he left undisturbed. He was the patron of agriculture, the arts, and sciences. He built many public edifices, and caused the poems of Homer to be collected and edited. He was succeeded in the tyranny by his eldest son HIPPIAS (*q. v.*). J. R. S. S.

Pistachio-nut, or **Green Almond** [*pistachio* is from Span. *pistacho* < Lat. *pista'cium* = Gr. πιστάκιον, pistachio-nut, deriv. of πιστάκη, pistachio-tree, from Pers. *pistah*. Cf. Arab. *fistaq*]: the fruit of the pistachio-tree, *Pistacia vera* (family *Anacardiaceæ*), which is common in the S. of Europe and in Asia and Africa. The nut is delicious for dessert. The kernel is somewhat like that of the almond, but is green. The nut yields a good table oil. To the same genus belong the mastich, the terebinth, and other valuable trees. Lamb fattened upon pistachio-nuts is a famous delicacy.

Pistil [from Lat. *pistil'lum*, pestle, so called from its shape]: the part of a flower which produces ovules. It normally occupies the center of the flower, the stamens, petals, and sepals, when present, surrounding it. It is a leaf-structure (phyllome), and in its simplest form consists of a single phyllome (technically a "carpel"), folded upward so



Pistils: *a*, simple of *Isopyrum*; *b* and *c*, compound of *Staphylea*; *d* and *e*, compound of *Ascyrum*; enlarged.

that its edges meet (*a*). Here the ovules normally grow upon the infolded edges (placentæ). In many cases two or more pistils (carpels) grow more or less perfectly into a compound structure (*b c d e*). Here the ovules still grow upon the phyllome edges, but these may be the edges of the same or of different phyllomes, according as each phyllome is fully infolded (*b c*), or only partially so, its edges joining with those of other phyllomes (*d e*). In the pistils of many plants the placenta undergoes some displacement; thus the ovules may be on the surface or the midrib of the carpel.

In every pistil, whether simple or compound, the enlarged, ovule-bearing part is called the ovary, the more or less slender portion above it is the style, and this is terminated by the stigma. The style may be very long, as in Indian corn, where it is known as the "silk," or very short, or even wanting, as in the barberry. The stigma is composed of a soft, specialized tissue, commonly exuding a sticky substance, and designed for the reception of the pollen. It may be a cap on the summit of the style, a surface extending downward for some distance, or it may be more or less branched.

A flower may have many simple pistils, and this appears to have been the condition in primitive flowers, now illustrated by the crowfoots (*Ranunculaceæ*) and water-plantains (*Alismaceæ*); more commonly, however, the pistils have united into a single compound pistil, as in the great majority of flowering plants. Moreover, many compound

pistils have undergone such structural simplification that they often appear to be simple, as in the composites, where the bicarpellary pistil has but a single ovule, and appears at first sight to be monocarpellary.

Although the pistil normally occupies the inner and upper part of the flower (then said to be *superior* to the other organs), it may seem to be below the other parts by the growth of the latter above it (when it is said to be *inferior* to the other organs), as in the composites, irises, and orchids. As the seeds form, the pistil (now called the *pericarp*) undergoes certain modifications, sometimes becoming fleshy, sometimes wholly or in part hard and stony, while sometimes it simply dries into a brittle pod.

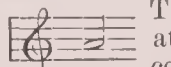
CHARLES E. BESSEY.

Pistoja, pĕĕs-tō′yăă (anc. *Pistoria*): town; in the province of Florence, Italy; 21 miles N. W. of the city of Florence (see map of Italy, ref. 4–D). It lies in a fertile valley between two spurs of the Apennines, one of which separates the valley of the lower Arno from that of the Ombrone, a torrent flowing a little to the E. of this town. A wall, rhomboidal in outline, surrounds the town, which is entered by four gates besides the railway barrier. The streets are wide and well paved, and the squares large. The cathedral, in form an ancient basilica, was built in the twelfth century, rebuilt by Niccolo da Pisa, and since modernized. It contains a famous silver altar and the cenotaph of Cino da Pistoja. San Bartolomeo, San Giovanni, and Sant' Andrea are all churches of very ancient dates; the last named contains a pulpit of white marble (1301) exquisitely wrought in alto-rilievo; also a marble group by Niccolo da Pisa. The bishop's palace is an imposing edifice. The façade of the hospital is decorated with remarkable terracottas by the younger members of the Della Robbia family, representing the seven works of mercy. In 62 B. C. Catiline was defeated here. Gregory the Great sent Pistoja its first bishop in 594. After a long period of prosperity the town fell under the dominion of Florence early in the fourteenth century. The manufactures of Pistoja consist chiefly of linens, glass, needles, and especially firearms. Pistols are said to have been first made here, a fact which is thought by many to explain their name. Pop. (1892) 20,190.

Pitaval, pĕĕ′tăă′vaal′, FRANÇOIS GAYOT, de: legal writer; b. at Lyons, France, in 1673; d. in Paris in 1743. After serving for a time in the army he studied law, and, being admitted as an advocate in 1713, practiced in Paris, and acquired a name by his publication of *Causes célèbres et intéressantes* (20 vols., Paris, 1734–43), which was a collection of celebrated law cases and their decisions. It was continued after the death of Pitaval by François Richer (22 vols., Amsterdam, 1772–88). In 1842 Hitzig and Häring began a similar collection at Leipzig, under the title of *Der neue Pitaval*, which was afterward continued by Vollert. He undertook a number of collections similar to *Causes célèbres*, some of which were of a more frivolous character. Among the most celebrated are the *Bibliothèque des Gens de Cour, ou Mélanges curieux des bons mots de Henri IV., de Louis XIV.*, etc. (2 vols., Paris, 1772, and 8 vols., 1746); *L'Art d'orner l'esprit en l'amusant* (2 vols., Paris, 1748); *Esprit des Conversations agréables* (3 vols., Paris, 1731); *Saillies d'esprit* (2 vols., 1732). Revised by F. STURGES ALLEN.

Pitcairn Island: island in the Pacific Ocean; in lat. 25° 3′ S., lon. 130° 6′ W. Area, 1¼ sq. miles. It is the only place on the route from South America to Otaheite in which fresh water can be procured. It was discovered in 1767 and colonized in 1790 by nine mutineers from H. M. S. Bounty and eighteen Tahitians—six men and twelve women. After successive murders there were left on the island in 1800 one Englishman who called himself John Adams, together with eight or nine women and several children. From these the present inhabitants, about 150, are descended. They came under British control in 1839. See NORFOLK ISLAND and T. B. Murray's *Pitcairn Island* (new ed. 1885).

Pitch: in music, the degree of acuteness or gravity of a sound, as distinguished from its other qualities, as loudness, harshness, or smoothness, etc. The fixing of some invariable standard of pitch, whereby any given note of the scale shall represent a sound of one and the same degree of acuteness in all written music, has been an object of interest and importance from the first rise of musical science. It is improbable that in early times, when music was in its rudest state, there was any standard corresponding to what we now call *concert-pitch*: for though the ancient Greeks had a certain familiarity with the relations and order of intervals, yet the very imperfect nature of their instruments seems to forbid the conclusion that the adjustment of such instruments to a strictly accurate pitch was an object of much practical importance. There is much room for conjecture in regard to the mode in which the pitch of the scale came to be settled by common consent as it stood, for instance, in the fifteenth or sixteenth century. It is probable that the organ-builders of that period contributed as much to the settlement of the question of pitch as those who found its solution in the doctrine of vibrations. The organ-builder knew that an open pipe about 2 feet long and of moderate diameter would give the sound which we now call "middle C"; and the theorist knew that the column of air in such a pipe would make 512 vibrations in a second of time; but in all such cases the practical issue would prove of more immediate consequence than the theoretical; and the fixing of any *one* sound by a pipe of a certain length would be, in fact, the fixing of the whole scale above and below, whether that sound were taken as tonic, dominant, or any other term in the octave. When by this or any other means a standard of pitch was once established, conformity to it would almost necessarily follow in vocal exercises and in the construction and tuning of instruments generally. This conformity, however, has never been strictly exact, either in time or place. From the seventeenth century down to the death of Beethoven evidence shows that the pitch was practically the same in various countries. From this date, however, the orchestral wind instruments began to be much improved in construction, and their manufacturers and players alike discovered that a slightly higher pitch much enhanced the quality and brilliancy of the instruments. As the strings were obliged to tune to the wind instruments, a gradual rise of pitch necessarily ensued, affecting voices as well whenever orchestral accompaniment was employed. In 1878 it was stated that the pitch at the Italian opera in London (not the pitch of Italy) was a semitone above that of Beethoven's day. All attempts to better this state of things in England have failed. The vocalist singing with orchestra must either have the piece transposed downward or tax his throat. Unfortunately this is not always a mere question of compass or endurance, but of a changed quality as compared with the composer's design.

In 1858 the French Government appointed a joint commission of distinguished musicians and physicists to examine and determine the question.  They reported in Feb., 1859, fixing the standard A at 435 double vibrations per second. This was confirmed by law, and has had a most beneficial musical influence in France and elsewhere. In the U. S. more or less discrepancy has existed, principally through the desire of piano-manufacturers to retain a high pitch for the sake of greater brilliancy. The orchestral pitch has not been so high as the English, although a trifle higher than the French. It was agreed, however, by the principal piano-manufacturers in convention at New York that the trade should adopt the French standard pitch (A = 435 double vibrations per second) for all musical instruments manufactured in the U. S., and that the change be accomplished on the part of all manufacturers by July 1, 1892. In view of the above the well-chosen title of "international pitch" was adopted as agreeing with that of France, Italy, and Germany. D. B.

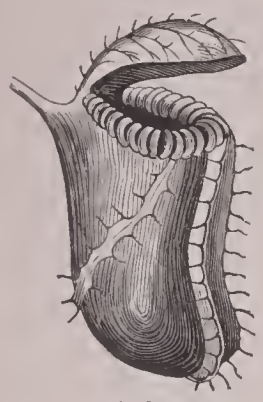
Pitch: See TAR.

Pitchblende: See URANINITE.

Pitcher, THOMAS GAMBLE: soldier; b. at Rockport, Ind., Oct. 23, 1824; graduated at the U. S. Military Academy, and entered the army as brevet second lieutenant of infantry July, 1845; served with his company in Texas throughout the Mexican war, receiving brevet of first lieutenant at Contreras and Churubusco; attained a captaincy 1858; served on the frontier till 1861; was severely wounded at the battle of Cedar Mountain, Aug. 9, 1862; was appointed brigadier-general of volunteers Nov., 1862, and on recovery from his wound served as assistant provost-marshal-general. He was appointed colonel Forty-fourth Infantry in 1866; transferred to First Infantry 1870; superintendent U. S. Military Academy 1866–70; governor of Soldiers' Home 1870–78; retired June, 1878; superintendent of New York State Soldiers' and Sailors' Home 1880–87. D. at Fort Bayard, N. M., Oct. 21, 1895. J. M.

Pitcher-plants: plants which have their leaves, or some considerable portion of the leaf, in the form of a pitcher,

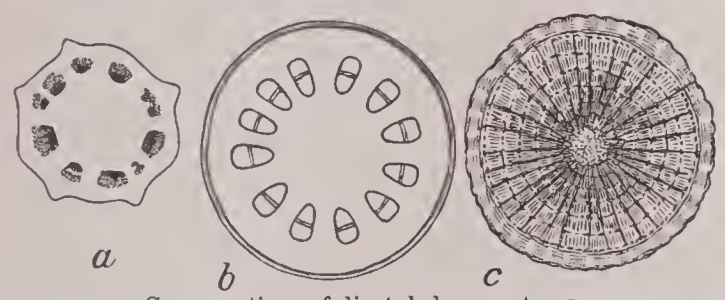
urn, trumpet-shaped tube, or other hollow vessel (technically called an *ascidium*) capable of holding water. The principal kinds belong to five different genera of plants in three families, which have no near relationship or resemblance except in the pitchers. All, or nearly all, are insectivorous. One, of a single species, peculiar to Southwestern Australia, is thought to belong to the Saxifrage family, where it stands alone. It is named *Cephalotus follicularis*. The leaves are all in a cluster next the ground; some are flat and of ordinary conformation; others are oval pitchers, hanging from a short stalk near the top on one side, and fitted with a lid, which neatly covers the mouth, resting at first upon a thickened and crested ring which surrounds and strengthens the orifice, but opening on its hinge as soon as the pitcher is full grown. It has long been observed that this pitcher secretes a watery fluid and entraps many insects. Little more is yet known as to its action, although the plant has long been in conservatories; but it is difficult of cultivation. The other pitcher-plants belong to two families, which so far as known contain only pitcher-bearing plants. One of them, *Nepenthaceæ*, consists of numerous species of one genus, chiefly inhabiting the Indian Archipelago; the other, *Sarraceniaceæ*, is wholly American, mainly North American, and consists of three genera—one, of a single species in the mountains of California; another, of one species, in the mountains of British Guiana; the third, of several species, confined to Atlantic North America. This is *Sarracenia*. The pitchers are all at the root, and appear to rise from the ground in a cluster. Instead of a lid, they have a sort of hood at the top, and a projecting wing runs down the inner or upper side from top to bottom. See Insectivorous Plants and Nepenthes. Revised by Charles E. Bessey.



Cephalotus.

Pitchstone: See Obsidian.

Pith: the central, usually soft, tissue in the stems of dicotyledonous plants. When the stem is young it consists throughout of uniform tissue, in which fibro-vascular bundles arise by a differentiation of the cells in certain columns equidistant from the center (*a*). The tissue inside of the



Cross-sections of dicotyledonous stems.

ring of bundles is the pith, and it is evident that that lying outside of the ring, the primary bark, is a part of the same tissue-mass. As the bundles become larger the pith and bark become more widely separated (*b*), and here the connecting radiating portions are known as "medullary rays." In woody stems the fibro-vascular bundles crowd so closely against one another that the connecting medullary rays are very thin, now known as the "silver grain" of wood (*c*).

The pith is continuous from the main stem into all its branches and branchlets. During the first year or two (rarely longer) the pith-cells are active, and are used for the storage of starch and other foodstuff; after this they die and are functionless. Charles E. Bessey.

Pithom [Egypt. *Pa-Tum*, dwelling of Tum or Atum; Copt. *Pethom*; Gr. Πάτουμος]: the Hebrew name of one of the "store-cities" of Egypt, built by the Israelites (Ex. i. 11) for Ramses II., at the east end of the Wadi Tumilat, just W. of the line of the Suez Canal, and at the present railway station, Ramses. The site was discovered by Naville in 1883 (*Store-city of Pithom*, 3d ed. 1888, first *Memoir* of the Egyptian Exploration Fund). The civil name of the place was Theku-t (Succoth), the second station mentioned in the Exodus itinerary. The discovery was particularly important, because it tended to fix both the date and the route of the Exodus. The general view is that the Exodus occurred under Meneptah, the follower of Ramses II. See also Heroöpolis. Charles R. Gillett.

Pitman, Sir Isaac: founder of the Pitman system of shorthand; b. at Trowbridge, Wiltshire, England, Jan. 4, 1813; was educated in the normal college of the British and Foreign School Society at London; was appointed master of the British School at Barton-on-Humber 1832; established a similar school at Wotton-under-Edge 1836; published *Stenographic Shorthand* (1837) and *Phonography, or Writing of Sound* (1840), giving the principles of his invention of a superior method of shorthand called phonography, since so widely diffused as almost to have extinguished the earlier systems; removed to Bath, where he conducted a school 1839–43; devoted himself to the perfection and propagation of phonography and its complement phonetics; founded in 1843 the Phonetic Society, and established the Phonetic Institute, a printing-office from which he has brought out for many years *The Phonetic Journal* (weekly, with a lithographed *Supplement*); issued several revised manuals of phonography and a considerable number of standard works in phonetic printing. His most complete professional work is the *Phonographic Reporter's Companion* (1853). His system was introduced into the U. S. by S. P. Andrews and A. F. Boyle in their *Complete Phonographic Class-book* (1847), soon followed by many similar works. He was knighted in 1894. D. Jan. 22, 1897. See Reed's *Biography of Isaac Pitman* (1890).—His brother, Benn Pitman, b. at Trowbridge, July 22, 1822, lectured on phonography in Great Britain 1843–52, and aided his brother in compiling text-books; removed to the U. S., settling at Cincinnati, where he devoted himself to phonography; published a *Manual of Phonography* (New York, 1855); reported the treason trials at Indianapolis (1865) and the trial of the assassins of President Lincoln (New York, 1865). In 1873 he abandoned reporting and became connected with the school of design, now the art academy of the University of Cincinnati, as lecturer and teacher. With Jerome B. Howard he published *The Phonographic Dictionary* (1883). His present system differs slightly from that of his brother.

Pito: See Chica.

Piton Bark: See Caribbee Bark.

Pitra, pē'traa', Jean Baptiste: ecclesiastic and author; b. at Champforgeuil, Saône-et-Loire, France, Aug. 31, 1812; took holy orders; became a member of the Benedictine congregation of Solesmes; published *Spicilegium Solesmense* (5 vols., Paris, 1852–60); was commissioned in 1858 by Pius IX. to write a history of Oriental rites and canon law, of which the first volume appeared in 1864, second in 1868, under the title of *Juris Ecclesiastici Græcorum Historia et Monumenta*. He became a cardinal Mar. 16, 1863; librarian of the Vatican in 1869, and cardinal-bishop of Frascati 1879. D. Feb. 3, 1889.

Pit River Indians: See Palaihnihan Indians.

Pitt, William: See Chatham, Earl of.

Pitt, William, generally called the Younger Pitt: statesman; second son of the Earl of Chatham; b. at Hayes, near Bromley, Kent, England, May 28, 1759; being of delicate constitution, he was educated by private tutor until he entered the University of Cambridge, in 1773; was called to the bar in 1780. He was elected M. P. for the pocket borough of Appleby in Jan., 1781, and allied himself to the opposition party under the leadership of Shelburne, and by brilliant speech at once won a position as a leader. Although he opposed the ministry on many occasions and denounced the war with the American colonies, he did not unreservedly ally himself to the opposition. He refused office under the Whig ministry of Rockingham, and at this time began the only partially successful advocacy of parliamentary reform which marked his political career. On the death of Rockingham he was given the great place of Chancellor of the Exchequer by Shelburne, who was made First Lord of the Treasury, in July, 1782. In 1783 Pitt resigned office with Shelburne, who was driven from power by the coalition of North (who had been leader of the Tories) with Rockingham and Fox, who had been Whig leaders. In the next session a cabinet was formed by North and Fox, who were made Secretaries of State with ostensibly equal power, and peace was made with the American colonies on terms practically the same as those of the treaty the negotiation of which had contributed to the downfall of the Shelburne ministry; but Fox's bill for transferring the government of India from the East Indian Company to seven commissioners was defeated, and the coalition cabinet compelled to retire. Pitt, in Dec., 1783, was called upon to form a new cabinet, be-

ALLEGHENY.

Churches.

1. North Ave. M. E. Church, B 3
2. Christ Chapel, B 3
3. Fourth Pres. Church, B 3
4. First Pres. Church, B 3
5. Presby. Church, B 3

Public Buildings, &c.

6. City Hall, B 3
7. Carnegie Library, B 3
8. Market, B 3
11. Soldiers Monument, B 3

Railroad Stations.

9. P. Ft. W. & Chi. R. R., B 3
10. West Penn. R. R., C 3
12. P & W. R. R., C 3

PITTSBURG.

Churches.

9. Fourth Ave. Baptist Church, C 4
13. Cathedral, C 4
19. Trinity Church, C 4
20. First Presby. Church, C 4

Railroad Stations.

2. Balt. & Ohio R. R., C 4
24. Union Station, C 3
25. P. & L. E. R. R., C 4

Banks and Business Buildings.

5. Marine National Bank, C 4
8. St. Nicholas Building, C 4
10. Bakewell Law " C 4
11. Kuhne " " C 4
14. Carnegie Building, C 4
15. Anchor Savings Bank, C 4
21. Second National Bank, C 4
22. Diamond National Bank, C 4

Theatres, &c.

17. Grand Opera House, C 4
18. Masonic Hall, C 4

Public Buildings.

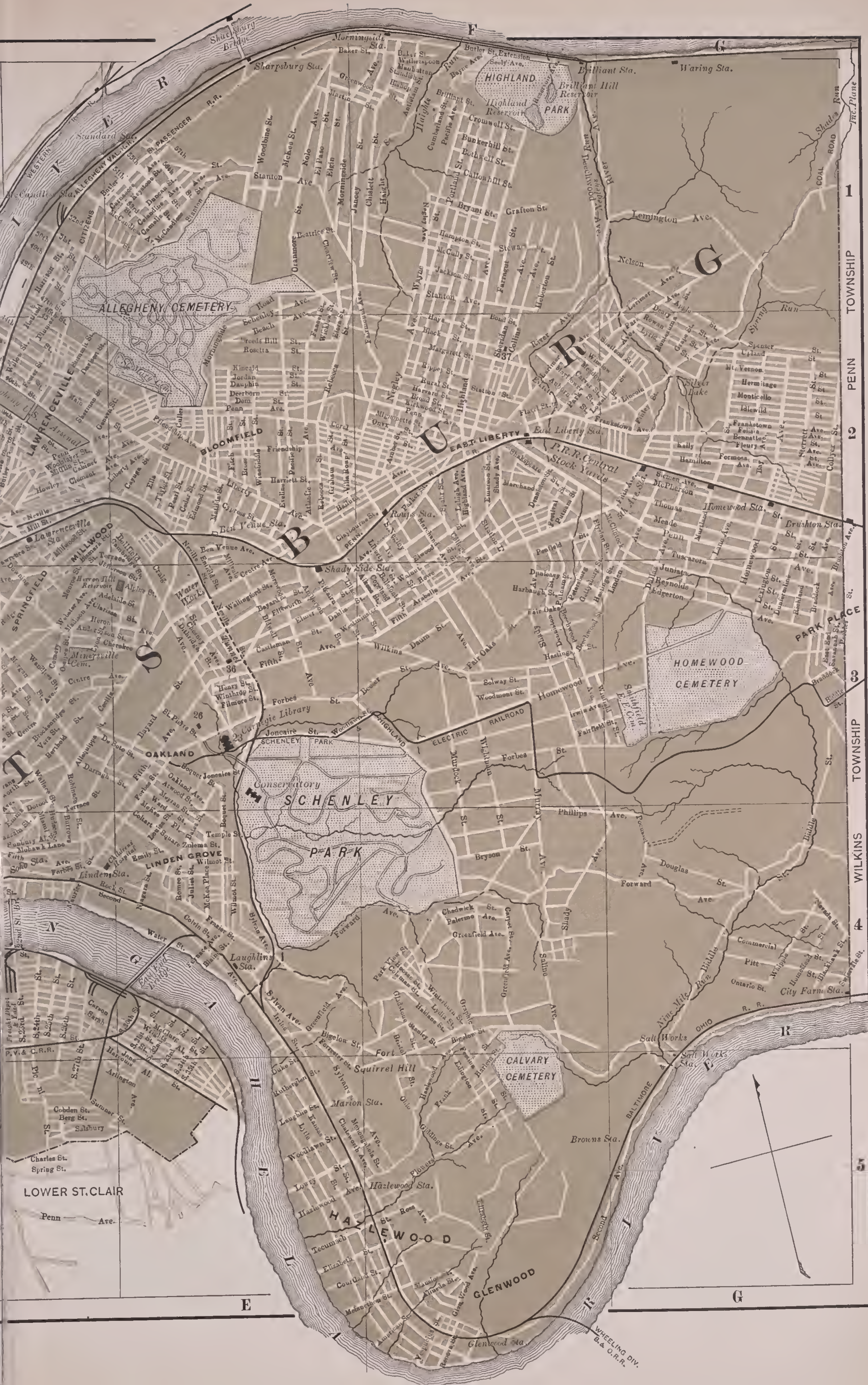
3. Homœopathic Hospital, C 4
4. Custom House and Post Off., B
12. Court House, C 4
16. City Hall, C 4
23. Carnegie Library, E 3

Hotels.

1. Monongahela House, C 4
6. Central Hotel, C 4
7. St. Charles Hotel, C 4

PITTSBURG AND ALLEGHENY

SCALE
0 ¼ ½ ¾ 1 Mile



PITTSBURG
ALLEGHENY CEMETERY
HIGHLAND PARK
Highland Reservoir
Brilliant Hill Reservoir
Brilliant Sta.
Waring Sta.
Sharpsburg Sta.
Sharpsburg Bridge
Morningside Sta.
McCandless Sta.
Standard Sta.
WESTERN
ALLEGHENY VAL. R.R.
PASSENGER R.R.
CITIZENS
LAWRENCEVILLE
U. S. Arsenal
Lawrenceville Sta.
MILLWOOD
SPRINGFIELD
BLOOMFIELD
Herron Hill Reservoir
Minersville Cem.
Water Works
EAST LIBERTY
East Liberty Sta.
P.R.R. Central Stock Yards
Homewood Sta.
Brushton Sta.
Ben Venue Sta.
Roups Sta.
Shady Side Sta.
PENN.
OAKLAND
Carnegie Library
Conservatory
SCHENLEY PARK
HIGHLAND & ELECTRIC RAILROAD
HOMEWOOD CEMETERY
Smithfield E. E. Cem.
PARK PLACE
LINDEN GROVE
Children's Hospital
Linden Sta.
Soho Sta.
Laughlins Sta.
East End Bridge
P.V. & C.R.R.
Freight Depot & Yard
LOWER ST. CLAIR
Squirrel Hill
Marion Sta.
Hazlewood Sta.
HAZLEWOOD
GLENWOOD
Glenwood Sta.
CALVARY CEMETERY
Salt Works
Salt Works Sta.
Browns Sta.
City Farm Sta.
Nine Mile Run
BALTIMORE & OHIO R.R.
WHEELING DIV. B.& O.R.R.
MONONGAHELA RIVER
ALLEGHENY RIVER
Negleys Run
Spring Run
Shades Run
Inc. Plane
COAL ROAD
Silver Lake
PENN TOWNSHIP
WILKINS TOWNSHIP
E
F
G
1
2
3
4
5

ing made First Lord of the Treasury and Chancellor of the Exchequer, and Henry Dundas (*q. v.*) became his chief counselor and adviser. Although Pitt had a good majority in the House of Lords, in the Commons he was opposed by practically all the great parliamentary debaters of his day, including Fox, Burke, North, and Sheridan. Although met with repeated adverse votes in the Commons he refused to resign or dissolve Parliament until, in 1784, he had succeeded in obtaining a majority, and then dissolved Parliament. At the general election he obtained a large majority and was established in the position of leader of the ministry, which he maintained for fourteen years. His administration was marked by parliamentary reforms, the establishment of the right of Parliament to provide for the exercise of supreme power during the incapacity of the king, the putting down of direct parliamentary corruption, and the abolition of many sinecures; reform in the system of collecting revenues and making loans, the reorganization of the Indian government upon the basis which continued until the abolition of the East Indian Company in 1858, the revision of the system of trade duties, and the making of an enlightened commercial treaty with France. He remained strictly neutral with regard to the opposing parties in the French Revolution, but in response to the pressure of public opinion he declared a war against the French Jacobins, which was weakly and unskillfully conducted, and marked by many disasters. His lack of success in this war, and the severity of his suppressive measures for putting down Jacobinism at home, weakened his position, and in Mar., 1801, on the failure to carry out his plan for uniting England and Ireland and removing the disabilities of the Roman Catholics, he resigned office. A new ministry was formed which concluded the Peace of Amiens in May, 1801, but in 1804 the ministry was defeated and Pitt was recalled. He formed a new ministry, made up, with the exception of Henry Dundas, of men of inferior talents, the king refusing to allow Fox to be summoned and Fox's friends refusing to accept positions without him. In 1805 he was driven from office and, embittered by England's reverses, he died at Putney, Jan. 23, 1806. F. Sturges Allen.

Pitta: a generic name, adopted as a common name for any bird of the family Pittidæ (*q. v.*).

Pit'tacus (in Gr. Πίττακος): one of the Seven Wise Men of Greece; b. at Mytilene in Lesbos 652 B. C.; as a leader of the democratic party participated very actively in all the feuds and embroilments of his native city, and in 589 B. C. was chosen *æsymnetes* (ruler with absolute power), which office he filled to 579 B. C. D. 569 B. C. Of his acts as a ruler nothing is known; of his elegiac poems Diogenes Laertius has preserved a few lines. Revised by J. R. S. Sterrett.

Pit'tidæ [Mod. Lat., named from *Pit'ta*, the typical genus, from Gr. πίττα, pitch]: a family of passerine birds popularly known under the name ant-thrushes. They are larger than the thrush, with a large head, plump body, short, even tail, and, for a passerine bird, remarkably long legs. They are strikingly or showily colored with black, white, red, and peculiar metallic blues. They are inhabitants of India and the contiguous regions, as well as Western Africa, Australia, and Madagascar, where alone the species of *Philopitta* are found. The family embraces only two genera—i. e. *Pitta* and *Philopitta*. F. A. Lucas.

Pitt-Lewis, George: See the Appendix.

Pittos'porum Family: the *Pittosporaceæ*; dicotyledonous shrubs and trees, with alternate leaves; flowers perfect, dichlamydeous; sepals and petals five each, free or coherent; stamens five, free; superior ovary, mostly bicarpellary, one-celled, many-ovuled. About ninety species are known, all natives of the region S. of the equator (exclusive of South America). The largest genus. *Pittosporum*, is represented by many shrubby species grown in conservatories, notably *P. tobira*, *P. viridiflorum*, *P. eugenioides*, etc. Species of *Sollya*, *Billardiera*, and *Marianthus*, all natives of Australia, are grown in conservatories. C. E. B.

Pittsburg: city; Crawford co., Kan.; on the Atch., Top. and S. Fé, the Kan. City, Ft. Scott and Mem., the Kan. City, Pitts. and Gulf, the Mo. Pac., and the St. L. and San Fran. railways; 10 miles S. E. of Girard, the county-seat (for location, see map of Kansas, ref. 7–K). It is in a coal-mining region, and contains zinc-works, a public high school, 3 national banks with combined capital of $250,000, a State bank with capital of $10,000, and 2 daily and 5 weekly newspapers. Pop. (1880) 624; (1890) 6,697; (1900) 10,112.

Pittsburg, or **Pittsburgh** (*Pittsburg* is the spelling adopted by the U. S. postal authorities; *Pittsburgh* is that of the municipal authorities): city; capital of Allegheny co., Pa.; at the confluence of the Allegheny and Monongahela rivers, which here form the Ohio river; on eight main and several branch lines of railway; 148 miles S. of Erie, 354 miles W. by N. of Philadelphia (for location, see map of Pennsylvania, ref. 5–A). It is 698 feet above tide-level at Philadelphia, is picturesque in its location and surroundings, has a length of 8 miles and an extreme width of 5 miles, and has an area of 28⅔ sq. miles. It is the second city in the State in population, manufactures, and wealth. The town originally occupied a very limited plateau between the Allegheny and Monongahela rivers, and was closely environed by lofty hills. As the city enlarged its borders these hills were at first either cut down or greatly reduced, but afterward they were left undisturbed as to size, and the city now spreads for miles over the hilltops, Herron Hill, 535 feet above the city datum line, being the highest, and Highland Avenue, 372 feet, being one of the most beautifully improved portions of the city. There are 450 miles of streets, of which 243 miles are paved and 275 miles sewered, and they are lighted by 2,570 arc-lights of 200-candle power, and by 3,150 gasoline lamps. The city is connected with Allegheny and other suburbs by seventeen bridges, twelve for general traffic and five for railways. The principal lines of railways centering in Pittsburg are the Pennsylvania system, the Baltimore and Ohio, and the Vanderbilt system. The Allegheny, Monongahela, and Ohio rivers form a waterway for an enormous freight and passenger traffic, extending 100 miles N. by the Allegheny, 100 miles S. into West Virginia by the Monongahela, and by way of the Ohio river S. to the Gulf of Mexico, W. to the foot of the Rocky Mountains, and N. to the Canadian border. During 1899 the river tonnage of freight originating in Pittsburg was 5,863,120 tons; railway tonnage, 49,475,211 tons—a total of 55,338,331 tons, which was larger than that of any other city in the U. S., and was claimed to be the largest in the world. Navigation on the three rivers has been greatly facilitated by the construction of dams principally on the movable plan. The greatest achievement in the way of river improvement is the Davis island dam, 5 miles below the city, on the Ohio river; this is the first of a series of movable dams for the permanent improvement of the river. The lock is 600 feet long and 110 feet wide: length of dam and width of lock, 1,333 feet. The dam creates a lake or pool of navigable water 8 miles long, throwing around Pittsburg a fine harbor unaffected by drought or low water in the rivers. Over seven years were spent in its construction. During periods of high water no dam or obstruction of any kind appears in the river, but as soon as the water begins to recede the wickets are raised and a uniform depth of water is preserved. The cost was about $1,000,000.

Pittsburg is the center of the greatest natural-gas field in the U. S. It is estimated that $40,000,000 are invested in the production and distribution of this smokeless fuel for domestic purposes and light manufacturing. The Pittsburg companies own 2,500 miles of pipe line, 1,200 wells, supply 500 mills and factories and 40,000 families. The daily consumption amounts to 110,000,000 cubic feet. The city is also the center of the petroleum-producing territory. In 1897 the total production in the Pittsburg district was 34,548,000 barrels, valued at $48,367,000.

The bituminous coal-field by which Pittsburg is surrounded is estimated at 14,000 sq. miles in extent; 140 mines are operated, all owned by two Pittsburg firms, employing 20,000 persons, whose wages reach about $8,500,000 per annum. The production in 1899 was 24,935,593 tons. The output of coke in the Pittsburg region in 1899 from 19,689 ovens aggregated 10,129,764 tons; value, $20,260,000. The region contains a total area of 87,776 acres, 11,219 of which have been mined and 683 reserved for buildings. All the plants are owned and operated by Pittsburg firms, and the output was 65 per cent. of all coke made in the U. S.

Pittsburg produced in 1898 one-third of the entire amount of iron and steel manufactured in the U. S. The 30 blast furnaces and 60 rolling-mills in the territory produced 3,022,901 tons of pig-iron, 52,352 tons of crucible steel ingots, 3,380,437 tons of all other kinds of steel, 2,091,503 tons of rails, bars, bolts, rods, shapes, and skelp-iron, and 444,850 tons of sheets and plates. More than half of the Bessemer steel, rolled iron and steel, rails, and plates and sheets made in the U. S. is manufactured here, making a total product of steel and iron of 8,992,043 tons. The Car-

negie Company (now of the United States Steel Corporation), owns many mills at Pittsburg, including the famous Homestead armor-plate mill, employs 30,000 workmen, and has an annual capacity of 3,250,000 gross tons of steel. The Westinghouse companies, which manufacture air-brakes, railway signals and electric machinery of all kinds, have a capitalization of $35,000,000, employ 9,000 workmen, and have an annual output valued at $30,000,000. Pittsburg is the leading plate-glass center of the world, having within a radius of 40 miles seven immense factories, with a yearly capacity of 24,500,000 sq. feet. These factories represent a direct investment of more than $12,000,000, and give employment to 5,000 people, and indirectly to many more in the immediate vicinity. Twenty-three firms are engaged in the manufacture of flint and lime glass. The annual production of tableware alone is about 63,000 tons; of bottles upward of 60,000,000; of lamp-chimneys upward of 40,000,000. The product of window glass in 1899 was 2,573,800 boxes, equal to 128,690,000 feet, or about 40 per cent. of the total product of the U. S.

Within or on the borders of the city are large mills for the manufacture of railway locomotives, stationary engines, steel bridges, steel tubing, and coal-drilling machinery. Other industries include the manufacture of artistic brass goods, fire-brick, salt, stoves, building-brick, chemicals, white lead, paper, corks, and pickles. There are 23 large wholesale grocery houses in the city whose operations exceed $25,000,000 a year; 6 houses engaged in the dry-goods and carpet trade whose yearly sales approximate $15,000,000; and 4 clothing houses whose annual sales exceed $4,600,000.

Conspicuous among the public buildings of the city are the county buildings, cost $2,500,000; Carnegie Library, at the entrance to Schenley Park, cost $1,100,000; U. S. custom-house and post-office, cost $1,500,000. In 1900 Andrew Carnegie pledged the erection and endowment of a great technical school. It is expected that $25,000,000 will be devoted by Mr. Carnegie to this institution. The fine main building of the Exposition Society was burned on March 17, 1901, but will soon be rebuilt. The city contains 258 churches, of which 197 are Protestant, 58 are Roman Catholic, and 3 Jewish. In 1900 there were 81 public-school buildings, which cost $3,500,000, including a new high-school building, which cost $250,000; 46,000 pupils, and 965 teachers. The high-school building is used exclusively for normal and commercial classes. Among the charitable institutions are seven hospitals: the Western Pennsylvania, the Homœopathic, the Mercy, the Pittsburg Infirmary, the Home for Incurables, and St. Francis's and St. Mary's hospitals. There are ten public parks: Schenley, the gift of Mrs. Schenley, of England, formerly of Pittsburg, a tract of 422 acres endowed by nature with rare beauty; Highland, a tract of 366 acres, which connects the East End with the Highland reservoir; and eight minor parks aggregating 122 acres. The city has recently constructed 2 boulevards, Grant, 3 miles long, and Beechwood, 7 miles long, extending from the business part of the city through Schenley Park to Highland Park, at a cost of $995,000. The city in January, 1901, contained 32 national banks with a combined capital and surplus of $27,850,000, 24 State banks with capital and surplus of $8,650,000, and seven trust companies with capital and surplus of $5,415,000. The exchanges of the Pittsburg clearing house during 1899 aggregated $1,528,478,652. There were 50 newspapers, of which 10 were dailies.

The territory occupied by the city of Pittsburg and Allegheny County was originally claimed by the French, on the grounds of discovery and explorations by La Salle in 1669. Traders and Indians followed soon after and made a lodgment in what promised to be a valuable acquisition of territory. The French resolved to expel the traders, and sent Capt. Celeron de Bienville with a company of soldiers and Indians in 1749 to take military possession of the land, claimed as far east as the Allegheny Mountains. In April, 1754, a company of militia arrived, under orders from Gov. Dinwiddie of Virginia, to establish a fort at the junction of the Allegheny and Monongahela rivers. While the erection of this work was in progress the French, led by Capt. Contrecœur with a large force of soldiers and Indians, fell upon the little band under command of Ensign Ward and compelled it to surrender. This was the beginning of the French war. The expulsion of the traders was followed by the erection of Fort Duquesne, named in honor of the governor of Canada. The English Government determined to regain the territory, and to this end sent Gen. Braddock with a large force of English and Virginian troops to drive out the French. The expedition met with a disastrous defeat in the famous battle of Braddock's Fields, July 9, 1755, at the hands of the French and Indians. Fort Duquesne was abandoned and burned Nov. 24, 1758. Gen. Forbes at once took possession, rebuilt the fort, and named it Fort Pitt in honor of the great English statesman. Pop. (1880) 156,389; (1890) 238,617; (1900) 321,616.

Revised by E. W. Hassler.

Pittsburg Landing: See Shiloh.

Pittsfield: city (site granted to Boston in 1735, known as Boston Plantation till its incorporation as a village under its present name in 1761, chartered as a city in 1890); county-seat of Berkshire co., Mass. (for location, see map of Massachusetts, ref. 2–C); between two branches of the Housatonic river; on the Boston and Albany, and the Berkshire division of the N. Y., N. H. and Hart. railways; 50 miles E. S. E. of Albany, N. Y., 53 miles W. N. W. of Springfield. It is on a plateau nearly 1,200 feet above sea-level, in a beautiful valley between the Hoosac Mountains on the E. and the Taconic Mountains on the W., through which flow the Hoosac and Housatonic rivers, and is partly surrounded by hills some 600 feet higher than the plateau. There are several lakes which discharge into the Housatonic river, from one of which, Ashley, is derived the supply of water for domestic purposes. The lakes and branches of the river afford fine power for manufacturing. The city has gas and electric light plants, 3 public parks, county court-house of white marble that cost nearly $400,000, Athenæum building that cost $100,000 and contains an art gallery, a museum, and a free library; Hospital of the House of Mercy, Old Woman's Home, Training-school for Nurses, 3 national banks with combined capital of $825,000, 2 savings-banks with deposits of $3,212,619; and 2 daily and 5 weekly periodicals. There are 11 churches, 24 public-school buildings, public-school property valued at over $215,000, and 15 cotton and woolen mills, 3 shoe factories, 2 machine-shops, a paper-mill, and other industrial works. The Berkshire Agricultural Society (1810) has large exhibition-grounds. Pop. (1880) 13,364; (1890) 17,281; (1900) 21,766. Editor of "Journal."

Pittston: city; Luzerne co., Pa.; on the Susquehanna river, near the mouth of the Lackawanna, and the Del., Lack. and West., the Del. and Hudson, the Lehigh Valley, the Cent. of N. J., the Erie and Wyo. Valley, and the Wilkesbarre and East. railways; 8 miles N. E. of Wilkesbarre, the county-seat, and 10 miles S. E. of Scranton (for location, see map of Pennsylvania, ref. 3–H). It is the geographical center of the Wyoming anthracite coal-field. The city is 1½ miles long, with an average width of half a mile. It is connected by a belt-line electric railway, running on both sides of the Susquehanna, with Wilkesbarre, Nanticoke, and Plymouth, and by four bridges across the river with the boroughs of West Pittston and Exeter, and, including the boroughs of West Pittston, Exeter, and Hughestown, and other contiguous territory, is the trade, postal, telegraph, and express center of a region which contains a population of more than 30,000 within a radius of 2 miles. Pittston is lighted by gas and electricity, and has a well-equipped volunteer fire department. There are English, German, Slavonian and Polish Roman Catholic, English and Welsh Baptist, Presbyterian, Methodist Episcopal, Methodist Protestant, Protestant Episcopal, Congregational, and Lutheran churches, a high school, 5 other public-schools, public-school property valued at over $80,000, a hospital erected in 1893, a national bank (First) with capital of $250,000, 2 savings-banks (Miners' and People's) with capital of $60,000 and $75,000 respectively, and a daily, a weekly, and a monthly periodical. Manufacturing is promoted by cheap fuel, superior railway facilities, and natural advantages. The establishments include 3 machine-shops, 3 planing-mills, 3 breweries, 2 knitting-mills, 2 pork-packing houses, stove-works, ladies' underwear factory, steam flour-mills, paper-mill, terra-cotta works, steel-range works, pressed-brick works, and dye-works. In 1894 the city had an assessed valuation of $750,000 and a debt of $32,000, and was about to increase the debt to the constitutional limit to aid local improvements. Pittston was named after William Pitt; was formerly a part of Pittston township, which was laid out in 1768; was settled about 1770; became a post-office station under the name of Pittston Ferry in 1811; was incorporated as a borough in 1853, and as a city of the third class in 1894. Pop. (1880) 7,472; (1890) 10,302; (1900) 12,556.—West Pittston, on the opposite side of the river, is largely a village of homes; has 5 Protestant churches and high school; in 1894 had an assessed valuation of $581,774, public-school

property valued at $63,000, and a debt of $16.000, about to be increased to constitutional limit for local improvements. The Luzerne County fair-grounds are immediately S. of the borough line. Pop. (1880) 2,544; (1890) 3,906; (1900) 5,846.

THEO. HART, EDITOR OF "EVENING GAZETTE."

Pitu'itary Body: See HYPOPHYSIS.

Piu'ra: a maritime department in the extreme northwestern part of Peru, bordering on Ecuador. Area, 27,201 sq. miles. The western or coast region consists mainly of deserts, which, however, afford a scanty pasturage at certain seasons; they are varied by rocky hills and headlands, and are divided by the fertile valley of the river Chira. The eastern part lies in the Cordillera, which here is of no great height, and is interspersed with valleys of tropical luxuriance. Grazing and cotton-growing are the principal rural industries; coal-beds exist; silver and to some extent gold are mined; a rich petroleum basin has been discovered, and several borings have been made. Pop., by census of 1876, 155,502; in 1894, nearly 200,000. Piura, the capital and largest town (pop. 1889, 8,000), lies on the river Piura in a fertile valley (see map of South America, ref. 4–B). It is connected by rail with its port of Paita. H. H. S.

Pi'us [Lat., liter., pious, religious, dutiful]: the name of nine popes. PIUS I., about the middle of the second century, of whom very little is accurately known.—PIUS II. (*Æneas Sylvio Piccolimini*), 1457–64; a native of Siena; humanist; secretary to the Council of Basel, friend and counselor of Frederick III.; brought about the Concordats "of the princes" (1446) and of Aschaffenburg (1448); made Bishop of Trent and afterward of Siena; proclaimed cardinal (1456) by Calixtus III., and succeeded the latter as pope (1457). The great object of his pontificate was a crusade against the Turks, but it proved abortive. As pope he rejected several principles and utterances of his earlier life, and labored hard to restore the Roman see to its ancient glory. As a writer he is known by his letters, his *History of Frederick III.*, his *Description of Germany*, and *Commentaries* on events of his own time.—PIUS III. (1503), a nephew of Pius II., reigned only twenty-six days.—PIUS IV. (*Giovanni Angelo de' Medici*), 1559–65; reopened the sessions of the Council of Trent, issued the profession of faith actually taken by all who hold any ecclesiastical office, either in the pastoral care or in seminaries and universities; conceded, by request of civil authorities, communion under both species to the laity of the German states; this was afterward withdrawn.—PIUS V. (*Michele Ghislieri*), 1566–72; published (1566) the *Roman Catechism*, and later on corrected editions of the Breviary and Missal; was very active against the spread of Protestantism; excommunicated Queen Elizabeth; and contributed much to the victory of Lepanto (1571). He died in the odor of sanctity, and was canonized by Clement XI. (1712).—PIUS VI. (*Giovanni Angelo de' Braschi*), 1775–99; improved the administration of the papal state; dried the Pontine marshes; built the Museo Clementino-Pio; visited Vienna 1782; condemned (1794) eighty-five propositions of the Synod of Pistoja (1786) as contrary to Catholic faith and discipline; rejected the principles and acts of the Congress of Ems in his *Reply to the Metropolituns* of Mayence, Treves, Cologne, and Salzburg, on the Apostolic Nunciatures (1789); refused to sanction the civil constitution of the French clergy; lost Avignon and the Venaissin to France (1790), and (1796–97) the northern part of the papal state to the new Cisalpine Republic, with a heavy indemnity in money, manuscripts, and art-works; signed the Treaty of Tolentino (1797), by which the dismemberment of his state was confirmed; and was carried off to France in Feb., 1798, by Gen. Berthier. He died, aged eighty-one, at Valence, Aug. 29, 1799, after suffering much cruelty and persecution from Napoleon.—PIUS VII. (*Gregorio Barnaba Chiaramonti*), 1800–23; a relative of Pius VI.; elected at Venice; signed the concordat of 1801 with Napoleon, by which the French Church was divided anew into ten metropolitan and fifty suffragan sees; the resignation of the actual bishops requested; the presentations of the new ones accorded to Napoleon; the Roman Catholic religion acknowledged as that of the state; and the salaries of the clergy paid by the latter, as a reparation for the confiscated estates. This concordat underwent various modifications. In 1821 a division into eighty dioceses was adopted, which has been further modified, until now there are in France eighty-four sees. The Roman Church has never recognized the Organic Articles which Napoleon added to the original concordat for political purposes. Pius visited Paris for the coronation of Napoleon (Dec. 2, 1804); refused to declare null the marriage of the emperor's brother, Jerome, with Miss Patterson; was seized by Napoleon's orders July 6, 1809, and imprisoned at Savona, while his cardinals were summoned to Paris, and the papal state abolished (Feb. 7, 1810); confirmed unwillingly the decrees of the National Council (1811); was brought (1812) from Savona to Fontainebleau, in order to terrify him into submission to the emperor's will; signed a new concordat (Jan. 25, 1813), which sacrificed many important rights of the pope; soon regretted his step, and by the advice of the black cardinals, notably Pietro and Pacca, recalled it in a document wherein he declared he would rather die than persevere in his sinful act. He was set free by Napoleon after the battle of Leipzig (Jan. 23, 1814), and saw Napoleon resign his throne in the very castle of Fontainebleau; returned to Rome (May 24, 1814); had several provinces of the papal state restored to him by the Congress of Vienna (1815); fled to Genoa on occasion of the escape of Napoleon from Elba; signed concordats with several European nations, and restored the Jesuits 1814. (See Wiseman, *The Last Four Popes*, London, 1859).—PIUS VIII. (*Francesco Xaverio Castiglione*), 1829–30; denounced indifferentism, Bible societies, and Freemasonry; obtained the erection of an Armenian archbishopric at Constantinople, and condemned the slave-trade.—PIUS IX. (*Giovanni Maria Mastai-Ferretti*), 1846–78; began his pontificate by an amnesty and liberal reforms; fled from Rome on an outbreak of revolution (1848); restored by France (1850); deprived of the legations (1860) by Victor Emmanuel, in spite of the spirited defense of the papal zouaves; maintained his independence against Garibaldi (1867), but was entirely dispossessed of the temporal power (Sept. 20, 1870) by the army of Victor Emmanuel; refused to accept the "guarantees" of May 15, 1871, as implying an indirect recognition of the "accomplished facts"; confined himself thenceforth to the precincts of the Vatican. The pontificate of Pius IX. is notable for many acts of importance. He declared the Immaculate Conception of the Blessed Virgin Mary to be a dogma, or ancient belief of the Church (Dec. 8, 1854); published the *Syllabus of* (80) *Errors*, extracted from previous documents of his pontificate (1864); convoked the Vatican Council (1868), in which the papal infallibility was declared by the constitution *Pastor Æternus* (July 18, 1870); restored the hierarchy in England (1850) and Holland (1853); canonized the Japanese martyrs (1867) on the occasion of the eighteenth century of the martyrdom of SS. Peter and Paul; established national colleges at Rome; encouraged the missions, protected learning, and elevated many distinguished scholars to places of influence. As a man, he was remarkable for his gentle and humane character, his geniality and affability, which never deserted him. He died Feb. 7, 1878, aged eighty-six, after a reign of over thirty-one years, the only one that surpasses the traditional twenty-five of St. Peter. He is buried at San Lorenzo fuori le Mura. See O'Reilly, *Life of Pius IX.*; the *Acta Pii IX.*; Cardinal Manning, *History of the Vatican Council.*

JOHN J. KEANE.

Piute or **Paiute Indians**: See SHOSHONEAN INDIANS.

Pizar'ro, FRANCISCO: conqueror of Peru; b. at Truxillo, Estremadura, Spain, about 1471. He was the illegitimate son of a Spanish officer; received no regular education, but served with his father in Italy; and ultimately drifted to America, where he first appears at Darien as a soldier under Ojeda (1509); the latter left the colony in his charge during its period of greatest suffering. (See DARIEN.) He was connected with various raids against the Indians, was with Balboa in the discovery of the Pacific 1513, and about 1519 settled at Panama. Rumors of a rich country to the S. had reached the isthmus, and in 1522 Pizarro joined with Diego de Almagro and a priest named Luque in a scheme for its discovery and conquest by way of the Pacific coast. The first attempt, in 1524, failed. In a second they were aided financially by Gaspar de Espinosa; great sufferings were endured, but Pizarro overcame them by his dogged pertinacity, and in 1528 saw and visited Tumbez and other towns of the Peruvian coast, where he was well received. With certain proof of the riches of the country he hastened to Spain, where he was empowered to conquer and settle Peru (at his own expense), and was appointed its governor, Almagro receiving the title of marshal. Espinosa continued to aid the enterprise, and Pizarro was able to leave Panama in Jan., 1531, with three vessels and 185 men; Hernando de Soto joined him in the Gulf of Guayaquil with re-enforcements; Almagro and others followed too late to share in

the first plunder. Pizarro landed at Tumbez; at Caxamarca, Nov. 15, 1532, he met the Inca Atahualpa, who had just conquered his brother Huascar, and was going to receive the crown at Cuzco. Atahualpa, while on a peaceful visit to Pizarro, was treacherously seized and his unarmed escort was massacred. To obtain his liberty he promised to fill a room with gold, and he actually collected, through his officers, a sum equal to 4,605,670 ducats, equivalent to $17,500,000 of modern money. Though this was appropriated by Pizarro and his band, the Inca was basely killed on a false charge of conspiracy. Pizarro now marched to Cuzco; he met with some resistance from Atahualpa's generals, but at Cuzco the legitimate Inca, Manco, swore fealty to the sovereign of Spain, and was allowed to reign as a puppet monarch under surveillance. Pizarro received the title of marquis, and founded Lima (Jan., 1535) as his capital. Manco escaped in Apr., 1536, and headed an Indian uprising, which, for a time, threatened to drive the Spaniards from the country; but aid flocked in from the other colonies, and the Indians were subdued. Almagro had frequently quarreled with Pizarro, whom he accused of appropriating all the benefits of the conquest, though the enterprise had been a joint one. He was quieted for a time by being made governor of Chili, but in 1537 he returned disappointed from that country and seized Cuzco, claiming that it lay within his domain. War with Pizarro followed; Almagro was defeated at Las Salinas Apr. 26, 1528, and was soon after captured and executed. Pizarro allowed many of Almagro's followers to live at Lima, where they conspired and murdered him in his palace June 26, 1541. He was an ignorant and often brutal soldier, though with a natural genius for command, and no worse than other leaders of the time.

HERBERT H. SMITH.

Pizarro, GONZALO: half-brother (also illegitimate) of Francisco Pizarro; b. at Truxillo about 1506. He followed his brother in the conquest of Peru 1531–34; took part in the defense of Cuzco against Manco Inca 1536; was captured by Almagro, but escaped and led the infantry against him at Las Salinas; and subsequently conquered Charcas or Bolivia, where he received a grant of the rich mining region around Potosí, and acquired great wealth. In 1540 he was made governor of Quito; thence, in 1541, he led an unsuccessful expedition over the mountains to the forests of the Napo, where ORELLANA (*q. v.*) deserted him and became the first explorer of the Amazon. In 1544 the viceroy Nuñez Vela arrived to enforce the "new laws" against Indian slavery. Pizarro headed a rebellion against him, seized Lima Oct., 1544, drove the viceroy into New Granada, and ultimately defeated and killed him at the battle of Añaquito, near Quito, Jan. 18, 1546. Pizarro's officers took possession of Panama, and for a year he ruled Peru undisturbed. Pedro de la Gasca, sent from Spain to subdue the rebellion, gained possession of the Isthmus by politic means and landed in Peru. Pizarro retreated southward, and near Lake Titicaca defeated the royalist force of Centeno, Oct. 26, 1547. Elated with his success, he returned and met Gasca's army near Cuzco, but his forces deserted him without fighting, he surrendered, and was executed at Cuzco Apr. 12 (?), 1548. Other brothers of the Pizarro family were JUAN, who was killed during the defense of Cuzco, July, 1536; and HERNANDO (legitimate), who was prominent in the conquest and commanded the army against Almagro 1538; he returned to Spain, where he was imprisoned for many years.—PEDRO PIZARRO, a cousin of the conqueror and his page, wrote an account of the conquest which has been published in modern times.—FERNANDO PIZARRO Y ORELLANA, grandson of Hernando and great-grandson of the conqueror, published, in 1639, *Varones ilustres del Nuevo Mundo*, which includes lives of the Pizarros and other conquerors of the New World. Descendants of the family have been prominent in Spanish America and in Brazil.

HERBERT H. SMITH.

Placenta [from Lat. *placen'ta*, flat cake, from Gr. πλακοῦς, πλακοῦντος, flat cake, deriv. of πλάξ, πλακός, anything flat and broad]: a special organ developed in the higher mammals (hence *Mammalia placentalia*) for the nourishment of the embryo while it remains in the uterus. Referring the reader to the articles FŒTUS and EMBRYOLOGY, where the human placenta is described, for a description of the parts concerned, we may here mention some of the modifications of this organ in the different orders of mammals. The chorion of the embryo may be regarded as the central structure in the formation of the placenta. Upon its surface are developed numerous small branching outgrowths (villi), into which ramifications of the embryonic blood-vessels extend. These villi enter into more or less intimate connection with the mucous uterine walls of the mother, and through them nourishment is brought to the young. Accordingly as the villi are arranged the character of the placenta varies. Thus in the pig, horse, etc., they are evenly distributed over the surface of the chorion, giving rise to a diffuse placenta. In most other forms they are restricted to certain regions, and the rest of the chorion is smooth and contains but few blood-vessels. Among the ruminants (cow, sheep, deer) the villi are aggregated in patches (cotyledons) varying from 5 to 100 or more (cotyledonary placenta). In the carnivores the villi are arranged in a ring (zonary placenta), while in the primates, bats, insectivores, and rodents they take the shape of a disk (*placenta discoidea*). The degree of union between the villi and the maternal tissues varies considerably. In those forms with diffuse and cotyledonary placentæ the villi extend into corresponding pits in the uterine walls, but the union is not intimate, and a little pulling is sufficient to effect a separation. In these forms at birth the embryonic placenta becomes separated from the maternal portion, and the latter remains behind (*placenta non deciduata*). In the other types the union is more intimate, the parts so growing together that separation is no longer possible without injury to the uterine mucosa. In these forms (*placenta decidua*) a portion of the uterine mucous membrane is cast as a part of the after-birth. Among the edentates almost every type of placenta is said to occur.

The attempt has been made to use placental characters as an aid in classification, but not with perfect success. The literature is large. Prominent works are Turner's *Anatomy of the Placenta* (Edinburgh, 1876); Minot, *Uterus and Embryo, Journal of Morphology* (ii., 1889; contains bibliography); and papers by Hubrecht (*Quarterly Journal of Micros. Science*, 1889–94).

J. S. KINGSLEY.

Placenta'lia [deriv. of *placenta*]: a name given by Owen to those mammals provided with a placenta. It is equivalent to the Monodelphia of recent authors. See MAMMALS.

Placentia: See PIACENZA.

Plac'idus, LUCTATIUS: a grammarian of the fifth century; author of a valuable glossary of obsolete and difficult words largely drawn from Plautus. He also composed scholia to the poet Statius. The best editions of the *Glossæ* are by A. Deuerling (Leipzig, 1875) and G. Goetz in *Corpus Glossariorum Latinorum*, vol. v., pp. 1–158 (Leipzig, 1894). M. W.

Placoph'ora [Mod. Lat., from Gr. πλάξ, plate + φέρειν, bear, in allusion to the several plate-like shells]: the order of MOLLUSCA (*q. v.*) which contains the chitons.

Plague [from Lat. *pla'ga*, stroke, blow, deriv. of *plan'gere*, strike (cf. Gr. πληγή, blow, deriv. of πλήσσειν, strike]: a malignant and fatal contagious fever, also called *bubonic plague*, from the frequency of suppurating lymphatic glands, so-called *buboes*. It is now little known, but was formerly endemic in Egypt and the Levant, and spread in devastating epidemics throughout Europe. By its mortality it was an obstacle to the growth of countries and the advance of civilization. It was termed "the pest," the "black death," and the "great mortality." Its first appearance in Europe was at Constantinople in A. D. 544. Since that time epidemics have occurred at variable intervals; there were forty-five in the seventeenth century. The Great Plague of London was in 1665, and was supposed to have been brought from Holland. It is estimated that in Europe 25,000,000 have died of plague. The disease has prevailed in brief and local epidemics during the eighteenth and first half of the nineteenth centuries—at Copenhagen in 1712, Marseilles 1720, Moscow 1771, Malta 1813, Silesia 1819, Bulgaria (in the Russian army) in 1828–29. Its last appearance in Egypt was in 1844. In 1857–58 it occurred among the Arabs of North Africa, in 1857 in Mesopotamia, and in 1871 in Persian Kurdistan. An epidemic in the provinces bordering the Volga in 1878 attracted considerable attention among scientific men. The plague is now regarded as a zymotic disease, dependent upon insalubrious and poisonous atmospheric or telluric conditions, a *materies morbi* gaining access to the blood, and rapidly multiplying in it and destroying its nutritive elements. In malignity and nature it resembles typhus fever. The propagation of the disease occurs by direct or indirect contagion. In Egypt the overflow of the Nile was considered its pestilential source. Overcrowding, bad ventilation, uncleanliness, deficient food, and

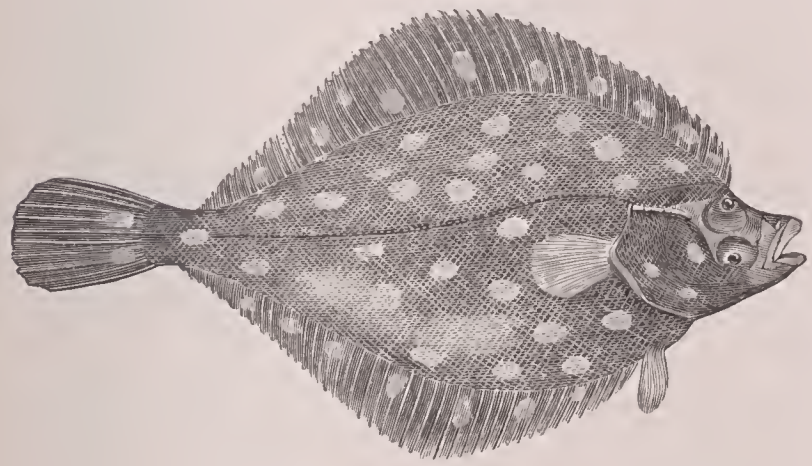
residence in damp, marshy soils have been considered the predisposing causes of local epidemics. After exposure there is a period of latency or incubation of from two to seven days. The disease has four stages, yet all may occur in rapid succession and brief time: (1) invasion, (2) fever, (3) local phlegmons, and (4) collapse or convalescence. It is preceded by lassitude and enfeeblement of mind and body; its definite onset is announced by shivering, headache, vertigo, vomiting, high fever-heat, great prostration, stupor or unconsciousness, blood in the urine or from the bowels, the appearance of buboes or suppurative enlargement of lymphatic glands, or of carbuncles; or, again, in fatal cases, of petechiæ or purple spots and mottling of the skin. Hæmorrhage into the lungs and from the lungs was a frequent symptom of the "black death" of the Middle Ages. Its duration is from two to ten days, and convalescence is slow. It is prevented by hygienic measures and public quarantine, but its treatment, beyond general measures of stimulation and nutritive support, avails little.

Revised by WILLIAM PEPPER.

Plagues of Egypt: a series of calamities, ten in number, which befel the Egyptians (Ex. vii. 14, ff.); due to the refusal of King Pharaoh to let the Israelites depart from his country. They have been explained upon a natural basis somewhat as follows. The red (blood) color of the Nile is alleged to have been witnessed in historic times, and is explained by the presence of infusoria from the swamps whose waters run into the Nile. During high Nile the frogs, the Egyptian symbol of "multitude," sought the higher ground and, dying when the water rapidly fell, were gathered into heaps, there to rot. The drying pools engendered multitudes of gnats and flies, whose part consisted in causing cutaneous irritation and in spreading the contagion of the murrain, which is regarded as anthrax, a disease due to the dead frogs. This disease principally attacks cattle, but may be communicated to men. Its outward manifestation would be in "boils," while inwardly it would prove fatal, particularly when re-enforced by the meat diet necessitated by the destruction of vegetable life after the plagues of the hail and locusts. Hail, thunder, and the east wind, the agents of other plagues, were usual phenomena except as to intensity. There are, nevertheless, other features of the plagues recorded in Exodus which are not capable of so easy an explanation, and even if the theory outlined above be granted there would remain the miracles of providence, if not of power.

CHARLES R. GILLETT.

Plaice: a flat-fish, *Pleuronectes platessa*, weighing from 6 to 12 lb. It feeds on mollusca, crustacea, and young fish,



The plaice.

and inhabits sandy banks and muddy grounds in the sea. It is highly esteemed for food, and is common on the European coasts. See PLEURONECTIDÆ.

Plain: a broad expanse of level or nearly level land. Plains are here considered with respect to the origin of their strata; to their altitude, whereby they are associated with plateaus; to the degree of development of valleys across their surface; and to their distribution, climate, fertility, and resources.

Marine Plains.—The largest plains of the world consist of horizontal strata, deposited when the region was the bed of a lake or the floor of the shallow ocean margin. For example, the COASTAL PLAIN (*q. v.*) of the Eastern U. S. is a surface of small relief, formerly part of the continental shelf. (See OCEAN.) When the land stood lower than now, it received sediments borne down by rivers or worn by waves; at present it is revealed in consequence of an even uplift, although a considerable extent of the shelf still remains under the sea. Its marine origin is indicated not only by its bedded structure, but also by its numerous fossils. Close study of this region demonstrates that it is geologically in a debatable state, oscillating up and down in the course of geological periods; at present exposing less surface as land than in a recently past period (see COAST), but more than in a still earlier period. The great plains of the U. S. are of a more complex history. Their sediments, as indicated by fossils, are in part marine, in part lacustrine. It is evident from their present slight incline that the region must have been uplifted and inclined since the strata were deposited.

Lacustrine Plains.—The plain of Hungary may be taken as the type of a lacustrine plain; its basin is inclosed by the Carpathian Mountains on the E., and the Danube has now cut a deep outlet-valley through them; but at an earlier time, before the outlet was cut so deep, a lake existed behind the mountains, and the present plain is composed chiefly of sediments brought into the lake from the inclosing slopes. The plain of the middle Rhine, between the Vosges and the Black Forest Mountains, and the Vale of Kashmir in Northwest India have a similar history; all these examples being more or less strewn over by river flood-plain deposits since their lakes disappeared. Plains, partly of lacustrine origin, partly of surface stream-wash, are well exhibited in the interior basins of Utah and Nevada (see BONNEVILLE LAKE and LAHONTAN LAKE), as well as in other basins of interior drainage, such as the inner plateau of Mexico, and presumably the great central depression of Asia. Basins of this kind are formed by the uneven uplift of mountain ranges and plateaus around their borders, while other ranges diversify their interior. The waste from the crests and shoulders of the mountains accumulates in the intermediate hollows, burying the mountains even up to their waists, and producing broad even plains. The process of degrading the mountains and filling the depressions proceeds in the dry climate of to-day, when streams spread out detritus as they wither after leaving the mountains, as well as in the former more humid climate of the region, when the wash from the mountains ran into lakes; but the most extensive plains of Utah and Nevada are old lake-bottoms revealed by desiccation, and not yet covered by the stream-wash of a dry climate. Sometimes the disappearance of former lakes leaves a broad central depression covered with a level sheet of salt, such as are known in Tibet, in Persia, and in the intermontane depression to which the southward discharge of Lake Titicaca flows in Bolivia. Broad saliferous marshes of this kind occur on the Argentine pampas, there called *salinas*. In regions of extreme dryness even the wind-borne dust from the uplands aids in filling up the depressions. Much importance has been attributed to this process in forming extended plains in inner China, their fine soil being generally given the German name *loess*. Peculiar examples of lacustrine plains are found in those regions where the retreating ice-sheet of the glacial period obstructed the flow of rivers whose basins sloped against it. Smooth sheets of fine silt were deposited in the lakes thus formed; but with the further retreat of the ice, the lakes were discharged and the lake-bottom plains laid bare. Many of the northern prairies of the U. S. are of this origin. See PRAIRIE and AGASSIZ, LAKE.

Fluviatile Plains.—Large rivers build broad flood-plains (see FLOOD-PLAIN) in their valleys, and delta plains (see DELTA) at their mouths. The Mississippi gives an example of a flood-plain with delta front, well inclosed between bluffs of the slightly higher marine coastal plain. Here must be included also various extensive areas over which wandering rivers have spread out their detritus. The plain of the "valley" of California, the plain of the "valley" of the Po, the Indo-Gangetic plain of Northern India, and the plain of Eastern China are all of this character, having received their materials from adjacent mountains. Along the margin of the sea, in shallow bays and lagoons protected by bars from the outer waves, tidal marshes are built up to high-tide level. These plains attain a considerable area along the coast of the U. S.

Lava-plains; *Ice-plains.*—Extensive outflows of lava have occurred in various parts of the world, flooding the lower lands and thus forming broad plains of remarkably level surface. These are exceptionally well illustrated in the basin of the Shoshone river in Southern Idaho. The river has transsected the plain in its canyon, revealing the

bedded structure of the lavas. The vast plains of ice and snow that cover Greenland, and that presumably exist inland from the Antarctic ice-wall, as seen by Ross, should not be forgotten. Nansen's journey across Greenland demonstrates that the interior of that land is a vast desert plain of ice and snow. The Malaspina glacier at the foot of Mt. St. Elias, in Canada, may be regarded as a glacial delta plain, being supplied by valley glaciers from the mountains, and spreading out over a surface of 15 by 40 miles on the coastal lowland. (See GLACIERS.) During the glacial period, ice-plains like those of Greenland had great extension in Northeastern America and Northwestern Europe. It was during the presence of these creeping ice-sheets that many of the smooth plains of unstratified glacial drift (till) were spread out in Ohio and the adjacent northern central States; for while glacial action has ordinarily been looked on as chiefly destructive, it was chiefly constructive in these regions, where the ice-sheet was relatively thin, its motion reduced, and the quantity of loose material beneath it excessive. Its action in Ohio may therefore be contrasted with its more destructive action in Canada, much in the same way that the constructive action of a river in its delta may be contrasted with the destructive action of its head-waters. Many fertile prairies in the northern central States are till-plains.

Dissection of Plains.—River flood-plains, being built at a slope suitable to the grade of their rivers, do not suffer dissection, unless the volume of the river is altered or the slope of the land is changed by tilting. The latter seems to have been the case with those former flood-plains, remnants of which are now seen in upper terrace-plains of many of the northern valleys of the U. S.

Marine plains, when rising above sea-level, may acquire a greater or less altitude, the loftier areas being called plateaus. (See PLATEAU.) They are then dissected by their streams and thus diversified in the course of geological periods of time. Many examples can be collected in various stages of development. Plains may thus acquire so strong and varied a relief as to be popularly called rolling or hilly country. The littoral portion of the gently inclined coastal plain from New Jersey to Texas is very little dissected, and only by shallow valleys; it presents broad stretches of almost dead-level surface. Further inland, where the ascending plain is higher and has been out of the sea longer, it is more diversified, giving a pleasing variety of gentle hills and valleys. It is not infrequently the case that the former inland extension of a coastal plain has been stripped off from its foundation rocks, and that the edges of the more resistant strata of the plain thus take the form of inland-facing slopes or escarpments. The lowland on the inner side of the escarpment is then chiefly drained by longitudinal streams, which escape by occasional transverse valleys through the outer and higher part of the plain. The belt of elevated ground from Navesink S. W. across New Jersey to Delaware Bay is of this origin; railways and canal between New York and Philadelphia follow the inner longitudinal lowland. If the coastal plain consists of several alternating harder and softer strata of considerable thickness and gentle seaward inclination, several higher and lower belts roughly parallel to the coast-line may be developed by denudation; the inner slope of the higher belts being relatively steep, while the outer slope is gentle and even. The coastal plain of Alabama has several of these belts, of which the Chunnenugga ridge is the strongest; it descends by a tame escarpment to an inner lowland belt. In Texas, similar features are well shown; one of the most distinct of the inward ascending plains being the Grand Prairie, which falls off westward by a well-marked ragged inland-facing escarpment to the central denuded region of the State. The Cotswold and the Chiltern hills, drained by the upper Thames in England, belong here; they descend gently to the S. E. and more abruptly in ragged escarpments to the N. W. The Niagara upland of Western New York terminates in an escarpment facing the ancient crystalline area of Canada. (See NIAGARA FALLS.) Wisconsin possesses a well-marked example of this kind; its central denuded plain being inclosed on the S. and W. by dissected uplands rising from the plain in very ragged escarpments and numerous detached outliers.

Plains of Denudation.—When plains have long been above the sea, the widening valleys consume the uplands, decreasing the variety of form that was for a time developed, and ultimately producing a broad lowland of denudation. A great part of the SAHARA (*q. v.*) is well advanced toward this consummation, its broadly denuded surface having a variety of open lowlands, retreating escarpments, and isolated outliers; but it is a mistake to regard it as an even lowland, and only a very small marginal part of its area is below sea-level. The great plains in the western part of the U. S. have also reached an advanced stage of denudation, as their numerous isolated mesas and outliers testify.

At any stage in the reduction of uplifted plains to lowlands of denudation the region may again be elevated and enter a new cycle of dissection and denudation. Large areas in Central Missouri, Southern Ohio, and Northern Kentucky have this composite history, their even uplands of to-day being old lowlands of denudation. Portions of the Great Plains, as in Eastern Montana, are similarly uplifted lowlands of advanced denudation, occasionally surmounted by unconsumed mesas and outliers, and now trenched across by young valleys that belong to the new cycle of dissection; many bad-land areas are found along the borders of these valleys of the second generation. Northwestern France possesses a well-marked old plain of denudation, now raised to an upland and beautifully dissected by the valleys of its rejuvenated streams.

Plains of quite another kind occur in regions of disordered structure that were once mountainous, but which are now reduced to lowlands of faint relief by long continued denudation. These lowlands are never so even as those formed beneath seas or lakes; nor have they commonly an extended surface; they most commonly occur as gently rolling lowlands, associated with low ridges that are not yet subdued to the lowland level. The open lowlands of the great Appalachian valley and the more irregular lowlands that run among the Appalachian ridges are of this kind. Mention of related features will be found under PLATEAU.

The climatic conditions of plains are in many cases closely associated with their conditions of origin. For example, the ice-plains are deserts of cold; the plains of interior basins, once lacustrine, are now prevailingly arid and desert, peopled only where streams descend from the inclosing mountains and afford water for natural or artificial irrigation. Salt-plains, the residual deposits of certain evaporated lakes, are absolutely barren. On the other hand, the flood-plains of rivers are ordinarily fertile, being of fine soil and plentiful water-supply; they may be productive even when bordered by deserts, as in the famous case of the Nile and in many less-known examples, such as those which descend from the Andes through the deserts on the westward slope. Delta plains of large rivers are fertile; but those of smaller rivers descending from mountains close to the sea are often stony. Lava-plains are deserts until a soil is formed by weathering their surface; then they may be fertile, as in the lava plateau of Southern India. Marine plains are of such vast extent that they embrace all conditions of climate and fertility. They include the frozen ground of Siberia and Northern Canada; the arid steppes of Western Asia, yielding grass under their summer rains; the broad Sahara, whose varied surface is parched by the drying trade-winds, refreshed by winter rains on its northern border, by summer rains on its southern border. In the New World there are the luxuriant selvas of the Amazon, partly marine, partly fluviatile in origin, well watered by the equatorial rains; the llanos of Venezuela and the campos of inner Brazil, well watered and grassed under a vertical sun, but dry and dusty in the opposite season. The Argentine pampas are prevailingly too dry, being like the Great Plains of the U. S. in the rain-shadow of the Cordilleras. (See DESERTS and RAIN.) South America, narrowing in the temperate zone, has no analogue to the broad plains and uplands of the eastern part of the U. S.

Resources of Plains.—Lacustrine plains and river flood-plains usually have a fine soil, admirable for agriculture if the climate is favorable; but they have no mineral resources except clays and sand, or salt in the case of certain lacustrine plains. Young marine plains, however well adapted to agriculture, are, as a rule, poor in mineral products, although they sometimes have, in addition to sand and clay, valuable deposits of marl and phosphates, useful as fertilizers, and sometimes diatomaceous earth, useful in various arts. In the absence of good road metal, and by reason of the flatness and poor drainage of the surface, the roads of all these plains are prevailingly poor, being least bad on gravels and worst on clays. Older dissected plains, whose rocks were deposited long ago, and whose surface may have been through successive cycles of denudation, may be as rich agriculturally as the younger forms; as, for example, in the famous Blue Grass region of Central Kentucky; and they

possess in addition a moderate variety of useful minerals and plentiful good road metal. Coal and iron ores are found in the dissected uplands of the Ohio valley; ores of lead and zinc occur in the uplands of Missouri, Iowa, and Wisconsin. Building-stones, limestone, and clay, as well as road materials of high value, are here well distributed. Those lowland plains which are produced by the denudation of former mountains have a great variety of mineral products. The forest products vary greatly with the climate.

W. M. Davis.

Plainfield: city (incorporated as a city in 1869); Union co., N. J.; on Green Brook, and the Central Railroad of N. J.; 11 miles N. of New Brunswick, 24 miles W. S. W. of New York city (for location, see map of New Jersey, ref. 3–D). It is a beautiful residential place, with Netherwood Heights on the E. and ranges of the Blue Mountains on the W. The city and cluster of suburban villages are lighted with gas and electricity, and are laid out with broad straight streets tastefully ornamented with lawns, parks, and shade trees. Plainfield contains 14 churches, 5 public-school buildings, public-school property valued at over $180,000, a seminary for young ladies, an academy for boys, public library and art gallery, public-school, seminary, and Y. M. C. A. libraries, 2 music-halls, Muhlenberg Hospital, 2 national banks with combined capital of $350,000, a savings-bank, and 3 daily, 2 weekly, and three monthly periodicals. The principal industries are the manufacture of printing-presses, oil-cloth, carpets, and machine tools. Pop. (1880) 8,125; (1890) 11,267; (1900) 15,369.

Plain Song, or **Plain Chant** (Lat. *can'tus fir'mus*, Ital. *canto fermo*): in music, the simple, grave, and unadorned chant in which the services of the Catholic Church have been rendered from a very early age. It consists largely of monotone, and its inflections seldom exceed the range of an octave. The ecclesiastical chant is supposed to be chiefly of Greek origin, with some modifications brought in from Hebrew sources by the converts from Judaism in the first centuries. Prior to the time of St. Ambrose (fourth century) the music of the Church was in a rude and unsettled condition, but by his skill and energy it assumed the more regular form known as the Ambrosian chant. At a later period Gregory the Great introduced many improvements, corrected certain abuses, and gave to the ritual chant that more systematic form which has since borne his name. Plain song is usually written in black note on a stave of four lines, with either a C or an F clef. See Gregorian Music.

Revised by Dudley Buck.

Plains, The, or **The Great Plains**: one of the great physiographic districts of North America. Through the entire breadth of the U. S. from Texas to the northern boundary and thence for a distance half as great in the Dominion of Canada, a sloping plateau descends eastward from the eastern base of the Rocky Mountains. Its breadth is from 300 to 600 miles, and the eastward descent in that distance ranges from 2,000 to 5,000 feet. The plain appears to have been more nearly level until a late geologic period, being partly occupied by lakes in early Neocene time. It then received its inclination through the uplifting of its western edge at a time when the plateau carrying the Rocky Mountains was also raised. Its surface is diversified by a few mountain districts, such as the Black Hills and Sun Dance Hills, by numerous streams which cross it from W. to E. and have excavated valleys to a depth of several hundred feet below the general surface, and by other districts, such as the Bad Lands of Dakota, where the surface has been intricately sculptured by rains and minor streams; but in general the surface is undulatory and monotonous. The characteristic feature of the climate is aridity, the amount of rainfall ranging from ten or fifteen degrees at the west to twenty or twenty-five degrees at the east. In the western portions agriculture can not be practiced without artificial irrigation of the land, and at the east it is somewhat precarious, as severe suffering is caused by occasional droughts. In general the stream-beds are of such character that the control of their waters for purposes of irrigation is difficult, but near the mountains the conditions are more favorable and an increasing acreage is irrigated. This, however, must always constitute but a small fraction of the entire surface, and grazing is likely to remain the prevailing industry of the region. In general the plains are treeless except in the immediate vicinity of permanent streams, but there are a few forest tracts in the northern portion and elsewhere near the eastern margin. See Plain.

G. K. Gilbert.

Plaintiff [from Anglo-Fr. = O. Fr. *plaintif*, complaining, deriv. of *plainte*, complaint. Cf. Eng. *plaintive*]: one who makes plaint; that is, one who states in a common-law court his cause of action against another. In equity courts, the moving party in a suit is called the complainant; and in admiralty and ecclesiastical tribunals, the libelant. Sometimes the legal title to the claim sued upon is in one person, while another holds the equitable title thereto. The former is known as the legal plaintiff, while the latter is the equitable plaintiff. Under the common-law procedure a claim which had been assigned was suable only in the name of the assigner, who was called the nominal plaintiff, while the one who brought and enforced the action was the real plaintiff. Modern codes generally require actions to be brought in the names of the real parties in interest. Plaintiff in error designates the one who sues out a writ of error.

Francis M. Burdick.

Plaisted, Harris Merrill: See the Appendix.

Planché, plaň'shā', James Robinson: playwright, archæologist, and herald; b. in London, Feb. 27, 1796; became early distinguished as a writer of plays and librettos; gave great attention to archæology and costumes, on which subjects he wrote; aided in founding the British Archæological Association, and was long its honorary secretary and editor of its *Journal*; author of some 200 dramatic pieces; published in 1852 *The Pursuivant of Arms* (3d ed. 1874), a treatise on heraldic subjects, which procured him the appointment of Rouge Croix Pursuivant in 1854. In 1866 he was promoted to be Somerset Herald. He wrote books of travel, songs, etc. D. May 29, 1880.

Plancy, plaň'see', Jacques Albin Simon Collin, de, generally called **Collin de Plancy**: author; b. at Plancy, department of Aube, France, Jan. 28, 1793; went to Paris in 1812; built up a business as a printer, publisher, editor, and author, and wrote *Dictionnaire infernal*, *Dictionnaire féodal*, *Mémoires d'un Vilain au 14e Siècle*, *Taxe des Parties casuelles de la Boutique du Pape*, *Biographie pittoresque des Jésuites*, *Le Diable peint par lui-même*, etc.—all in an anti-religious, revolutionary, and frivolous manner. In 1830 he fled from Paris on account of pecuniary difficulties, and settled at Brussels, where he wrote *Fastes militaires de la Belgique*, *Histoire des premières Années du Règne de Léopold*, and other things—all very flattering to the national vanity of the Belgians. In 1837 he was able to return to Paris, and he went back thoroughly converted. He then wrote *Légendes de la Sainte Vierge*, *Légendes des Origines*, *Légendes du Juif-Errant*, *Chronique de Godefroy de Bouillon*, *Légendes des Sept Péchés capitaux*, *Légendes des Esprits et des Démons qui circulent autour de nous*, *Le Chansonnier du Chrétien*, etc. The method which he generally applied in making a new book consisted in cutting up two old ones and rearranging their contents. The new book was then generally provided with a new pseudonym. Among the many names he employed as an author are Paul Béranger, Croquelardon, Hormisdas-Peath, Baron Nilense, Saint-Albin, and Johannes Videlbius. D. Jan. 13, 1881. Revised by A. G. Canfield.

Planer-tree [named from J. S. Planer (1743–89), a German botanist]: a rather small ulmaceous tree (*Planera aquatica*) of swampy lands in the southern parts of the U. S. It has the general appearance of the elms, but is quite distinct from them in flower and fruit. Its timber is hard, and suitable for many economic uses. The wood of *Planera abelicea*, of the Levant, is aromatic. It is the Cretan false sandal-wood of old writers. Another planer-tree is *P. richardi* of Persia and the Caucasus, partly naturalized in Europe, and sometimes called *zelkona*. It is a tall and handsome tree, producing excellent timber.

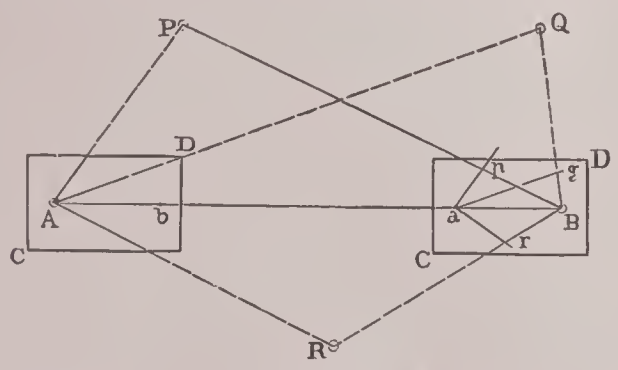
Revised by L. H. Bailey.

Planet [viâ O. Fr. from Lat. *plane'ta* = Gr. πλανήτης, planet, liter., wanderer, deriv. of πλάνη, a wandering, deriv. of πλανᾶσθαι, wander]: originally, any one of those heavenly bodies which seemed to change their positions on the celestial sphere. In the earliest days it was noticed that all the constellations and the thousands of stars which formed them preserved their relative positions from year to year and from generation to generation without any apparent change whatever, rising and setting as if they were fixed to the interior of a revolving sphere encompassing the whole earth. Seven celestial bodies were found to form an exception; these were the sun, the moon, and five bright stars, Mercury, Venus, Mars, Jupiter, and Saturn. From the changing positions of these bodies they derived their appellation of planets. See Ptolemaic System.

When the Copernican system was established a different classification became necessary. One of the planets, the sun, became the center of the solar system. The term planet could therefore no longer be applied to it. On the other hand, the earth itself became a heavenly body, revolving around the sun like the five known planets. The position of the moon alone remained unchanged. It was still a planet revolving around the earth. Thus by a natural use of words the term planet was applied to all the bodies which perform their revolutions around the sun. Those which, like the moon and the satellites of Jupiter, revolve around these planets are sometimes called secondary planets; but in the practical use of words the term planet is now applied only to those bodies of which the sun is the center of motion.

Among the common characters possessed by the planets are (1) they are globular bodies, rotating on their axes, and therefore slightly ellipsoidal in figure; (2) most of them are probably surrounded by atmospheres, more or less dense; (3) they shine by reflecting the light of the sun. Particulars of their relations to each other and of the elements of their orbits are given in the article SOLAR SYSTEM. A detailed description of each of the major planets is given under its name. S. NEWCOMB.

Plane-table: an instrument used in surveying for mapping in the field. It is particularly employed for making topographical maps in cases where a triangulation has first been executed. It is not used where great accuracy is required, but is particularly valuable on account of the rapidity with which it can be used in good weather. Although an ancient instrument, its use has been mainly confined to topographical mapping on a small scale. The plane-table consists essentially of a drawing-board mounted on a tripod in such manner that its upper surface may be made horizontal, and so that the entire table may be turned in azimuth through any angle whatever. The combination of parts by which these motions are effected is similar to that employed in leveling and orienting the horizontal limb of an engineer's transit. The instrument as described is accompanied by a ruler, usually of brass, and provided with a telescope so mounted that its line of collimation and the edge of the ruler shall always be in the same plane. The telescope is arranged with a vertical arc, by means of which small angles of elevation and of depression may be measured. The paper on which the map is to be made is stretched and held firmly in contact with the table by suitable clamps. One of the methods of using the plane-table is indicated in the diagram. Let it be required to determine the relative



position of the points P, Q, and R. Two stations, A and B, are selected as the extremities of a base-line, A B, and each is marked by a flag; the distance between them is measured; a line, A*b*, is drawn on the paper C D to any suitable scale to represent the line A B. The plane-table is then set up at A and leveled, so that the point A of the table shall be over the corresponding point A in the field; the edge of the ruler is then made to coincide with the line A*b*, and then the latter is turned in azimuth till the flag at B coincides with the intersection of the cross-hairs of the telescope, and in this position it is clamped. The telescope is then turned in succession upon the objects P, Q, and R, the edge of the ruler always touching the point A; and in each of these positions a pencil line is drawn along the edge of the ruler. The instrument is then taken to B and leveled, so that the point B of the table shall be over the point B in the field; the edge of the ruler is made to coincide with B*a*, and then the telescope is directed to the flag at A; and in this position the table is clamped. The telescope is then turned in succession to the points P, Q, and R, and in each position a line is drawn along the edge of the ruler intersecting the lines drawn to the same points at the other station; the points *p*, *q*, and *r*, in which the latter lines intersect the former, have the same relative positions on the plot that the given points have in the field. Another method is to determine the distances AP and AR by means of a stadia-rod, when they may be laid off to scale from A, thus locating *p* and *r*; by this method it will be unnecessary to transfer the table to B. Revised by MANSFIELD MERRIMAN.

Planetoid: See ASTEROID.

Plane-tree Family [*plane* is viâ O. Fr. from Lat. *pla'tanus* = Gr. πλάτανος, plane-tree, deriv. of πλατύς, broad]: the *Platanaceæ*; trees with alternate palmately veined leaves; flowers monœcious, much reduced, in globular heads; perianth of three to six sepal-like scales; stamens three to six; pistils two to eight, superior, each with a single ovule. The single genus, *Platanus*, contains six species, widely distributed in north temperate regions. *P. occidentalis* is the common plane-tree or buttonwood of the Eastern U. S., where it is often erroneously called sycamore. *P. orientalis*, the plane-tree of the Old World, which resembles the former species, is occasionally planted in America. In Cretaceous and Tertiary times there were many more species of *Platanus* than are now living. C. E. BESSEY.

Planquette, plăn'ket', ROBERT: opera-composer; b. in Paris, France, July 31, 1850; educated in the Paris Conservatory. His early operettas, *Valet de Cour*, *Le Serment de Mme. Gringoire*, and *Paille d'Avoine*, were successful. Next came his greatest success, *Les Cloches de Corneville*, well known in English as *The Chimes of Normandy*; first performed in Paris Apr. 19, 1877. He has since composed several operettas, including *Rip Van Winkle*, *Le Chevalier Gaston*, *Les Voltigeurs*, and *Nell Gwynne*. D. E. H.

Plant: See VEGETABLE KINGDOM, BOTANY, GEOGRAPHICAL BOTANY; PLANTS, FOSSIL; PHYSIOLOGY, VEGETABLE; MORPHOLOGY, VEGETABLE; CLIMATE, etc.

Plantag'enet: the surname of the Angevine dynasty of English monarchs, derived from the marriage of Matilda, daughter of Henry I., to Geoffrey Plantagenet, Count of Anjou. The Plantagenet monarchs reigned from 1154 to 1485, when the victory of Bosworth transferred the crown to the house of Tudor. They were usually ambitious and warlike princes. See ENGLAND, HISTORY OF.

Plantain [from O. Fr. *plantain*, plane-tree: Span. *plántano*, *plátano* < Lat. *pla'tanus*. See PLANE-TREE FAMILY]: the fruit of the coarser cultivated varieties of *Musa paradisiaca*, the finer and more delicate sorts being called bananas. The plantain is a native of the East Indies, but is now common in nearly all hot countries. It is of the family *Musaceæ*. The plantain furnishes a very large part of the food of the human race in some hot countries. The leaves yield a fiber which closely resembles MANILLA HEMP (*q. v.*). The name plantain is also applied to the species of the weedy genus *Plantago*, inhabitants of all yards and waste places in temperate climates. Revised by L. H. BAILEY.

Plantain Family: the *Plantaginaceæ*; a family of dicotyledonous herbs of doubtful affinity found in nearly every part of the world, but mostly in temperate regions. Most of the species, of which there are from 150 to 200, belong to the genus *Plantago*. The common plantain, *Plantago major*, is common in nearly every part of the world. Although nearly inert, it is employed in domestic medicine. Its seeds are fed to cage-birds, and its young leaves, boiled as pot-herbs, are palatable. In the U. S. the ribwort (*P. lanceolata*) is a common weed. The fleaworts (*P. psyllium* and *P. arenaria*) are raised in France for the seeds, which yield a valuable size for cotton goods and paper. CHARLES E. BESSEY.

Plant-cutter: a bird of the genus *Phytotoma*, so called from its habit of cutting off leaves and buds from trees and plants. The birds of this genus are characterized by tooth-like serrations along the edge of the mandible as well as inside the upper jaw. The few species are peculiar to South America, and are very destructive. They resemble sparrows in appearance, but are most nearly related to the tanagers.

Plantigrada, or **Plantigrades** [from Lat., pl. of *plantigradus*, plantigrade, from Lat. *planta*, sole + *gradi*, walk]: those animals in which the heel touches the ground in walking, as the bear, raccoon, etc. The term is the opposite of DIGITIGRADA (*q. v.*), and was employed by Illiger for a "family" of mammals, including species now placed in separate families. It is now used in a descriptive sense only. F. A. L.

Plant Jelly: See PECTIN.

Plant-louse: See APHIDES and GALL INSECTS.

Plants, Fossil: plants or vegetable impressions preserved in the earth by natural agencies, such as inhumation, petrifaction, carbonization, or incrustation.

History of the Science.—In view of the great abundance of vegetable remains now known to occur in nearly all the great systems of rocks throughout the world, it has been considered remarkable that no mention of their existence should have been found in the writings of the ancient Greeks and Romans nor in any extant work earlier than the thirteenth century. The first published allusion to fossil plants thus far discovered occurs in the treatise on minerals of Albertus Magnus, which appeared in the last half of that century. More than a hundred years later Martin Luther, in his commentaries on the books of Moses, brought forward the existence of petrified wood as evidence of the Noachian deluge, and during the sixteenth century considerable discussion was carried on by Agricola, Matthiolus, Gesner, and others relative to the nature and origin of vegetable petrifactions, embodying the vague speculations of these early times.

All this, however, had reference to petrified or lignitized blocks of wood or trunks of trees, and betrayed no acquaintance on the part of these writers with any of the definite organs of plants in the fossil state. It was not until toward the close of the seventeenth century that these latter at length attracted attention, and although Daniel Major of Jena, in 1664 included some such in his *Lithologia curiosa*, it remained for Edward Lhwyd, a Welshman, in 1699, in an important illustrated work, to furnish the basis for the future scientific study of fossil plants. From this time to the close of the eighteenth century the evidence rapidly accumulated, and discussion was rife and sometimes acrimonious.

The primitive notion of the formation of these objects in the rocks, through the action of a *virtus formativa* or *vis lapidifica*, gave way to the Lutheran doctrine that they represented plants that were washed up and stranded on the shores of Europe by the flood, of which Scheuchzer proved the most vigorous champion. The botanists who at last began to examine the abundant Carboniferous ferns taken from the coal-mines declared that they were not the same as those then inhabiting the country, but were of tropical aspect, and the theory was set on foot that by some great convulsion the vegetation of the torrid zone had once been torn from the soil by tidal waves of the sea and transported to more northern climes. Among those who leaned toward this view was Antoine Jussieu, the first of the great line of botanists of that name.

In this pregeologic age the idea that the fossil plants were extinct forms and belonged to a past age of the world had not yet dawned, but it was destined soon to do so, and the teachings of Leonardo da Vinci, Leibnitz, and Lehmann at last prepared the way for Blumenbach, who, before the end of the eighteenth century, laid the foundation for the true science, upon which Baron von Schlotheim, Count Sternberg, and especially Adolphe Brongniart, early in the nineteenth century, erected so noble a superstructure.

The succeeding half century brought forth an extensive literature of fossil plants, embracing among others the works of Göppert, Unger, Schimper, Williamson, Heer, Ettingshausen, Schenk, Saporta, and Carruthers in Europe, of Sir William Dawson in Canada, and of Lesquereux and Newberry in the U. S.

Progress in the knowledge of fossil plants naturally increased with the quantity and quality of the material brought to light. Scheuchzer in 1723 enumerated 445 species, and attempted to classify them according to the system of Tournefort, but his work was unscientific, and his species largely fanciful. Brongniart in 1828 described 501 species after a thorough revision of all the specimens known and careful exclusion of doubtful material. This formed a solid basis for future work, and the number of authenticated forms rapidly increased. Unger was able to catalogue 1,648 species in 1845, and three years later Göppert raised this to 2,055. Progress was unabated during the next twenty-five years, and Schimper's great work, published in 1874, describes about 6,000 species of fossil plants. At the present time (1895), though all care were exercised in eliminating synonyms, there would probably remain upward of 10,000 forms which, so far as can be known, are distinct.

When we consider that the present known flora of the globe comprises over 150,000 species of plants, the number of fossil plants, distributed as they are through so many geologic periods, seems small indeed, but it is still true that the representation from some horizons and particular localities occasionally approaches the numerical relations that subsist at the present time. But the botanist is interested in the number of these forms only as furnishing a basis for their classification, and thus throwing light upon the real character of the extinct vegetation of the earth.

Difficulties in the Way of the Study of Fossil Plants.—The study of fossil plants presents peculiar difficulties to the paleontologist from the fragmentary character of most plant-remains, and from the incomplete preservation of their perishable tissues. Of many extinct species of trees, in which the individuals may have been 100 feet in height, the only traces yet obtained are a few leaves of which the outlines and the nervation are imperfectly preserved. All botanists know how variable the leaves of trees are; and since they often find much difficulty in discriminating between genera and species when many entire individuals, complete in root, stem, leaf, flower, and fruit, are before them, it is not surprising that they have little faith in the deductions made from a few variable and incomplete organs. No doubt the inherent difficulties of the subject have favored hasty generalization—have, in fact, led to many errors—and should inspire a proper caution; yet many fossil plants have been discovered, and the preservation of some of them is so complete that they afford material for legitimate and important deductions in regard to the history of plant-life on the globe; indeed, it may be said that the generalities of this history are already well established.

Geological History of the Principal Types of Vegetation.—The plants now inhabiting the earth's surface, as well as those that have successively flourished during the several geologic ages of its history, may be divided into a few great groups which constitute so many different kinds or *types* of vegetation, varying greatly in form and general character as well as in their degree of structural advancement or perfection. The time and manner in which these several great types made their appearance on the globe are indicated, in so far as they can be known at all, by fossil plants. It therefore becomes a matter of the highest interest to endeavor to trace these types of vegetation back to their origin, and to note the manner of their subsequent development.

According to the most approved modern classification of plants the vegetable kingdom is primarily divided into the four co-ordinate groups or sub-kingdoms called respectively, 1, *Thallophytes*; 2, *Bryophytes*; 3, *Pteridophytes*; and 4, *Spermophytes*; the first of which embraces the lowest cryptogams, the second the mosses and liverworts (these two constituting the old division of cellular cryptogams), the third the vascular cryptogams, and the fourth all phanerogams. These divisions are, however, usually broader than the *types* which will be treated below, and in most cases embrace several such. It must also be remembered that in dealing with the extinct forms of the remote past one is looking back through the stages of plant-development. In fact, there is no longer any doubt that many of those ancient types really embodied the primal elements of several of those which in the slow course of ages were evolved out of them, and ultimately assumed more definite and distinct form. They are in such cases what have been called *comprehensive types*—i. e. types that comprehend in their structures the inchoate germs of later forms. Such types have also been happily termed *prophetic*, in that they contain the promise and prophecy of a life that is to flourish in subsequent ages.

The types of vegetation whose history the study of fossil plants serves best to elucidate are the following: Under the Thallophytes fall, in ascending order of development, 1, the *Protophytes*; 2, the *Algæ*; 3, the *Characeæ*; 4, the *Lichens*; and 5, the *Fungi*. The Bryophytes play so inconspicuous a *rôle* that their subdivision is unnecessary. Under the Pteridophytes are ranged, 1, the *Ferns*; 2, the *Rhizocarps*; 3, the *Equisetineæ*; and 4, the *Lycopodineæ*. The above ten types complete the cryptogamic series, which, though it fills a subordinate place in the present flora, assumes extraordinary prominence in the history of past plant-life. The great sub-kingdom of spermophytes or phanerogams has for its leading fossil types, 1, the *Gymnosperms*; 2, the *Monocotyledons*; and 3, the *Dicotyledons*; the last two constituting the *Angiosperms*, which crown the vegetable series. The geological history of these thirteen types of vegetation may be briefly sketched as follows:

The Protophytes.—From the supposed absence of the lowest forms of cellular cryptogams in the older rocks it has been argued that such forms are of comparatively modern origin. The greater part of these, however, are of such a

soft or gelatinous nature that they obviously could not be preserved under any ordinary conditions of sedimentation. The diatoms, which possess siliceous shields, are preserved in vast abundance in many parts of the world, heavy deposits of diatomaceous earth occurring along the Potomac and James rivers in Maryland and Virginia, at Monterey in California, in Bohemia, and many other parts of Europe, as well as in remoter regions. But all such beds are of Tertiary or more recent date, and it is fair to claim that this group at least is of modern origin.

The fact that plants alone can transform inorganic into organic matter has justly been brought forward in support of the claim that plant-life must have preceded animal life. But however conclusive this proposition may seem it would have little value for science if not confirmed by facts. There are, however, certain facts bearing upon this question which were confidently urged long before the discovery of any of the primitive forms of vegetable life in the older sedimentary rocks. Chief among these is the existence of vast deposits of plumbago or graphite, a pure form of carbon, in rocks too ancient to contain any definite forms of life either animal or vegetable—viz., in the Laurentian system of Canada and other ancient deposits. The doubts that existed in the minds of some as to the organic origin of graphite would seem now to be dispelled by the discovery of the fronds of ferns in the Devonian in the state of graphite.

The nature of the vegetation that produced the Laurentian graphite beds is of course conjectural, but within the last decade, due chiefly to the investigations of Reinsch, it has been made practically certain that the waters of the Paleozoic seas teemed with myriad forms of lowly cryptogamic life, forms related to the *Myxomycetes* and other protophytes. The metamorphic rocks have probably lost all traces of these structures, while those of the Cambrian and Silurian do not seem to be adapted to retaining them, but from the Devonian upward to the Cretaceous, and especially in the Carboniferous, impressed upon the coal itself and occupying the chinks and crevices in its seams and lumps, these strange microscopic organisms have left their traces in great profusion. Much light is thus thrown on the origin of coal, while the existence of a great abundance of primordial vegetable life as the food and sustenance of the early animals seems sufficiently demonstrated.

The Algæ.—There has been much animated discussion as to the nature of certain objects which have been held by some paleobotanists to be fossil algæ. These consist of markings and reliefs of somewhat definite form resembling living Algæ upon the rocks of Paleozoic or even earlier ages. The most important of these have been referred by these authors to the genera *Bilobites*, *Cruziana*, *Rhysophycus*, *Vexillum*, *Eophyton*, *Dendrophycus*, etc. In most cases they are so indefinite that even the most sanguine admit their doubtful character; in a few, however, the evidence of their vegetable origin is more distinct. But in nearly all it has been called in question, and the problem is one for which from its very nature a definite settlement can scarcely be hoped. The principal authors who have maintained that these markings represent real plants are the Marquis Saporta and Senhor Delgado, while of those who have most vigorously attacked this view Dr. A. G. Nathorst has taken the lead, and been followed by Dawson, Newberry, and many others. All, however, admit that there is no antecedent improbability that algæ inhabited the waters in which these rocks were laid down, and also that some of these forms really represent such organisms. Among the best authenticated of these fossil algæ may be mentioned forms of *Buthotrephis*, *Palæophycus*, *Licrophycus*, *Phytopsis*, *Sphenothallus*, *Harlania* (*Arthrophycus*), and *Palæochondrites* of the Silurian, and *Spirophyton*, *Fucoides*, and *Nematophyton* of the Devonian. The remarkable trunks from the Lower Devonian of Canada, described by Dawson and Penhallow under the name of *Nematophyton*, and claimed to represent veritable trees, have been subjected to the most rigid examination, and are pronounced to be Algæ allied to the *Laminariæ*. Similar trunks have also been found lower in the scale, even as low as the Denbighshire Grits at the base of the Lower Silurian. Amid all the diversity of opinion therefore it seems evident that the Paleozoic seas contained and probably abounded in marine algæ; while the occurrence of *Nematophyton*, above mentioned, which is held to have inhabited the land, tends to show that this type formed no exception to the law, so well exemplified by the higher ones, that the prevailing types of structure reached a higher expression in Paleozoic time than the same types exhibit at the present time.

In later geological formations the forms of algæ, though less robust, are more definite and better preserved, and from the Carboniferous to the Miocene, but especially in the Cretaceous and Eocene (Flysch), such genera as *Chondrites*, *Halymenites*, *Sphærococcites*, *Gyrophyllites*, *Münsteria*, *Cylindrites*, *Delesserites*, *Cystoseira*, etc., are of common occurrence.

The *Characeæ*, which mark a sort of transition from the algæ to the bryophytes, are represented in the fossil state by some sixty species of the genus *Chara*, which makes the "feather beds" at the bottom of ponds and rivers, all founded on the characteristic spirally twisted "fruits" of that genus. They range from the Oölite to the Pleistocene, but are most abundant in the Eocene. That the group may have had a much earlier origin is at least suggested by the discovery in the Lower Devonian (Corniferous Limestone) of Ohio of small bodies having a great general resemblance to *Chara* fruits, though differing in both the number and direction of the coils. The former reference of these forms, as well as of the nearly identical *Saccamina* of Dawson, to the *Foraminifera* is disputed by Brady, the highest authority on that group of animals.

The Lichens.—This group, which is classed with the fungi by many modern botanists, but forms a type very distinct in external appearance, though abundant at the present day is hardly known in the fossil state, some dozen species only, part of which are of doubtful character, having been described, all from the late Tertiary deposits. Those, however, that have been found imbedded in amber are very perfectly preserved, and belong in some instances to the same species with the lichens most common in Europe and America at the present time. From their nature the lichens are not likely to be preserved, but it is probable that certain of the hard and woody forms that grow on trees will be found attached to petrified trunks so abundant in some places. It seems quite certain that if these plants had been at all abundant in the forests of the coal period they would have been found in connection with the perfectly preserved impressions of the external surfaces of trees in our coal mines. It is probable that lichens, if they existed at all, were much less abundant in the Carboniferous period than they are at present.

The Fungi.—Quite a large number of fossil fungi have been described first and last by Unger, Göppert, Heer, and others, and Prof. Meschinelli has recently published, as a part of Saccardo's great work on the fungi of the globe, a complete list of all the known species, amounting to 329, and classed under forty-one genera. They are chiefly Tertiary, and found forming spots on dicotyledonous leaves. Such are the large genera *Sphærites*, *Xylomites*, etc., but the genera *Archagaricon*, *Peronosporites*, *Protomycites*, and *Excipulites* are Carboniferous, and there are a few Mesozoic forms.

The Bryophytes.—The plants of this group, which include the mosses and liverworts, and with the thallophytes constitute the cellular cryptogams, form a conspicuous feature in the present vegetation of the world. They were, however, prior to the year 1885, unknown with certainty in any formation older than the Tertiary. It is true that Debey and Ettingshausen in 1859 had figured an obscure form from the Upper Cretaceous of Limburg, in Belgium, which they regarded as an ancestral moss, and still earlier (1839) Roemer had made known another equally uncertain supposed museite from the Wealden of Hanover, neither of which, however, was accepted by Schimper, the great authority on both living and fossil mosses. The celebrated Swiss paleontologist Oswald Heer, having in 1865 detected certain beetles of the genus *Byrrhus* that now live exclusively among mosses as occurring in the Lias of Schambelen in Switzerland, remarked that the ground at that spot was then probably carpeted with mosses, and ventured the prediction that their fossil remains would yet be found. This prediction has not yet been verified for any part of the Mesozoic age, but its sagacity has been strongly vindicated by the identification in 1885 by Renault and Zeiller in the coal-measures of Commentry, department of Allier, France, of what these authors regard as a true moss allied to *Polytrichum*, to which they gave the name *Muscites polytrichaceus*. This accidental discovery of mosses in the Carboniferous is due to the extremely favorable conditions that existed at that period for the preservation of fossil plants, even those least adapted to it, and the absence of the

Bryophytes throughout the Mesozoic must in like manner be attributed to the less favorable conditions for the preservation of plant remains that characterize that prolonged period. That plants of this type will some time be found in considerable abundance in the Paleozoic and the history of the type be traced through the several systems of Mesozoic strata is a forecast which is justified by the history of science.

Both mosses and liverworts occur in considerable abundance in the Tertiary, especially in the amber and lignite or brown coal, to the latter of which they seem to have contributed largely, as they now do to the formation of peat. The species found in the amber are so perfectly preserved that their generic and specific characters may often be determined with accuracy, and it is an interesting fact that all the species so determined are closely allied to, and some are identical with, those now growing in Europe. The *Marchantia polymorpha*, a liverwort, is perhaps the most widely distributed of all living plants, and a fossil species, *M. sezannensis*, from the lowest Tertiary (Paleocene) strata of France, closely resembles it and may have been its progenitor. The *Hepaticæ*, or liverwort family, are somewhat less highly organized than the *Musci*, or moss family, and their future discovery much earlier in the series would not be a matter of surprise.

The Pteridophytes.—These embrace the great group more popularly known as the vascular cryptogams, and it is not an exaggeration to say that they have a greater interest for paleobotany than any other one of the primary subdivisions of the vegetable kingdom. Nearly all the living types are represented in the fossil state, but several of these, especially the ferns, *Equisetineæ* and *Lycopodineæ*, attained in Paleozoic time a development and luxuriance far exceeding those exhibited by the same types at the present day. They constituted the bulk of the great coal flora, assumed the stature of true trees, and formed veritable forests on the low marshy continents and islands of the Carboniferous epoch.

The Ferns.—Probably the most conspicuous type of ancient vegetation was that of the ferns. The ferns of temperate regions are now chiefly small herbaceous plants, but in the tropics tree-ferns still abound. In the Carboniferous there were doubtless some ferns of low stature, but there is evidence that the tree-ferns were a regular constituent of the forests everywhere, and that in many places they overshadowed all other vegetation. The classification of ferns is chiefly possible only by their fruiting organs, but the remains that have come down contain these only in extremely rare cases, so that it is still scarcely known to which of the living groups the great genera *Pecopteris*, *Neuropteris*, etc., are most closely related. Discoveries, however, point to the conclusion that these ancient forms were very unlike those of modern, or even of Mesozoic time, and that there was almost as great a change at the close of the Paleozoic in the character of the ferns as in that of the other types of pteridophytes.

The Rhizocarps.—The small family of rhizocarps includes the popularly little-known genera *Marsilea*, *Pilularia*, *Salvinia*, and *Azolla*. They differ in appearance from most ferns, but structurally they are the same except in bearing two kinds of spores, the one kind small, called microspores, and performing male functions, the other large, called macrospores, and performing female functions. The first named of these genera occurs in the fossil state, the four or five species of fossil *Marsilea* ranging from the Jurassic to the Miocene. *Salvinia* is even better represented, a dozen or more species occurring in the Upper Cretaceous and through the Tertiary. But the type is probably much older. Sir J. W. Dawson is disposed to refer his Devonian genus *Psilophyton* to the rhizocarps, and it certainly does closely resemble the modern *Pilularia* or pillworts. The Mesozoic *Sagenopteris* is now referred to the *Marsileaceæ*, and this may take with it the much older *Glossopteris* and its allies. But besides these indications of the antiquity of this type there have now been found at a number of places in the Devonian the characteristic spore-cases of the rhizocarps, most resembling those of *Salvinia*. These occur in Canada, Illinois, Ohio, and Brazil. Dawson has described a number of species founded on these objects under the name of *Protosalvinia*, and he cogently argues that they indicate the prevalence in those ages of an abundant rhizocarpean flora.

The Equisetineæ.—This type is only represented in the living flora by the genus *Equisetum*, the scouring-rushes, so called from the quantity of silex contained in their tissues. They are mostly low, rush-like, but leafless marsh-plants with jointed stems. In the early floras, however, the type embraced the great family *Calamariæ*, including the genera *Calamites*, *Calamodendron*, *Asterophyllites*, *Annularia*, and a host of other forms mostly of arborescent character and strange aspect. They abound in the coal-measures of all countries, and reach far back into the Devonian. They became extinct at the close of the Paleozoic and were succeeded by Triassic forms of *Equisetum*, much larger than those of the present day, and by the allied genus *Schizoneura*. Reduced forms of *Equisetum* continue through the Tertiary, at the close of which the type had dwindled to something like its present insignificance.

The Lycopodineæ.—If the ferns were the most universal and ubiquitous of the primordial types of vegetation, the lycopods excelled in their size, majesty, and strangeness. For to this type, now represented by the humble ground-pines or club-mosses, belonged the great Carboniferous genera *Lepidodendron* and *Sigillaria* with their numerous relatives, whose scaly trunks are so abundant in the roof-stones of all coal-mines. It was also one or several of these great trees whose subterranean parts are known as *Stigmaria*, and which form such conspicuous and grotesque objects in the coal-measures of nearly all countries. These plants were also true forest-trees, rising above the ferns and calamites and dominating the Carboniferous landscape. They probably had their origin in the Silurian, being abundant in the Devonian, where many species of *Lepidodendron* have been found, and where the anomalous *Berwynia* and *Arthrostigma* described by Dawson may have preceded and begotten them.

All these monarchs of the Paleozoic forests went down with the calamites before the Permian winter, to be but feebly succeeded by forms of *Lycopodites* connecting them with the modern *Lycopodium*. Of other lycopods the genus *Selaginella* is sparingly represented in the fossil state from the Cretaceous upward, while forms allied to *Isoëtes*, the quillworts, have been found in the Jurassic and also in the Miocene.

The Gymnosperms.—This group, now constituting a class in botany, and perhaps too comprehensive to be regarded as a single type, embraces the three natural orders *Cycadaceæ*, *Coniferæ*, and *Gnetaceæ*. The first two of these are among the most important families of fossil plants.

The *Cycadaceæ*, now a rare group, but familiar to all through the common *Cycas revoluta* of the greenhouses, and seeming, by its external appearance at least, to connect the tree-ferns with the palms, once formed the leading type of vegetation over the greater part of the earth. This was in Jurassic time, since which, like the great cryptogamic types of earlier ages, it has declined and nearly disappeared.

The *Coniferæ*, or cone-bearing family of plants, which embraces the pines, firs, spruces, cedars, etc., had a very early origin, being found in forms approaching some of the living ones at the close of the Carboniferous, when such genera as *Walchia*, *Ullmannia*, and *Voltzia* made their appearance. These, however, as well as the modified Mesozoic forms, *Brachyphyllum*, *Palissya*, *Araucarites*, etc., that succeeded them, were more closely allied to the present South American araucarian pines than to those that make up the evergreen forests of the northern hemisphere, while the predominant Cretaceous and Tertiary forms so closely approach the great redwoods of Western North America that most of them have been referred to the genus *Sequoia*. The true pines were of more modern origin.

The *Gnetaceæ* embrace the three genera *Gnetum*, *Ephedra*, and *Welwitschia*, all singular plants, the last two especially being among the most anomalous of all known forms of vegetable life. *Ephedra* is the only one of the three genera to which any fossil plants are believed to be related. One such was described by Heer from the Oölite of Siberia under the name of *Ephedrites antiquus*. Another has been found in the Upper Jurassic of France. Two others range through the Tertiary, and one, possibly a true *Ephedra*, is a celebrated amber-plant. The genus has also been found in the Pleistocene.

There exist in the flora of the globe certain forms which bear evidence of being the lingering representatives of great families that have flourished in the remote past, and are now approaching extinction. Such forms have been appropriately called *waning types*. To this class belong the genera *Equisetum* and *Lycopodium*. The modern cycads are a further illustration. Some of the most interesting of these waning types, however, belong to the *Coniferæ*, chief

among which are the well-known maidenhair-tree, *Ginkgo biloba*, and the redwood and mammoth trees of the Pacific coast. The maidenhair-tree is the sole survivor of a long line of ancestors which appear to have been abundant at different epochs. It can be traced back through all the ages of Cenozoic and Mesozoic time, with little change in the form of leaf until the Oölite is reached, when the blade becomes so divided that some of its extreme forms take the name of *Baiera*, a genus ranging through most of the Mesozoic. In the Permian it is replaced by the still more dissected forms *Ginkgophyllum* and *Trichopitys*, which are probably its ancestors, and these in turn were preceded, and perhaps begotten, by the whittleseyas, noeggerathias, and cordaïtes of the Carboniferous and Devonian measures.

That the sequoias are a waning type is proved by their extremely restricted range and number in the present flora, coupled with their great abundance and wide distribution in the floras of the past, the two Californian species being all that remain of more than fifty species known in the fossil state, ranging from the Jurassic to the Pliocene, and from Greenland and Spitzbergen to Chili and New Zealand.

These are by no means the only cases, and the class of gymnosperms bears evidence of having been very gradually ushered into existence. Toward the close of the Carboniferous there appeared a number of aberrant forms, such as *Dolerophyllum*, *Psygmophyllum*, *Cannophyllites*, *Dicranophyllum*, etc., which are probably ancestral Gymnosperms, and these, with the line of *Taxineæ* leading from *Cordaïtes* to the modern ginkgo and the yews, it has been proposed to erect into a group to be called *progymnosperms*. Indeed, the Marquis Saporta would take the *Cycadaceæ* out of the true gymnospermic column and unite them with this ancestral group.

The Monocotyledons.—Much interest attaches to this type of vegetation, which, though comparatively small, has the extraordinary merit of furnishing all the cereals for man's use. None of these, however, are found at any remote geologic epoch, and they seem, singularly enough, to have been developed at about the same time that man made his appearance on the earth. The ancestry of this type is enshrouded in obscurity, and some have maintained that its origin was not as remote as that of the dicotyledons. Certain it is that none of the now recognized forms of monocotyledonous plants have been recognized with certainty at an earlier period than the Cretaceous. There are, however, certain peculiar forms of extinct vegetation occurring in the Lower Trias and extending to the Upper Jurassic, that have been referred with confidence by some authors to the monocotyledons. Such are the *Yuccites* and *Æthophyllum* of the Buntersandstein of Alsatia, and the *Williamsonia* and *Weltrichia* of the Rhetic and Oölite. To these have been added the *Dichoneuron hookeri* of the Permian of Russia. Of these and some other forms usually referred to the *Cycadaceæ*, Saporta would establish an ancestral group, the *proangiosperms*, analogous to the progymnosperms abovementioned. This author, in conjunction with Dr. Marion, made an exceedingly praiseworthy effort to demonstrate from both paleontology and embryology the transition from the monocotyledon to the dicotyledon, and at least succeeded in showing that the distinction so obvious between the linear parallel-nerved monocotyledonous and the broad netted-veined dicotyledonous leaf is obliterated in many cases in the life-history of these plants.

With the exception of the palms the monocotyledons have played an unimportant *rôle* in the past history of vegetation. The date of their first appearance is imperfectly known on account of the problematical character of most of the early forms. All those that can with certainty be so classed occur as late as the Cretaceous, while the ancestors of our grasses and cereals, as well as of the now abundant rushes, club-rushes, and sedges do not appear earlier than the Tertiary. The chief interest centers in the palms, which began their career in the Upper Cretaceous and attained their maximum development in the early Tertiary. During all but the latter part (Pliocene) of Tertiary time, as well as during the Senonian and Laramie periods (Upper Cretaceous), the palms flourished in great luxuriance, and have left their gigantic leaves and peculiar fruits in the rocks of Europe and North America as far north as England and Vancouver island. Among the richest of these deposits of palms are those of Golden and Florissant, Colorado, representing the Laramie, Denver, and Green river formations, where *Sabal major* and *Flabellaria florissanti* exhibit leaves from 2 to 4 feet in width.

The Dicotyledons.—This great type, embracing most deciduous trees and foliage-plants and thousands of broad-leaved evergreen tropical and subtropical trees and shrubs, now constitutes the dominant vegetation of the globe. It had no existence in the earlier geologic ages and only came on the scene in late Mesozoic time. But it soon outstripped all its competitors, vying with the palms for the mastery during the late Cretaceous and gaining the complete ascendant during early Tertiary time. Its geologic history is chiefly known through leaves that have been dropped or blown by the winds into the waters of the seas, lakes, and rivers on whose shores these plants grew, and which, from the thin and broad nature of such organs, were quickly covered by the sediment and preserved in the rocks. Other organs, such as flowers and fruits, especially the latter, are, however, sometimes found, and by their aid the determinations based on leaves alone can then be verified or corrected. The necessity for identifying so large a mass of material from leaves alone has created a new department of botany previously neglected. The form of leaves was formerly alone relied upon in describing plants, but this furnishes little aid to the paleobotanist, who must determine not only the species but the genus and even the order from such data alone. This led to the study of nervation, which was found to have a much higher systematic value. It may be said that while form possesses only specific value, nervation possesses generic, and sometimes ordinal, value in the classification of plants, and a somewhat complete system of classification has been laboriously elaborated, based on the nature and arrangement of the veins and veinlets that distribute the fibro-vascular bundles to the blade of the leaf.

Throughout Cretaceous and all but late Tertiary time the evidence thus presented goes to prove that the dicotyledonous vegetation consisted chiefly of trees and shrubs with somewhat thick, tough, and leathery leaves, such as now characterize the flora of tropical and subtropical countries, and this is in harmony with the views of most geologists that the climate of the earth has undergone a gradual change by the slow lowering of its temperature, at least down to the beginning of the last series of glacial epochs, during and since which little is known of the fossil vegetation.

Many Cretaceous and early Tertiary forms have been referred to genera that now exist, such as *Populus*, *Salix*, *Sassafras*, *Platanus*, *Quercus*, *Ficus*, *Magnolia*, *Liriodendron*, *Viburnum*, etc., and doubtless such references possess a degree of correctness, but it is better to make the mental reservation in most cases that these ancient forms are probably the forerunners and ancestors of the living genera, and that could their flowers, fruits, and other organs be perfectly known it might be necessary to create new genera for their reception.

The Dicotyledons furnish numerous examples of waning types as defined above. Such is the genus *Sassafras*, with only one living representative of some dozen fossil species. The same is true of the tulip-tree, *Liriodendron tulipifera*, and the ancestors of both these species date back to the Lower Cretaceous. *Liquidambar* is a somewhat similar example, and seems to merge into *Platanus*, which is probably the most interesting genus from this point of view.

Geological Résumé.—The general character of the fossil vegetation of the globe has been depicted in the foregoing paragraphs, but in treating the great types, some of which range through a series of geologic ages, it has not been possible to convey as clear an idea as seems desirable of the flora of each of the successive periods of geologic time. A brief *résumé*, therefore, from this point of view, seems to be justified even at the risk of some slight repetition.

It should be premised, however, that the fundamental divisions of geologic time which are suggested by the history of plant-life differ slightly from those commonly adopted as based upon animal life. The Eophytic and Paleophytic ages correspond with sufficient exactness with the Eozoic (Archean and Algonkian) and Paleozoic (Cambrian, Silurian, Devonian, and Carboniferous) ages, but the Mesophytic age properly ends with the Jurassic instead of the Cretaceous, because it is here that the greatest break in the entire series occurs by the introduction and rapid rise of the great dicotyledonous flora which ever afterward maintained such an undisputed supremacy. Again, the Cenophytic age begins with the Cretaceous instead of the Tertiary, which is the point of origin of the Cenozoic, and is more completely broken in the plant than in the animal series by the approach of the glacial epoch, while this break occurs some-

what earlier in the former than in the latter, or at a point in the Neocene period corresponding approximately to the line drawn by Lyell between the Miocene and the Pliocene. Below this line there is everywhere evidence of a warm tropical or subtropical climate, and the introduction of forms indicative of a temperate or more or less arctic climate is here somewhat sudden and abrupt.

So far as plants are concerned, therefore, the geological series may be divided into five great ages: the Eophytic, Paleophytic, Mesophytic, Cenophytic, and Neophytic ages. The Eophytic and Paleophytic constitute the Primary, the Mesophytic the Secondary, the Cenophytic the Tertiary, and the Neophytic the Quaternary division of time. In the following enumeration of the successive floras, however, the lesser periods in more common use by geologists will be employed:

The Precambrian Flora.—Little as is known of what the real nature of the Eophytic flora was, there is still sufficient evidence, as was set forth when treating of the Protophytes, to make it tolerably safe to assume that this primitive vegetation consisted mainly or exclusively of the lowest forms of cryptogamic life—those unorganized plasmata, cytodes, or unicellular bodies which formed the initial life of the planet, and sprang by some unknown archegonic process from the womb of the great "mother of life," the sea. To such forms, and many still exist, the term Protophytes has been applied. The Eophytic period may therefore be appropriately called the age of Protophytes.

The Cambrian Flora.—The Cambrian, which is now recognized as including the Potsdam Sandstone, the Taconic system, and all below the Ordovician of some authors, contains many of the problematical organisms discussed under *Algæ*, some of which are undoubtedly plants belonging to that type, Among these are probably some of the species of *Fucoides*, *Buthotrephis*, and *Palæophycus* that have been described from rocks of this age in New York, Vermont, Wisconsin, and the Black Hills of South Dakota, as well as from England, Wales, Sweden, and other countries of Europe.

The Silurian Flora.—Scarcely more can be said for the Lower Silurian than for the Cambrian, and the same forms recur only in greater number and distinctness. But here is encountered in the Trenton Limestone the genus *Phytopsis*, and in the Hudson River Group the genera *Sphenothallus* and *Licrophycus*, as well as all the various forms from Southern Ohio, some of which are doubtless of vegetable nature. The *Sphenophyllum primævum* and *Protostigma sigillarioides*, as well as the supposed species of *Sigillaria*, described by Lesquereux from this deposit have been called in question and are still in doubt, and the same is true of *Eopteris morierei*, a supposed Lower Silurian fern from Southern France. It is therefore still uncertain whether any positive evidence exists of the occurrence of Pteridophytes or any form of land-vegetation in the Lower Silurian.

In the Upper Silurian, however, such forms have been found under conditions that seem to leave no doubt of their existence at that epoch. Besides the recurrence of the fucoidal remains with increasing abundance and definiteness of structure, there is not only the land-thallophyte *Nematophyton*, but the supposed rhizocarpean genus *Psilophyton*, and the probably pteridophytic *Protannularia*, *Arthrostigma*, *Berwynia*, and *Glyptodendron*, constituting a firm Silurian basis for the future land-vegetation of the globe.

The Devonian Flora.—The change in passing from the Silurian to the Devonian flora is so abrupt that it must be attributed in great part to the imperfection of the geological record. Still it strongly suggests that there may have been about the close of Silurian time a great lowering of temperature analogous to that which is now generally believed to have occurred at the close of the Carboniferous. Scarcely any of the fucoidal forms persisted, though some peculiar to that age, such as the *Spirophyton*, or cockstail fucoid, are found. But the places of these are supplied many times over by far higher types of land-plants, clearly impressed upon the rocks or petrified in place with their internal structure preserved, so as to leave no doubt as to their vegetable nature, and to enable us to determine their botanical relations. Not only were all the great types of Pteridophytes represented—the ferns by *Archæopteris*, *Cyclopteris*, *Sphenopteris*, *Rhachiopteris*, *Megalopteris*, etc.; the rhizocarps by *Psilophyton* and *Protosalvinia*; the *Calamariæ* by *Bornia*, *Calamites*, *Asterophyllites*, and *Annularia*; and the lycopods by *Lepidodendron*, *Sigillaria*, *Knorria*, and *Stigmaria*—but a large number of gymnospermous or progymnospermous forms were introduced, such as *Noeggerathia*, *Cordaïtes*, *Dadoxylon*, and *Syringoxylon*. The Devonian flora was therefore the beginning of the Carboniferous flora, which is next to be considered.

The Carboniferous Flora.—This flora is too well and popularly known to require a detailed examination. It was the climax in the development of all the great types of Pteridophytes above described. It flourished during a period of the earth's history marked by a warm, tropical climate, yet not too hot for the growth of land-vegetation; by a great preponderance of ocean over land; by a mostly low, flat, marshy condition of the land-surface, which was probably largely insular or peninsular, the islands, tongues, and necks of land, as well as the marshy and lake-strewn continental expanses bathed in the moisture of their almost steaming waters, and perhaps nearly always overhung with a nimbus cloud-envelope and drenched by ceaseless mists or rains. Under such conditions the luxuriant forests of tree-ferns, lepidophytes, calamites, and cordaïtes, flourished unmolested, and were able to attain that extraordinary development which constitutes one of the greatest wonders that science has revealed to man.

Toward the close of the period, during the phase which is commonly marked off as the Permian, a change began to take place in the character of the flora; the earlier forms were reduced in size and importance, and new ones, such as *Walchia* and *Ullmannia*, appeared, more nearly approaching the later forms of the *Coniferæ*. Among these the genus *Voltzia* is sparingly found, a form which was to reappear in the early Trias. The rapid and ultimately complete extinction during this epoch of the great Paleozoic Pteridophytes that reigned so absolutely over the preceding ages marks one of the most abrupt transitions in the geological history of the earth.

The Triassic Flora.—To pass from the Paleozoic to the Mesozoic age is to enter a new world. The calamites of the Carboniferous had disappeared, but these had given place to forms of true *Equisetum*, some of which, such as *E. rogersi* of the Richmond coal-field in Virginia, still attained a great size. The great lycopods of the coal-period had all perished, as no traces of them are found in the Triassic. The most noticeable trees of the Lower Trias are the peculiar conifers *Albertia* and *Voltzia*. They are both araucarians, but quite different from those which preceded and followed them. The most conspicuous and characteristic feature in the Triassic flora is the great development it exhibits of the family of cycads. These were so numerous, varied, and showy that they have caused the Triassic and Jurassic ages to be called by some the reign of cycads.

The flora of the Trias has now been somewhat thoroughly studied in North America from large collections made in the coal-basins of Richmond, Va., and of the Deep and Dan rivers, North Carolina, as well as from the Connecticut valley, from the Newark beds of New Jersey, and in the West from the copper region near Abiquiu, New Mexico. These investigations have revealed a flora most like that of the Upper Trias in the Old World, being composed of the same genera and in part of the same species. The ferns and cycads form the largest groups, and are about equally predominant. After these come the conifers and next the equiseta. More than one hundred species of these four types are now known from the American deposits. Careful comparisons have been made of this flora with those of other countries, and the conclusion has been reached that it represents the extreme upper member of that system, corresponding to the Upper Keuper or Rhetic of Europe.

This Upper Triassic flora is of the greatest interest, as it bears evidence of having migrated from the southern hemisphere. It abounds in Australia and India, and has been found in South Africa and the Argentine Republic. From these regions it seems to have spread in the Old World to Asia Minor, Cochin China, China proper, Japan, Siberia, and Europe, and in the New World to Honduras, Mexico, and the regions of the U. S. enumerated above. It appears in India and Australia at an earlier period, and is a modification of the Carboniferous types that existed there. These survived the ordeal that laid low the pteridophytic coal flora of the north, and reappeared in altered forms as the widespread Mesozoic flora of the globe.

The Jurassic Flora.—No fossil plants have yet been found in America which come from strata that have been identified with certainty as Jurassic, although the Triassic flora above described belongs, as stated, to the extreme top of

that system, and was long supposed to represent the Oölite, which in Europe is rich in plant-remains. On the Yorkshire coast of England and in many parts of France, Italy, and Germany, as well as in India and Siberia, there are extensive deposits of that age that contain fossil plants, of which some five or six hundred species have been described. Several hundred more are known from the Lias below, and the Coral, Portland, Purbeck, and Kimmeridge beds above the Oölite. These constitute simply a gradual modification of the Keuper and Rhetic flora already described, and their differences are too much matters of detail to require enumeration here.

The Cretaceous Flora.—As already remarked, the Cretaceous gave a new dispensation to the plant-life of the globe in the first appearance here of the great type of Dicotyledons. These are now known to occur at the very base of the system, but of peculiar form and character, indicative of an embryonic state, and mingled with other types—ferns, cycads, conifers, etc.—of Jurassic aspect. The Potomac formation of Virginia, first made known in its botanical relations by Prof. Fontaine in 1889, is the earliest in the world at which this type of vegetation is known to have existed. Saporta, however, has discovered dicotyledonous plants in collections from Portugal at a horizon only slightly higher. A single plant of this sub-class had been found by Heer during his study of the arctic floras in the Kome beds of Greenland, which were referred to the Lower Cretaceous, but not to its extreme base, prior to which none were known older than the Cenomanian or Middle Cretaceous of Europe. At that horizon they had long been known, and have been described from many parts of the Continent—Saxony, Bohemia, Moravia, etc.—also from the Atane beds of Greenland. The Dakota formation of Kansas and Nebraska is placed at about the same age, and has yielded a very large flora in which Dicotyledons greatly predominate. Until very recently it was believed that the Raritan and Amboy clays of New Jersey, which have also furnished plants of this type, were nearly of the same age, but researches now in progress point to an earlier date for these deposits, while the same flora has been found to extend southward to the Chesapeake Bay and Potomac river, where it blends with that of the Potomac formation. It likewise recurs in Alabama and Mississippi, where large collections have already been made, and it will probably be traced much farther.

The forms other than dicotyledons that characterize the Potomac formation—ferns, equiseta, cycads, and conifers—have been found in the Kootanie formation of the British Northwest Territories and at Great Falls, Montana; and during the summer of 1891 a flora was brought to light in the Trinity division of the great Comanche series of Texas which embodies the same types and is probably of the same age.

The Upper Cretaceous flora, which is also very rich and has been made known in many parts of Europe, in Greenland, and in British America, shows some advance toward that of the Tertiary, especially in the presence of palms, but also in the more modern character of both its dicotyledons and its less advanced types. Distinct from this and occupying the extreme Upper Cretaceous, perhaps extending into the Eocene, is the great Laramie formation of the Rocky Mountain region. Its flora is remarkable both in its character and its abundance. Notwithstanding its modern aspect, containing as it does several now living species, it still embraces a great number of wholly peculiar forms, some of which seem to be of South American type. This interesting flora is as yet only partially known to the world, and is still the object of active research.

The Tertiary Flora.—In the geological history of the earth there have been two great periods during which the deposition of vegetable matter has played a leading *rôle*—great shoaling periods, they may be called—resulting in extensive coal-beds, and in and about these, immense deposits of fossil plants. These periods were the Carboniferous and the Tertiary, or, in a more restricted sense, the coal-measures and the Eo-Miocene. No other periods can be compared with these from this point of view, and they seem to mark the completion of a great cycle in the ages.

The dicotyledons predominate in the Tertiary flora, and the generalities of its features have been already given in what has been said of the geological history of that type. The flora of the Tertiary is also so great and so varied that any detailed description of it would carry this article far beyond its prescribed limits. Probably half of all known species of fossil plants occur in the Tertiary, and these not only represent every one of the great types of vegetation that have been passed in review, but they also represent a great number of the orders and genera of the present flora of the earth. A few general conclusions drawn from the facts are therefore all that can, with propriety, be added:

1. Everything indicates that the flora of the Tertiary was directly derived from that of the Cretaceous, and has in turn given birth to the flora of the present day.

2. In the Eocene Tertiary a luxuriant vegetation covered the northern portion of the North American continent, Northern Asia, and the arctic lands as far north as Grinnel Land, lat. 81° 46′ N., and some 400 species of chiefly arborescent plants are represented in this arctic flora.

3. The number of arctic American Tertiary species found in European deposits of the same age is so large as to warrant the inference that there was a land connection between the two continents during this age. This community of character has also been considered indicative of the colonization of Europe by the American flora in the Miocene age, and the plane-tree of the Old World has been shown to have had an American origin. Moreover the similarity of the flora of Japan to that of Eastern North America indicates that there was a land-connection between North America and Asia during Tertiary time.

The Neophytic Flora.—The properly geological record of plant-life practically closes with the Miocene. The Plio-Pleistocene flora is very small, and most of the forms occurring in it are still living. The remainder are found upon comparison to resemble living ones more or less closely, which lessens the interest usually felt in them. The Auriferous Gravels of California and Australia contain, however, a good number of apparently extinct species represented chiefly in the former case by leaf-impressions and in the latter by fruits and seeds. Pleistocene plant-bearing deposits occur in many parts of Europe, notably at Utznach and Dürnten in Switzerland, at Cannstatt in France, and on the Norfolk, Suffolk, and Sussex coasts of England. They are also known in North America, as at Green's creek on the Ottawa river in Canada, near Columbus, Ky., on the Mississippi river, and at Boaz in Graves County of the same State. Dr. Nathorst has long been studying the glacial-drift deposits of Northern Europe to find remains of glacial vegetation, and has discovered many species. Some of the localities are as far south as Switzerland, Würtemberg, Bavaria, and Hungary. Prolonged study of the geographical distribution of living plants, in connection with the above-mentioned facts, has led to the following general conclusion: With the approach of the glacial period the flora of the Tertiary, where it could retreat, was driven southward; where it could not, it was destroyed, and even the lowlands were occupied by an arctic vegetation. When at length, however, the climate moderated after the ice period, these boreal plants moved northward or climbed the mountains, where they found a permanent arctic temperature. The more ancient flora that had been driven southward then gradually resumed its northward march, and, greatly modified by its long exile and wanderings, slowly reclaimed the less elevated territory, forming ultimately the present flora of the temperate zone.

Dominant Types of Geologic Ages.—A retrospective glance over the successive ages of geologic time, as stamped each by its peculiar flora, will make it possible to select in each case some type of plants which may be said to characterize that age, to dominate it, as it were, and reign for the time being over all other types. Thus the Eophytic age may be called the reign of protophytes; the Cambrian and Silurian taken together, the reign of algæ; the Devonian and Carboniferous taken together, the reign of pteridophytes; the Triassic and Jurassic taken together, the reign of gymnosperms; and the Cretaceous and Tertiary taken together, the reign of dicotyledons. The algæ culminated in the Upper Silurian; the ferns, lepidophytes, and calamites in the coal-measures; the cycads in the Oölite; the conifers in the Cretaceous; the palms in the Eocene; and the apetalous and polypetalous dicotyledons in the Miocene. The present may be regarded as the age of liliaceous and glumaceous monocotyledons and gamopetalous dicotyledons.

Relation of Fossil Plants to Biology in General.—The discovery and careful study of such large numbers of plant-forms occurring in the different geological formations have greatly enlarged the fund of knowledge relative to the history and development of plants, and led to extensive modifications in the prevailing system of classification.

Only a few of the more important of these results can be presented here.

It was formerly supposed that the structure of the stem constituted the most fundamental character in the classification of phanerogams, and that sub-kingdom was accordingly subdivided primarily into those possessing the endogenous and exogenous structures respectively. This classification naturally grouped the gymnosperms with the dicotyledonous angiosperms, leaving the monocotyledons to constitute a distinct class supposed to be lower in organization than any of these. But the order of appearance of these several types in the past history of the earth, as set forth above, showed that the gymnosperms antedated the monocotyledons by a vast period, and almost demonstrated their direct development out of the early cryptogams. At first it was sought to take advantage of this to disprove the true course of evolution of plant-life from the lower to the higher types; but, on the one hand, closer study of the internal structure of the gymnosperms soon showed that this was widely unlike that of the dicotyledons, while on the other, the investigations of German botanists established the real genetic relationship between the reproductive apparatus and function in gymnosperms and the higher cryptogams. Both these results may now be regarded as established in their general aspects, and discussion is narrowed down to the minor details. This affiliates the *Cycadaceæ* and *Coniferæ* with the cryptogams and separates the gymnosperms from the dicotyledons as forming a far earlier and less developed type of vegetation. The monocotyledons, possessing the closed ovary in common with the dicotyledons, can now be appropriately united with the latter to form the true angiosperms, giving to their endogenous structure its proper subordinate rank in the classification. To add to the force of these modifications it has more recently been discovered that a number of the more highly developed cryptogams of Paleozoic time acquired the exogenous structure. Such is the case with *Sigillaria*, *Stigmaria*, *Calamites*, *Calamodendron*, and other less prominent types. The truth seems to be that in the process of development in plants the exogenous structure has been attained in varying degrees along several ascending lines, and that there is a different kind of exogeny in the calamite, the lepidophyte, the cycad, the conifer, and the dicotyledonous angiosperm, while something resembling exogeny has been shown to exist in certain fossil ferns and in certain living monocotyledons.

Fossil plants also clearly illustrate the much wider truth that progress in organic development takes place by means of an irregular succession of new departures or fresh ramifications from the older or lower parts of the generally advancing trunk by a process which has been called *sympodial dichotomy*, and is not in any sense a continuous chain or linear series. The ancient types that reached so high a degree of development became extinct, while lower and less perfect types underwent advantageous modification and were perpetuated. In other words, evolution takes place through the extinction of trunk lines of descent and the persistence of unspecialized types—through the origination out of the lower, less differentiated forms of potentially higher types of structure, i. e. types of structure better adapted to their environment, while the forms that have become specialized and attained the maximum development possible for that type of structure, unable to change, succumb to the changing environment. Thus broadly viewed the law of evolution holds strictly throughout the geological history of the vegetable kingdom; that is to say, progress from the lower to the higher types went on with the advance of geologic time, and there was a general upward tendency in structural development through the great periods of geology. Although the highest forms of all the most ancient types have become extinct they have always been succeeded by higher types, and although the lower forms of these earliest types have sometimes persisted, they have always remained subordinate to the great ruling types that have distanced them in the race for life.

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Lester F. Ward.

Planula [Lat., liter., little plane]: a stage in the development of Cœlenterates, etc., in which a solid, two-layered embryo is developed, not by typical gastrulation (see Embryology), but by a cutting off of the inner ends of the cells of an earlier stage.

Plaquemine, plăăk'meen': town; capital of Iberville parish, La.; on the Mississippi river, and the Texas and Pacific Railway; 20 miles S. of Baton Rouge, 85 miles W. by N. of New Orleans (for location, see map of Louisiana, ref. 10–E). It is a shipping-point for cotton and sugar, and has sawmills and shingle-mills, barrel-factory, a State bank, the Academy of St. Basil, and a daily and two weekly newspapers. Pop. (1880) 2,061; (1890) 3,222; (1900) 3,590.

Plasma: See Blood; also Chalcedony.

Plassey, Battle of: See Clive.

Plaster [O. Eng. *plaster*, from Lat. **plas'trum*, *emplastrum* = Gr. ἔμπλαστρον, plaster, deriv. of ἐμπλάσσειν, daub on, stuff in; ἐν, in + πλάσσειν, to mould]: in pharmacy, an adhesive mixture of lead oxide and a fatty acid, or a resinous and fatty compound, often medicated, designed to be spread upon leather, linen, or even paper, and then applied to some portion of the human body. Plasters have a considerable use in medicine, and especially in surgery, where strips of adhesive plaster are employed for many purposes.

Plastering: See Stucco.

Plaster-of-Paris: See Gypsum.

Platæ'æ (in Gr. Πλαταιαί, or Πλάταια): ancient city of Greece, in Bœotia; on the northern slope of Mt. Cithæron; famous as the place where in 479 B.C. the Greeks under Pausanias totally routed the Persians under Mardonius. The city was destroyed by the Thebans, in 427 and in 374 B.C., but was both times rebuilt, and existed in the sixth century A.D. Remains of it are still visible near the village of Kokhla. The site was excavated by the American School of Classical Studies at Athens in 1889. See *American Journal of Archæology* (1889), pp. 428–439, and 1890, pp. 108–111.

Revised by J. R. S. Sterrett.

Plata, La: See Argentine Republic.

Plata, La (city): See La Plata.

Platanis'tidæ [Mod. Lat., named from *Platanis'ta*, the typical genus, from Lat. *platanis'ta* = Gr. πλατανιστής, an animal of the Ganges, perhaps the susu]: a family of the toothed cetaceans, allied to the dolphins and represented by the singular susus of the Indian rivers. The form is dolphin-like except as to the head, which is distinguished by its upraised forehead and its small eyes; the blow-hole is longitudinal; the beak is elongated; the cervical vertebræ are all separate; the costal cartilages remain unossified; the maxillary bones are remarkable for their large bony, incurved crests; the teeth are simple and destitute of cingulum or tubercle. The family is represented by a single known genus, with two species—(1) *Platanista gangetica*, inhabiting the Ganges and Brahmaputra and their tributaries; and (2) *P. indi*, found in the river Indus. They rarely exceed the length of 7 feet. Although the body appears to be adapted for swiftness, they are said to be rather sluggish animals; they prey upon fish, like their salt-water relatives.

Revised by F. A. Lucas.

Plata, Rio de la (in English often called *River Plate*): an inlet in the southeastern coast of South America; properly the estuary of the river Paraná (*q. v.*), but also receiving the Uruguay. It separates Uruguay on the N. from the Argentine Republic on the S. W. It is about 190 miles long and 143 miles wide at the mouth; the depth varies from 2½ to 10 fathoms; and the strong currents make navigation difficult. During storms, especially the *pamperos* of the winter months (May to October), the Plata is more dangerous than the open sea. The best harbor is that of Montevideo; there are no good natural ones on the Argentine side, landing being obstructed by wide shallows; a partial remedy has been formed in the artificial port of La Plata. The Rio de la Plata drains, by the Paraná, Paraguay and Uruguay, an area of about 1,100,000 sq. miles. H. H. S.

Plateau: a term introduced by the French geographer Buache in the eighteenth century, to designate elevated regions of somewhat even surface. Like plains, the greater number of plateaus are built of essentially horizontal strata, either sedimentary beds or lava-sheets. The effort to distinguish between plains and plateaus at some definite limit of altitude is not successful, because it introduces an arbitrary division where nature exhibits many gradations. The Great Plains of the U. S. are known as plains, although only their eastern border is below the altitude that is usually adopted as separating the two classes of forms. On the other hand, the term plateau is often justly applied to an upland having a moderate altitude above sea-level, but rising over a lower plain by a well-marked escarpment, as in the case of the Niagara limestone plateau of Western New York. Plateau is not an appropriate name for elevated basins, like the parks of the Rocky Mountains in Colorado or the Vale of Kashmir in the Himalaya Mountains, which are closely walled in on all sides by higher land; nor is the word well used to refer to the unseen foundation-mass of land above which mountains rise and into which valleys are not yet cut, although it is employed in this sense by some geographers.

Lofty plateaus are seldom so level as lowland plains; for example, the plateaus of Arizona are great blocks of country, 6,000 to 10,000 feet in altitude, separated from one another by profound divisional planes or "faults," each block having a slight inclination and a slightly different altitude from that of its neighbor; yet the *llano estacado* or stockaded plain of Western Texas, with an altitude of 3,000 or 4,000 feet, is remarkably smooth over great areas, being compared to the surface of the sea; its margin, however, is eroded into deep valleys and isolated outliers.

Owing to their height, plateaus may attain a great diversity and intensity of relief under the action of denuding forces, as in the high plateaus of Utah, whose marginal cliffs or escarpments are profoundly gashed by colossal ravines, or the plateaus of Arizona, which are trenched across by the cañon of the Colorado River (*q. v.*). Like lofty mountains, the uplands of lofty plateaus are cooler and generally better watered than the surrounding lowlands; thus one of the plateaus of Utah is named the Aquarius, from bearing streams and forests while overlooking arid and desert lower lands; but when, in spite of being high, plateaus are sheltered on the side toward the sea by yet more lofty mountains, they are dry, and instead of suffering dissection by outflowing streams, they may gather the waste from the adjacent higher slopes and build up their surface. Thus the broad interior plateau of Tibet, with an altitude of 12,000 or 14,000 feet, bordered on the S. by the towering Himalaya and broken by various mountain ranges, is an arid region, with glaring sun and strong dusty winds by day, and cold, relatively calm nights.

When plateaus are well dissected little of the even surface of the original upland may remain, the region being thoroughly invaded by irregularly branching valleys. The greater part of the Alleghany plateau is in this stage of development. In the northeastern part its inequality of form is so great as to give it the name of Catskill Mountains. In West Virginia it is deeply trenched by many valleys, notably by the canyon of New river, over 1,000 feet deep beneath the remaining portion of the upland, all of which is diversified by ramifying river branches. In Northern Alabama relatively large blocks of even upland remain between wide open valleys. Plateaus in this stage of varied form and strong relief are less easily occupied than in earlier or later stages. The people dwelling in strongly dissected plateaus have a difficult life; they can not move about easily, and their advance in civilization is slow.

In later stages of denudation the valleys within the plateaus widen and consume the greater part of the uplands, leaving only isolated masses, such as occur on a moderate scale in Saxon Switzerland, or with much greater magnitude in the interior of British Guiana, where great table-mountains—Roraima and its fellows—rise to commanding altitudes, descending on all sides by steep cliffs of 1,000 or more feet to the surrounding lower lands. Similar dissected plateaus and table-mountains of sandstone and lava beds are found in the plateau region of Abyssinia.

Denudation of Plateaus.—In the progress of denudation of a great plateau-mass the weaker strata are selected for faster consumption by the atmospheric forces, while the interbedded harder strata stand out in bold escarpments or cliffs. Thus in Eastern Utah, when standing on the margin of one of the higher plateaus at an altitude of 11,000 feet or more, the eye ranges over a vast expanse of nearly level terraces, descending from one to the next by cliffs of strange aspect, which, as described by Dutton, "are truly marvelous, whether considered with respect to their magnitude, their seemingly interminable length, their great number, or their singular sculpture." Each terrace slopes gently back from its cliff-edge to the foot of the next cliff behind it. Each cliff, 1,000 to 1,500 feet in height, marks the occurrence of a relatively resistant stratum in the plateau-mass, the total thickness of strata being 10,000 feet. Although for the most part barren of vegetation, the color of the region is greatly varied through reds, yellows, grays, and whites. The features thus described are the result of extensive denudation, while the whole region stood at a much less elevation above sea-level; since then it has been broadly uplifted, and the revived rivers and streams have trenched deep and narrow cañons across the terraced surface. It is a marvelous region, not only from its gigantic illustration of plateau-topography, but from its emphatic teaching of the principles of land-sculpture on a huge scale. A good example of a plateau, of gently ascending surface, terminating in a bold escarpment, is found in the Rauhe Alp and the associated uplands of Würtemberg. A series of similar forms of moderate altitude occurs on either side of Rheims in Northeastern France. These forms are of interest in their influence on products and occupations in populations of closely adjacent areas, above and below the escarpment.

Plateaus of another class possess an even surface in spite of being composed of disordered rocks, being in fact old mountain regions reduced to lowlands by long-continued denudation (see Plain), and then broadly elevated to greater altitude. The plateaus thus formed are never so smooth as the younger plains of the first class; when elevated they are again attacked by streams, and thus diversified in the manner already described for the other class of plateaus; but the valleys are still generally arranged in the prevailing trend of the former mountains, and the intervening plateau uplands therefore present a linear grouping quite unlike the remnants of plateaus of horizontal structure, in which the disposition of the interstream uplands and spurs is excessively irregular. Plateaus of the first class frequently possess well-marked cliffs that rim around their remnant masses, continuous for many miles; plateaus of the second class never possess these forms, but, on account of the tilted and disordered structure of their rocks, are worn into a ridge-like topography. While plateaus of the first class are built of unaltered sedimentary rocks or lava-sheets, those of the second class are often built of greatly disturbed metamorphic sedimentary rocks, or of foliated or massive crystalline rocks, such as prevailed deep within the original mountain mass, now laid bare by denudation. The mineral products of the two classes of plateaus are therefore quite unlike, the second class being much the richer in rarer minerals and in metallic ores.

The broad plateau-like uplands of the Ardennes, along the Franco-Belgian boundary and extending northeastward into Germany, are examples of the second class of plateaus: they are not yet much dissected, but are here and there deeply trenched, as by the Rhine, the Moselle, and the Meuse. The Black Forest is a highland of the same nature, but it was never so well worn down when a lowland, and it is now more dissected since its elevation. The Scotch highlands repeat the same features, but rise to a greater height, and are much interrupted by the opening of their deep glens. Much of the interior of the Scandinavian peninsula seems to belong in this class of forms; but it is still overlooked by so many bold eminences that were not consumed before its elevation to its present altitude that it is commonly classed with mountains; it is, moreover, traversed by deep valleys whose lower courses are submerged, producing the renowned fiords of the Norwegian coast. In the U. S. the highlands of Southeastern New York constitute a dissected plateau, although the relatively even uplands are not to be recognized by the traveler through the deep gorge of the Hudson. As a whole, the uplands slope gently to the S. E., but they may be traced with even altitude southwestward into the highlands of New Jersey, and northeastward into the western plateau (Berkshire Hills) of Massachusetts and beyond. Occasional eminences, unconsumed when the region was a lowland, rise here and there above the plateau uplands, and of these Mt. Monadnock in Southwestern New Hampshire may be taken as the type. The middle part of the Sierra Nevada is an inclined plateau of the same kind,

falling abruptly into the interior basin of Nevada, descending gently to the valley of California, and deeply trenched by cañons. See PHYSIOGRAPHY. W. M. DAVIS.

Plateau, plăă'tō', JOSEPH ANTOINE FERDINAND: physicist; b. in Brussels, Oct. 14, 1801. He was an authority in physiological optics and capillarity, but his writings extend over nearly the entire range of experimental physics. He was Professor of Physics in the University of Ghent from 1835 till his death, Sept. 15, 1883, in spite of the fact that in middle life he had sacrificed his eyesight to his studies of subjective vision. Notwithstanding that misfortune, he continued his investigations in physiological optics, observing through the eyes of members of his family. Thus in his paper on *Persistence of Vision* (1876) his son Felix and his son-in-law Van der Mensbrugghe were his visual assistants. Plateau's researches upon the surface tension of liquids were collected in book-form under the title *Statique expérimentale et théorique des Liquides soumis aux seules Forces moléculaires* (2 vols., 1873). His latest work was a very complete bibliography of works on physiologieal optics.

E. L. NICHOLS.

Plated Ware: See ELECTRO-PLATING.

Platen-Hallermünde, plaa'ten-haa'ler-mün-de, Graf von: poet; b. at Ansbach, Bavaria, Oct. 24, 1796; was educated in the military academy of Munich; served for a short time as an officer in the Bavarian army, but soon tired of military life and studied philology and philosophy at Würzburg and Erlangen. A pension which the King of Bavaria granted him in 1826 enabled him to devote himself entirely to literary pursuits. He went to Italy, where he lived during the rest of his life. D. at Syracuse, Sicily, Dec. 5, 1835. Though Platen in his excellent dramatic satires *Die verhängnissvolle Gabel* (1826) and *Der romantische Oedipus* (1829) is one of the strongest assailants of the romantic school, his earliest literary productions, the dramas *Der gläserne Pantoffel* (1823) and *Der Schatz des Rhampsinit* (1824), distinctly show the influence of romanticism. Of this, however, he gradually freed himself by the study of the classic ancient poets as well as by the development of his innate feeling for perfect artistic form. His mastership in regard to the latter is especially evinced in his poems, which by the purity of their rhymes and the easy handling of the most difficult and complicated rhythms became the models for the younger generations of German poets. While the true poetic value of his lyric productions must be questioned, Platen's claims as a reformer of the technics of poetry remain undisputed. See Platen's *Sämmtliche Werke* (1876); Schack, *Pandora* (1890); B. L. Gildersleeve, *Essays and Studies* (1890). JULIUS GOEBEL.

Plathelminthes [Gr. πλατύς, flat + ἕλμινς (plur. ἕλμινθες), a parasitic worm]: one of the divisions of the animal kingdom, embracing worm-like forms with unjointed bodies, in which no cœlom is recognizable, and in which the alimentary canal has but a single opening (mouth). Some live freely, and others as parasites. The free forms occur some on the land, some in fresh water, and some in the sea. The parasitic forms, which are usually provided with one or more suckers for adhering to the host, affect almost every group of animals, fastening themselves to the exterior, or occurring in the alimentary tract or penetrating into the various tissues of the body. Three classes are recognized: Turbellaria, Trematoda, and Cestoidea. The Nemertines, formerly regarded as members of this group, are now assigned a different position. J. S. KINGSLEY.

Platin-iridium: See IRIDIUM.

Platinum, or **Plat'ina** [*platinum* is Mod. Lat., from Span. *platina*, platinum, dimin. of *plata*, silver]: a whitish, steel-gray metal, malleable, very ductile, and as unalterable by ordinary agencies as gold. It occurs in the native state, and in this form its specific gravity ranges from 16 to 19, and its hardness upon the mineralogical scale from 4 to 4·5, being harder than either gold or silver, and a little softer than iron. When fused and refined, however, it is as soft as copper, and the gravity is increased to 21·5. The conductivity for heat at 12° C. is 8·4; for electricity of the annealed metal at 0° C. is 16·4; silver = 100. This metal was first discovered in Choco, South America, and was taken thence to Spain in 1735 by the traveler Ulloa. Its chemical and physical properties were studied by European chemists as early as 1750. The native mixture of metals from Siberia, called "polyxene," was analyzed in 1828 by Berzelius, who found it to contain iron, rhodium, iridium, palladium, copper, and osmium, the amount of platinum ranging from 73 to 86·5 per cent.

Platinum is found, like gold, chiefly in alluvial deposits, in rounded grains, *pépites* or nuggets, or in flattened scales worn smooth by attrition in the gravel of river-beds. It is there associated with gold and the other heavy metals, as iridium and iridosmine. Having nearly the same specific gravity as gold, it can not be separated from it by washing in the ordinary way, so that quicksilver, which will amalgamate with the gold and leave the platinum untouched, is used to effect the separation.

Daubrée has shown that a part, at least, of the metal from the Urals was originally imbedded with chromic iron in a serpentine rock derived from olivine. This view has been sustained by the discovery of platinum in place upon Mt. Soloncff, in an inclusion of chromite and serpentine in alternate bands with dolomite, in a country rock of olivine, or peridot, of the variety known as dunite. It has not been found, however, in regular veins in quartz, and its precise mode of occurrence is still obscure. A nugget of platinum weighing 104 grammes, associated with chromite, was found near Plattsburg, N. Y., and is believed to have been derived from serpentine rock. It has been discovered in the form of an arsenide in the Sudbury region, Ontario, Canada. This mineral, containing 52·57 per cent. of platinum, has been described under the name of sperrylite. It has the peculiar property of not being easily wetted by water, and the fine particles float on the surface. British Columbia has supplied a small amount of platinum annually since 1887. It is found in the beach-sands at Port Orford, Or., in small thin scales with osmiridium and other metals of the group. (See *Geol. Rec. Cal.*, p. 300.) The production, however, is only nominal, being incidental to gold-washing, the amount for the whole of the U. S. for 1890 being officially stated as 600 oz., and in 1898 225 oz., valued at $3,375. The metal is reported to have been found in New South Wales, but there is no notable production, and while the old localities of Columbia, Brazil, and Borneo may contribute somewhat to the total of the world's supply, the great bulk of the metal is produced in Russia from gravel deposits upon the western slope of the Ural Mountains in the government of Perm, where it is found on various private properties and state lands. In the mining district of Goroblagodat there are seventy allotments, or claims. The product of platinum is subject to a tax of 3 per cent. for leasehold claims and 4 per cent. for the freehold. There are two establishments in St. Petersburg for refining crude platinum ore, polyxene, but the greater portion of the product is exported in its crude state. Although the deposits were discovered in 1819, actual working for production of the metal did not begin until 1824, when rich deposits were found in the Nijnii-Tagilsk district.

From 1828 to 1845 platinum was coined and used as money in Russia in pieces of 3, 6, and 12 roubles; the total value of the platinum coinage was 4,250,000 roubles. During this period the production of platinum was much stimulated. When the coinage was stopped the production almost ceased for some years, but it revived in 1859. From that time the production has been variable according to the demand and price. From 1886 to 1890 the average yearly product was 206 pouds, equivalent to about 3,375 kilog., or 7,425 lb. avoir. The total production of crude platinum in Russia from 1824 to 1890, inclusive, was 6,373 pouds.

At present the most productive deposits are those at Nijnii-Tagilsk, belonging to Prince Donato, and those belonging to Count Shuvalov. In 1890 there were 5,853 men engaged in the production of platinum.

Nearly all the native platinum from the Urals is magnetic. Some masses have true polarity and hold iron filings like magnetic iron ore. There were several specimens of this kind in the collection sent to the Paris Exposition in 1867 by Prince Demidoff. One specimen at Paris was 6 inches in its greatest diameter, and weighed 13 lb. troy. A mass weighing 21 lb. is preserved in the Demidoff cabinet. Masses weighing from 9 to 12 lb. were shown by the Russian Government at Philadelphia 1876. A specimen weighing 4,728 grammes, and perfect in form, was shown at Vienna in 1873.

Platinum is infusible in any ordinary furnace, but melts freely in the flame of the oxyhydrogen or Hare furnace, and in the electric arc. Its melting-point is given as 1,779° C. When heated beyond fusion it begins to volatilize. The fused metal absorbs oxygen and "spits" on cooling. At a red heat it occludes hydrogen, which it retains on cooling. It has the property of condensing oxygen upon its surface,

and the gas so condensed has a high degree of chemical activity shown particularly in spongy platinum and Platinum Black (*q. v.*). At a red heat platinum permits hydrogen to pass through it, but is not permeable to oxygen, nitrogen, or carbonic acid. At a white heat it is easily welded, which permits of large masses being made from scraps and from platinum sponge.

Achard as early as 1784 worked the metal by alloying it with arsenic, shaping it as desired, and then expelling the arsenic by heat. The process of working platinum sponge into compact metal by compression, usually credited to Wollaston, is said to have originated with Thomas Cock, of England, about the year 1800. Since the production of large homogeneous masses by fusion before the oxyhydrogen flame, these processes have been abandoned. Dr. Hare, of Philadelphia, originated the modern method of fusion. As early as the year 1837 he melted 28 oz. into one homogeneous malleable mass. Deville and Debray, of Paris, perfected this method, and now ingots weighing 200 lb. or more are readily cast. An ingot of this weight was exhibited by Johnson & Matthey at the London Exhibition of 1862. A regulus of platin-iridium which weighed a quarter of a ton was made in 1874 for the metric commission in Paris.

The chief solvent of the metal is aqua regia, and the chloride is the most important salt. Platinum forms alloys with gold and silver and with many of the more fusible metals. These alloys are more fusible than pure platinum. When combined with iridium it forms an alloy of great hardness, especially well adapted for gun-vents and for standard weights and measures. The alloy known as platin-iridium is used for the manufacture of standard meters, and is melted in lime-crucibles upon Deville's method. For details of the process for the purification of platinum and its fusion in large quantities reference should be made to the memoirs of Deville and Debray upon platinum and the associated metals. Gold is used as the solder for platinum, but the best joints are made by the autogenic method. Molten platinum is regarded as the best standard of light.

The invention of the incandescent electrical lamp caused a great demand for platinum wire. It is estimated that the quantity required increased from nothing in 1880 to 55,000 oz. in 1892. Large quantities are consumed yearly for dental purposes, probably 35,000 oz. in the U. S. and 25,000 oz. in England. About 80,000 oz. are required yearly for sulphuric-acid stills. Chemists and jewelers require some 20,000 oz., making the entire consumption about 215,000 oz. yearly, of which probably 30 to 40 per cent. is old scrap (see *Eng. and Min. Jour.*, lv., 194). The U. S. importations of platinum for 1900 were 7,767 lb.

The price of platinum varies greatly: In Dec., 1891, it commanded $12 per oz. in New York; in Jan., 1892, $10.50; in Mar., 1892, it fell to $9. For the results of researches on the platinum metals and compounds, reference is made to a series of articles by Prof. Wolcott Gibbs in *The American Journal of Science*, xxix., 1860; xxxi., p. 63; xxxiv., p. 342; xxxvii., p. 57.

W. P. Blake.

Platinum Black: a finely divided form of platinum, resembling soot; discovered by Liebig. It has the property of condensing gases upon its surface in a remarkable degree. It absorbs many times its bulk of oxygen gas, and gives it off in contact with alcohol or ether, forming new compounds. It is capable of taking up 800 times its own volume of oxygen, and is a most active catalytic agent. Platinum sponge is another form of the metal, porous and slightly coherent, obtained by heating to redness the double chloride of platinum and ammonium. It also condenses gases upon its surface, and becomes red-hot in a current of hydrogen gas and inflames the gas. The hydrogen lamp of Döbereiner, a scientific toy used to a limited extent for producing a light before the discovery of friction matches, was based upon this property of platinum sponge.

W. P. Blake.

Pla'to [= Lat. = Gr. πλάτων, Plato, a nickname given him from his broad shoulders, deriv. of πλατύς, broad, his true name being *Aristocles* (Ἀριστοκλῆς)]: a Greek philosopher, who was born 429 B. C., and died at the age of eighty-one years. Solon and Codrus were both reckoned among his ancestors. With the opinions of all previous philosophers he seems to have been familiar. There are stories of his travels in Egypt and the East, but they rest on little or no foundation in his own writings. Aristotle shows an intimate acquaintance with his doctrines, but tells us hardly anything about him personally. The accounts given first by writers who lived many centuries after him, such as Proclus and Iamblichus, are of no value; and yet there is no philosopher of antiquity with whom we have the means of so close an acquaintance. There was one teacher whom he has made most familiar to us, and from whom, in turn, we become most familiar with the pupil: Plato and Socrates are inseparable names. They are one power in the world's movement. This view can be held without diminishing the value or the position of either. Plato is not the mere reporter, neither is Socrates the merely ideal sketch. The identity of the two minds appears especially in the *doctrine of ideas*. It is this, more than anything else, that gives character to the Platonic philosophy. It is, too, the doctrine which shows how far from the truth is the prevailing notion of this philosophy, as mystical, transcendental, imaginative, far removed from what is called "common sense" or "positive knowledge." "Nothing so clear," says the young man Simmias in the *Phædo*, "as this doctrine of reminiscence, and the ideas of the fair and the good thus awakened in the soul." The word *idea* is used in two different yet closely related aspects. An idea is, in the first place, what the mind adds to a sensation, so as to make it rational. Without it the sense is ἄλογος, as Plato supposed the animal to be (a view, in fact, held by Aristotle as well as Plato), mere sense, and of itself incapable of becoming anything more. His illustrations are drawn mainly from the mathematical ideas. In attempting to follow him here the utmost brevity must be consulted. Let us image to ourselves a confused mass of spots or points, such as the spatterings of a paint-brush thrown at hazard upon a canvas. There is visible, at first, no order, no idea —nothing for the mind, all for the sense. As far as the soul is concerned, there seems *nothing* there—or rather *no thing* since it is *form* of some kind that makes a *thing*; that is, a thing thinkable, a *res* or *reality* for the mind. The animal and the man see at first the same, neither more nor less. So far as sense is concerned, the former may even have the keener vision. The human subject at last beholds the dawning of something supersensual, though the light has come from himself. Even in a single point he sees something more than the point. It is the idea of unity. The spatterings begin to assume form, or the soul is waking up to give its own forms to the formless. He is rising above sense. He begins to see *continuity*, or the rudiments of line-extension. He looks more steadily; there is something more than mere lineality; rectilineality, or *straightness*, is coming into view. It may be a mere approach to it; for the cognition of defect, or deviation, or *non-straightness*, is just as positive an evidence of some supersensual measuring-rule or idea as the most perfect agreement. In all this he not only *cognizes*, but *re-cognizes*. This supersensual thing has an interest for him beyond anything of sense. There is beauty in it. He seems to *know* it, although it never may have crossed his sense before. Has he imagined it? What, then, called out that supersensual power? A closer gaze sees not only a series of points forming one straight line (or evenness, τὸ ἴσον), but another seeming to hold to it a peculiar relation. There is the equality, or the approach to equality, of angular spaces. Here is a new beauty, a new interest, which could not have come from lines, perfect or imperfect, inclining to each other in any manner however irregular. There is no name as yet, but the soul sees perpendicularity, and delights in it as satisfying its idea. In the same way it sees parallelism. It is another aspect of the τὸ ἴσον. It sees relation; it sees ratio, multiple, proportion. In this way one might go through the infinite range of the mathematical ideas. Their teaching is really ἀνάμνησις, recollection, but not merely the recollection of one object of sense by another, as of Simmias by Cebes, but the true calling up of something *in the soul* at the sight of some outward object serving as its perfect or imperfect diagram. It is that which gives intelligibility to the object, making it a real thing for the mind—its own creation, in fact, instead of the *tohu* and *bohu*, the utter formlessness of sense.

In an analogous way are seen the ideas of the *fair* and the *good*. The emotional mingles with them all. In the sight of a straight line even there is beauty, interest, emotion, something of the soul's own; and this is because, like all beauty, it is in some way soul seeing soul, and rejoicing at the sight. If such an appearance were made by nature, it only shows that ideas are older still, fashioning the laws and *powers* of nature in harmony with their forms and equalities. Or it is like the emotion of the boys in the *Meno* and the *Theætetus*, as Socrates, in his obstetric way,

delivers them of their mental births: it is something which they felt they had ever *known*, but did not *know* that they *knew* it. Even experience, here, teaches an *a priori* truth, strange as that may seem. A man need only carefully examine the difference in his own feelings between the learning of an inductive truth wholly from without, and the soul's recognition of an idea in geometry, in morals, or in æsthetics.

Now, this is not mystical or transcendental or a mere play upon words, as the followers of Mill would call it. It is clear as the light itself. It is, as has been said, the true doctrine of "common sense," of the κοινῶν ἐννοιῶν, and Plato is the most lucid of all writers in bringing it out. When a young man sees it, his mode of thinking, his philosophical and, in some respects, his theological, temperament is changed for ever.

Another Platonic doctrine, somewhat different from this, though often confounded with it, is that of *universals* as real existences. Nothing is more certain than that names for them are in language before the names of individuals; and that is one reason why Plato insists so much on dialectics as a mode of discovering universal truths. It is not generalization alone, but that within us, which makes us generalize, instead of being content with individual sense-objects. Without it we should be like the animal, who has no language, not from defect of vocal organs (for some are here superior to man), but because he has no inner or ideal world for which language is needed. We can not seek, says Plutarch, without some idea of that for which we are seeking. We must have some notion of universals before we can even think of classifying. *Humanity* is as real as the individual man, who becomes *man*—that is, who becomes *real*—by partaking of this divine creation. It was for this doctrine of universals that Plato was ever a favorite with the best of the Christian Fathers, the Schoolmen, and the Reformers. In the old Nominalism of Epicurus, especially as revived by Abelard, they saw the dissolution of all faith, even as the best thinkers now regard it as threatening the interest of all true science. If individuals are the only realities, it can not stop short of individual atoms. All forms are but accidental phenomena; there are no species; all are reduced to arbitrary classifications, having no standard but the ever-varying assimilations of sense.

Connected with *ideas* is Plato's doctrine of pre-existence. Did he mean an individual pre-existence? He sometimes seems to accommodate his language to such a conception. In the highly imaginative *Phædrus*, Socrates has something to say of unborn souls "riding on the supercelestial sphere." On the other hand, it is easy to see that to maintain such a pre-existence of *individual* souls in a former sense-world, like the present, would destroy the argument in the *Phædo*. The true ideal reminiscence is gone. It would only be a sense-notice in this life, recalling a preceding sense-notice in another. The whole of that immortal argument is based upon the fact of a sense-experience here, calling up an idea belonging to the very constitution of the soul regarded as lying back of all sense. It is the pre-existence, then, of something belonging to all rational souls, and by partaking of which they become rational as they are born into this life. "In the image of God made He man."

The doctrine of Plato, that evil dwells in matter, whether as an eternal or an acquired principle, might be regarded as a mere speculation, and in that sense comparatively harmless. It may be called, however, the great defect of the Platonic philosophy; not by making two eternals, but from the great practical mischief it works in its ethical teaching. It may be said to have given it ascetic features not derived from Pythagoras. It introduces a purgatorial idea into its otherwise most impressive system of future retribution; but worse than all is the view it gives of *sin* as mainly, if not wholly, belonging to the *flesh*. It is the φρόνημα σαρκός, taking the latter word literally for the very body itself, instead of using it, as Paul does, for all that is wrong in our perverted human nature. In consequence of this laying all evil upon the poor body, it ignores the sins of the spirit, or "lusts of the mind," as Paul calls them—the dire soul-sins, such as ambition, malice, revenge—that have little if anything to do with any corporeal constitution—or envy, that pure spiritual devilism, hatred of another's excellence, which a disembodied demon may be conceived as possessing in even a higher degree than the most fleshly man. These *soul-sins* are hardly mentioned by Plato at all. He stands in striking contrast with the Greek poets here, as his doctrine is equally opposed to a sound ethical psychology. The body would soon be all right, a σῶμα πνευματικόν, in fact, if the soul, the original corrupter, were perfectly pure; and yet to get away from this body, as the seat of evil, is represented, even in the *Phædon*, as the most morally deserving of human efforts.

To compensate for this great defect there is the noble argument, presented in so many places, that *virtue*, the good, the ἀγαθόν, inseparable from the καλόν, the fair, is the end of the rational life, instead of happiness, the ἡδύ, the pleasant, the agreeable, evermore resolving itself, in its more refined as well as its grosser forms, into pleasurable sensations as its ultimate analysis. If *happiness* be the *end*, whether of the individual or of the universe, then *virtue* is a *means*, a subordinate thing; and that is a position which Plato could not bear. It was not a compromise between Hedonism and Cyreneacism, that is, an identifying virtue with happiness, and making the latter, in the end, the unfailing accompaniment of the former, or, as it is commonly expressed, virtue its own reward. Any such thought of compensation would have destroyed the Platonic idea: "Men must serve God, or serve the good, for naught." See the picture of "the superlatively righteous man" (ὁ δικαιότατος ἀνήρ, in the second book of the *Republic*, 360, 361). He has the ring of Gyges that gives invisibility; he can do all evil with impunity and without reproach; yet is he righteous still. He may be the very opposite of this, having the reputation of unrighteousness, and no means of ever reversing the unjust decision; yet is he righteous still. The picture, even thus far, tries our Christian faith, but it does not stop here. He may be made to endure the severest pains, with no prospect of deliverance either now or at any other time; yet he is righteous still. The hope of compensation must have no place on the canvas. Finally, says this strange painter, what may a man thus conditioned expect from his fellow men? Wonderful is the answer: Ὁ δίκαιος, οὕτω διακείμενος, μαστιγώσεται, στρεβλώσεται, δεδήσεται, καὶ, τελευτῶν, πάντα κακὰ παθὼν, ἀνασχινδυλευθήσεται (The righteous man in this state will be scourged; he will suffer dislocating tortures; he shall be bound with cords, and, finally, after suffering all evils, he shall be impaled or crucified.) It is not at all strange that some of the Christian Fathers were almost inclined to regard this as a prophecy of Him, "the Prince and Perfecter of Faith," who, "instead of the joy set before him (ἀντὶ χαρᾶς), endured the cross, despising shame," that we might be "partakers of his righteousness." In another place (*Gorg.*, 494, 495) the same exhausting process is pursued in respect to *pleasure*. The ἡδύ, or happiness, if it is the end of being, becomes simply a question of *quantity*. It is the amount that is to be considered, whether it be the glut of some exquisite moment, or a thinner pleasure hoarded for its rarity and spread over a longer period. The cultivated Cyrenean has no right to talk of his refined happiness and to condemn that of others as gross and low. If the ἡδύ is the ἀγαθόν, then it constitutes the ἀγαθὸς ἀνήρ, and the man who gets the most of it is "the better man." Then, too, if the world were one huge ζῷον, so made as to be quivering forever with the maximum of ecstatic sensational delight, that would be the best of all possible worlds. Discard the ἀγαθόν as the end of life, and the maxim *De gustibus non est disputandum* becomes the highest ethical rule. Happiness in that case is only to be judged by its degree or its intensity. If there are real differences in pleasures, so that some may be called *good* and others *bad*, then there must be some more ultimate principle, not resolving itself into happiness or into "self-rewarding virtues," according to which their respective ranks and moral values are to be determined. The argument is unanswerable, and this gives rise to a like extreme statement in the opposite direction. Some of the lowest pleasures, as they are called, excel all others in the fullness of their pleasing sensations. Let the man who chooses this have it for his portion to all eternity—no palling, no abatement; one everlasting succession of never-paining, never-cloying, pleasurable, and even ecstatic, emotion. The Almighty might have made it so. He has, indeed, most mercifully put Nature in the way, making her his executioner, instead of the lawgiver, as a certain kind of modern ethics are inclined to regard it. Plato, however, presents it as an ethical and æsthetical supposition. What should we think of one who had chosen, and to whom there was permitted, for ever, such an uncloyed existence? The answer is most dramatically brought out of the moral feeling, even of the sensualist. Socrates but gives back to him his own rising thoughts: "Such an existence, would it not be δεινὸς καὶ αἰσχρός—awful and shame-

ful?" "Would he not be ἄθλιος, a very *wretch* indeed, not in the sense of pain, but as denoting the extreme of degradation and perdition, abhorrent to the rational mind?"

What is called Plato's hedonic view is carried even into the state. As he says, in the beginning of the fourth book and in other parts of the *Republic*, the object of government is not so much to make men happier or richer as to secure a healthy civic organism—ὅπως ὅτι μάλιστα ὅλη ἡ πόλις —"for in such a commonwealth may we best hope to find righteousness." There is the same idea in the *Gorgias*, that the true statesman is he who aims not to *please*, but to leave the people morally better, "healthier in their souls," than he found them.

There is one feature in the Platonic *Dialogues* which has not received the attention it deserves. Allusion is made to what are called the Platonic myths. For the more extensive and gorgeous of them the reader is referred to the close of the *Republic*, the *Phædon*, and the *Gorgias*; the first two setting forth the retributions of the unseen world, and the third the appalling scenes of the spiritual judgment "*for sins done in the body.*" Nowhere out of the writings of Paul does this expression assume a more terrific significance. The "sins done in the body," all appearing as marks in the soul, not one, the least, having failed in stamping itself upon the tablet of the eternal spiritual memory. There is the myth of *Prometheus* in the *Protagoras*, the fanciful myth of the *Phædrus*; the wholly original and splendid myth of the *Politicus*, setting forth the alternating cosmical periods, the one of the divine order, the other of Nature left to herself, when (in direct opposition to the latest scientific holdings) she inevitably begins to degenerate, as having in herself no principle of progression, or even of permanence, though even in her abandonment she may preserve some portions of the spermatic reasons that were sown during her diviner circuit.

Some dialogues, even quite long ones, seem to come to no result. These have been called *tentative*, sometimes skeptical. Socrates himself is made to style them the *kathartic*, sometimes the *kunegetic*. Their object is to evacuate the soul of error before the attempt to fill it with truth—to chase away the idols of the cavern in order to admit the sunlight with its realities; or, to use another figure, to test whether the idea so long sought proves to be, on its birth, a true offspring of the soul or nothing more than an ὠὸν ἀνεμιαῖον, an abortion, or *wind-egg*, to be cast away.

There have been various translations of Plato, such as those of Taylor, Sydenham, Victor Cousin, and others. The one, however, which for the English reader must supersede all others is that of Jowett. He has transferred this most spiritual and colloquial Greek into the most vivacious and, at the same time, idiomatic English. See Socrates, Idea, and Idealism, Philosophy, Plotinus, Immortality, Realism, and Soul. Revised by W. T. Harris.

Platt, Charles Adams: See the Appendix.

Platt, Thomas Collier: politician; b. in Owego, N. Y., July 15, 1833; was educated at Yale College, but early gave up the idea of a professional career; entered into business, was president of the Tioga National Bank, afterward of the United States Express Company; took an active part in politics, and was elected a member of Congress in 1873 and 1875. On Jan. 18, 1881, he was chosen U. S. Senator, but, on account of a disagreement between him and the executive with respect to the appointment of the collector of the port of New York, he resigned his seat on May 14, 1881. He was again elected to the U. S. Senate Jan., 1897.

Platt, William Henry: See the Appendix.

Plattdeutsch, or **Low Saxon**: the eastern branch of Low German. The term "Plattdeutsch" occurs first in the middle of the seventeenth century. Low Saxon is spoken in Northern Germany, its area covering about one-third of that of the German empire. It passes beyond the German boundary only toward the W., where it is found in the eastern provinces of the Netherlands. (See Dutch Language.) The boundary between Low Saxon and Low Frankish—and further on between Low Saxon and Midland German—lies E. of the Rhine, and may be roughly indicated by a line running from the southeast corner of the Zuyder Zee to a point a few miles beyond Elberfeld in the direction of Siegen. There it turns northeastward, running in an almost straight line to the Elbe, N. of Wittenberg. From Wittenberg the boundary-line takes its course eastward until it crosses the Spree near Lübben. There it again turns to the N. E., crosses the Oder at Fürstenberg, and finally reaches the Slavonic frontier in the Prussian province of Posen, near Birnbaum on the Warthe. In the east and north the boundary of the Low Saxon dialect coincides with that of the German language, which is, however, not exactly identical with that of the German empire.

There are, according to time and locality, several varieties of Low Saxon, viz.:

(1) *Old Saxon*, from the earliest times until about the end of the eleventh century. The earliest monument is a baptismal vow, composed for the mission among the heathen Saxons in 772 or soon afterward. The year 830 is generally assumed as the date of the most important work in Old Saxon, viz., the so-called *Heliand* (i. e. Saviour), a poem of about 6,000 lines in alliterative verse, narrating the life and death of the Saviour according to the four Gospels. Its author seems to have been a monk of the monastery Werden on the Ruhr. It is certain that the poem originated in the neighborhood of the Low Frankish dialect. For a long time the text of the *Heliand* was known from two fairly complete manuscripts (the *Cottonianus*, *C*, and the *Monacensis*, *M*) and a short fragment found in 1880 at Prague (and accordingly marked *P*). Another fragment (*V*) was discovered in Apr., 1894, by Prof. Zangemeister, of Heidelberg, in the Vatican Library at Rome. The same MS. in which this was found also contains several fragments (amounting altogether to 337 lines) of an Old Saxon *Genesis*, written like the *Heliand* in alliterative verse, and probably also the work of the author of the *Heliand*. This discovery is important in several respects, since it throws additional light on the question of the origin of the *Heliand*, and, among others, confirms the theory advanced in 1875 by Prof. Sievers that part (viz., about 600 lines) of the Anglo-Saxon *Genesis* was translated from an Old Saxon poem.

To the ninth and the beginning of the tenth century belong, furthermore, a formula of confession (apparently older than the *Heliand*), two charms, a fragment of a translation of one of Beda's homilies, two leaves (badly conserved) from a commentary to the Psalms, lists from two monasteries of taxes which they were entitled to collect, and finally several collections of glosses. Old Saxon dialect forms are recognizable, too, in one of the earliest and most important Old High German poems, the *Hildebrandslied*, which was transcribed into High Frankish from an Old Saxon original. Most of the remnants of Old Saxon literature come from the western part of the Saxon territory, especially from Westphalia and the districts near the area of the Low Frankish dialect. There existed at that time no common literary language in Low German, each scribe using, as a rule (i. e. unless he copied, more or less closely, the dialect of another manuscript), his own dialect. Toward the end of the tenth century literary production in Old Saxon apparently came to a stop; at least there is in tradition at that time a break which extends beyond the next 200 years.

(2) *Middle Low Saxon*, from the twelfth to the end of the sixteenth century. This period is distinguished from Old Saxon by differences similar to those that separate Middle Dutch from Old Dutch, or Middle High German from Old High German, the most noticeable among which is the transition of the earlier various vowels of inflectional endings into the one vowel *e*. There is every reason to believe that these changes took place gradually. The year 1100 is an approximative limit between the two periods, although, as far as literary tradition is concerned, the former ceases during the tenth century and the latter does not commence before the beginning of the thirteenth. The earliest poetical work in Middle Saxon appears to be the rhymed chronicle of Gandersheim (a convent in Brunswick, near the Hartz Mountains), written in 1216 by the priest Eberhard. Among the earliest prose works is the *Sachsenspiegel*, a description of the Saxon common and feudal law, made by the knight Eyke von Repechowe (or Repgau, in the duchy of Anhalt), probably between 1220 and 1230. This is one of the most important works in Low German and one of the chief sources of Germanic law. It was soon adopted as a legal code in Northern Germany and was imitated in Southern Germany by similar works, the best known of which is the *Schwabenspiegel*. To a cleric, who, like the author of the *Sachsenspiegel*, belonged to the family von Repgau in Anhalt, is due the first attempt in Middle Saxon historical prose, viz., the so-called *Saxon* or *Repgowish Chronicle*, written in or soon after the year 1237. It is noteworthy that most of the earlier Middle Low Saxon literature belongs to the region N. and E. of the Hartz Mountains, in the vicinity of Goslar, Blankenburg, Bernburg, and near the frontier of

those districts in which formerly Slavonic was spoken. Later on the center of literature is shifted northward, and a predominant position is occupied by the Hanse towns, Bremen, Hamburg, Lübeck, Lüneburg, Brunswick, Stralsund, Riga, and others. The culmination of Middle Low Saxon or, as it is generally termed, Middle Low German literature (from about 1350 to 1500) almost entirely coincides with that of the Hanseatic League. There is from the fourteenth century downward a remarkable uniformity in the literary language, which finds its explanation by the fact that the official language of the Hanseatic League (sometimes called *de ostersche Sprake*, the eastern language), or, in other words, the dialect of its metropolis, Lübeck, furnished the basis for a fixed literary language. The differences between the local dialects of Lübeck, Hamburg, Bremen, Lüneburg, Stralsund, and other towns of Northern Germany were from the outset very slight. Using in script the same dialect as Lübeck did not for these towns mean adopting a new but simply writing their own dialect. After this dialect had gained the rank of an official and literary language among the Northern German towns it was gradually adopted in literary usage in the southern and western parts of the Low Saxon territory, where it differed considerably from the local dialects. Traces, indeed, of local peculiarities are found in works written, e. g., in Brunswick or in Westphalia, but not to such an extent as we should find them if the scribes had really intended to write in their own dialect. Even in charters and private deeds the usage of local dialects is more and more superseded by that of the literary language. It is for this reason impossible to gain from our sources a correct idea of the condition of the Low German dialects at the Middle Saxon time. There is in Middle Low German after 1350 an extensive literature, both in poetry and in prose. Most of the poetical works lack in originality, and do not, with the exception of the beast-epic and of several ecclesiastical dramas, reach the standard of Middle High German literature. The best-known poem is the beast-epic *Reineke der Vos*, published at Lübeck in 1498. The work is a mere translation of the Dutch *Reinaert*. It follows closely that edition of *Reinaert's Historie* which about 1487 had been published by the Dutch schoolmaster Heinric van Alkmaer; but the unknown Low German author has translated so skillfully that his work reads like an original poem. It at once met with general favor and before 1662 there were 14 Low German editions, 7 Latin, 3 Danish, and 1 Swedish. As regards prose works, Middle Low German is in every respect superior to Middle High German. The prose style had been cultivated in Middle Saxon at an early date in legal, historical, and ecclesiastic writings. The authors even of those early works show a perfect command of the language, and we must admire, in translations as well as in works written originally in Low German, on the one hand a natural gift for narrating in a simple and entertaining manner, on the other hand a remarkable ability in expressing abstract thoughts and in easily handling difficult syntactical relations. Specimens of Low German prose of the best time are Detmar's *Chronic of Lübeck* (written between 1386 and 1400), the *Seelentrost* (a dogmatic work, preserved in several MSS., the earliest of which is from 1407), and the *Passional* (printed at Lübeck in 1488 and later, also found in earlier MSS.). After the beginning of the sixteenth century, when the Hanseatic League was losing its influence and High German began to occupy a predominant position in the Church and in literature, Low German entered upon a period of decline. The transition of the sixteenth to the seventeenth century marks the limit between Middle Saxon and Modern Saxon, since by that time High German had in Northern Germany become the recognized literary language.

(3) *Modern Low Saxon*, from about 1600 to the present time. While the present Low Saxon dialects differ considerably from Middle Low Saxon, there is but little difference between the language of the sixteenth and that of the early seventeenth century. Not a few Middle Low German books intended for the use of the people appeared in new editions in the first half of the seventeenth century, and in exceptional cases even later. The last Low German Bible was printed in 1621. With the exception of these posthumous works of Middle Low German literature, Low Saxon in the seventeenth and eighteenth centuries takes the position of a popular dialect, which is admitted into regular literature only occasionally and for special purposes—e. g. in rustic poems or in poems that ridicule current fashions and follies (especially those of the upper classes), or contrast Low German with High German. Here belong the *Veer Schertz Gedichte* (Four Humorous Poems), published in 1652 by Prof. Lauremberg (see Lauremberg, Johann), and in the eighteenth century several original poems (e. g. *Die hülflose Sassinne*) and translations of Vergil's *Eclogues* and of some of Horace's *Epistles and Satires* (partly published in 1729 and 1732, partly extant in a MS. volume of 1738), by the rector Caspar Abel. Low Saxon scenes occur in melodramas and comic operas of the sixteenth and the seventeenth centuries, the Low German peasant being a traditional favorite in the jester's part. Among the *Idyllen*, written in hexameters by the well-known poet Joh. Heinr. Voss, there are two in Low Saxon, viz., *De Winterawend* (1775) and *De Geldhapers* (1777). His example caused Joh. P. Hebel to publish in his native South German dialect his *Allemannische Gedichte*, which soon became popular, and in return encouraged Low Saxons to avail themselves more frequently of their dialect in poetry. There is at present an ample literature in Low Saxon, both in poetry and in prose, representing many local varieties of the dialect. The best-known modern authors in Plattdeutsch are Fritz Reuter (1810–74) and Klaus Groth (b. 1819). The former gained a prominent place among the German humorists by his *Ut mine Stromtid* (i. e. In my Farming Time), *Dörchläuchting* (i. e. His Highness), and other tales from Low German country life, written in the Mecklenburg dialect and collected under the name of *Olle Kamellen* (i. e. Old Stories). Groth's chief work is the *Quickborn* (i. e.—Spring of Life), a collection of poems written in the dialect of Ditmarschen (in Holstein), which were first published in 1852 and have gone through many editions since. While Reuter is an eminently realistic author, Groth's purpose was to write poems in which the Low German people might recognize themselves in an idealized form. Notwithstanding these and many other attempts to secure for the Plattdeutsch a place in literature, High German is at present in Northern Germany the language of literature, and also that of the school and the Church, of the Government, and of the educated classes. Low Saxon, as a spoken language, is losing ground from day to day. Even where the people still adhere to the Plattdeutsch, which as a rule is the case in the country districts, the genuine dialect is becoming adulterated by words and constructions borrowed from High German. On the other hand, the value of Low Saxon, both in its literary monuments and in its living dialects, as a means for investigating the development of German mental life and the history of the German language, is more and more appreciated. The center of the efforts that are made to this end is the Low German Dialect Society (*Verein für niederdeutsche Sprachforschung*), founded in 1875, whose publications consist of an annual volume (*Jahrbuch*), a monthly periodical (*Korrespondenzblatt*), a series of Low German texts (mostly reprints of earlier works), and a collection of dictionaries and grammatical studies. Among the works undertaken by individual scholars, the most important is the *Sprachatlas von Nord- und Mitteldeutschland*, which is being compiled, with the support of the German Government, by Dr. G. Wenker at Marburg. This author sent to every schoolteacher in Germany a sheet containing forty simple sentences in Modern German, and asked for a translation into the local dialects. These sentences were selected so as to contain certain words in which the peculiarities of the various dialects should appear. The 44,251 answers furnished him with the material for his maps. The first number of the *Sprachatlas*, containing six maps, appeared in 1881. Publication, however, was subsequently abandoned, and the author now gives his autograph maps to the Royal Library at Berlin for preservation. They are open to the inspection of scholars. The Modern Low Saxon dialects fall into two groups, viz., (1) Northeast Saxon, in Oldenburg, Bremen, Hanover, Brunswick, Hamburg, Holstein, Mecklenburg, Brandenburg, Pommern, East Prussia; (2) Westphalian, in the Prussian province of Westphalia and in the principality of Waldeck. The former are better known, since the writings of Reuter and Groth belong to that group. They are closely related to the Hanse dialect of Middle Low German literature. The Westphalian dialects are especially noteworthy on account of their vowel system, which to this day preserves many original features that were lost in the northeastern group more than 600 years ago. There are numerous local varieties in both groups.

References.* (*a*) *Old Saxon.*—Old Saxon literature is treated by R. Kögel in his *Geschichte der deutschen Litteratur*, vol. i., pt. 1 (Strassburg, 1894), p. 276, *seq.*, and in Paul's

* Works on Low German dialects in general are given under (*c*).

Grundriss der german. Philologie, vol. ii., pt. 1 (Strassburg, 1893), p. 198, *seq.* The best critical edition of the *Heliand* is the one by Sievers (Halle, 1878), which gives the MSS. *C* and *M*. The Prague fragment, *P*, was published by Lambel (Vienna, 1881), the Vatican fragment, *V* (with the Vatican fragments of the *Genesis*, by Zangemeister and Braune), in *Neue Heidelberger Jahrbücher*, iv., nr. 2 (Heidelberg, 1894). There are smaller editions, with vocabulary, by Rückert (Leipzig, 1876, with notes), Heyne (3d ed. Paderborn, 1883), and Behaghel (Halle, 1882). The best dictionary is Schmeller's *Glossarium Saxonicum* (Munich, 1840). The smaller Old Saxon texts are found in Heyne's *Kleinere altniederdeutsche Denkmäler* (2d ed. Paderborn, 1877). A new edition by J. H. Gallée is to appear at Leyden. For Old Saxon grammar, see Gallée's *Altsächsische Grammatik*, i. (Halle and Leyden, 1891), and W. Sehlüter, *Untersuchungen zur Geschichte d. altsächs. Sprache*, i. (Göttingen, 1892).

(*b*) *Middle Low Saxon.*—A brief sketch of Middle Low Saxon literature by H. Jellinghaus is found in Paul's *Grundriss*, ii., 1, p. 419, *seq.*; a fuller account of the poetry in Goedeke's *Deutsche Literaturgeschichte*, i., pp. 457–484. The Gandersheim chronicle was published by Weiland in *Deutsche Chroniken*, vol. ii., p. 397, *seq.* There is a critical edition of the *Sachsenspiegel*, by Homeyer, in 3 vols. (1835–44; vol. i. in 3d ed. 1861), and smaller editions by Weiske (6th ed. 1882) and by Lübben (1879). An edition of the *Saxon* or *Repgowish Chronicle*, by Weiland, appeared at Hanover in 1877. Recent editions (with vocabulary) of the Low Saxon *Reineke der Vos* are those by Lübben (Oldenburg, 1867), by K. Schröder (Leipzig, 1872), and by Prien (Halle, 1887). Many Middle Low Saxon texts are still unpublished. The elements of Middle Low Saxon grammar and specimens of various literary works are given in Lübben's *Mittelniederdeutsche Grammatik mit Chrestomathie und Glossar* (Leipzig, 1882). A comprehensive dictionary, in six volumes, was begun by Schiller in 1872 and finished by Lübben in 1881. There is a handy dictionary, in one volume, by Lübben and Walther (Norden, 1888).

(*c*) *Modern Low Saxon.*—For a bibliography of works on Low German in general and Modern Low Saxon in particular, see C. F. Herrmann, *Bibliotheca Germanica* (Halle, 1878), p. 67, *seq.*; von Bahder, *Die deutsche Philologie* (Paderborn, 1883), p. 160, *seq.*; Kauffmann, in Paul's *Grundriss*, i. (1891), p. 968, *seq.*; Mentz, *Bibliographie der deutschen Mundartenforschung* (Leipzig, 1892); also the *Jahresbericht über germanische Philologie*, vol. i., *seq.* (Berlin, 1879, *seq.*). Important periodicals are *Die deutschen Mundarten* (vols. i.–vi., 1854–58; vol. vii., 1877); *Jahrbuch des Vereins für niederd. Sprachforschung* (vol. i., *seq.*, 1875, *seq.*); *Korrespondenzblatt des Vereins für niederd. Sprachforschung* (vol. i., *seq.*, 1874, *seq.*). There are several dialect maps, e. g. Bernhardi, *Sprachkarte von Deutschland* (2d ed. Cassel, 1849); Piper, *Die Verbreitung der deutschen Dialekte bis um das Jahr 1300* (Lahr, 1880). Laurenberg's *Veer Schertz Gedichte* have been reprinted by Braune (Halle, 1879). Selections from Abel's poems are given by Hofmeister in the *Jahrbuch* of the Low German Dialect Society, vol. viii., p. 115, *seq.* (collected by Gaedertz). There is a small *Plattdeutsches Wörterbuch zu Fritz Reuters Werken*, by Frehse (Wismar, 1867). Groth's *Quickborn* contains a brief but valuable glossary by K. Müllenhoff. A comprehensive collection of specimens of the various dialects is Firmenich's *Germaniens Völkerstimmen* (3 vols., Berlin, 1843–68). Grammars and dictionaries are: (1) Northeast Saxon: Nerger, *Grammatik des mecklenburgischen Dialekts* (Leipzig, 1869); *Versuch eines Bremisch-Niedersächsischen Wörterbuches* (6 vols., Bremen, 1767–1869); Ten Doornkaat-Koolmann, *Wörterbuch der ostfries. Sprache* (3 vols., Norden, 1879–84); Schambach, *Göttingisch-Grubenhagensches Idiotikon* (Hanover, 1858); Schütz, *Holsteinisches Idiotikon* (4 vols., Hamburg, 1800–06), etc. (2) Westphalian: Holthausen, *Die Soester Mundart* (Norden, 1886); Woeste, *Wörterbuch der Westfälischen Mundart* (Norden, 1882). On classification of modern dialects and differences between Northeast Saxon and Westphalian, see Jellinghaus, *Zur Einteilung der niederdeutschen Mundarten* (Kiel, 1884); Wenker, *Das rheinische Platt* (Düsseldorf, 1877); reports on Wenker's *Sprachatlas* in *Anzeiger f. dt. Alterthum* (Berlin, 1892, *seq.*); Jostes, *Schriftsprache und Volksdialekte* (in *Jahrbuch* of Low German Dialect Society, xi., p. 85, *seq.*); Collitz, *Ueber das vergleichende Studium der niederdeutschen Mundarten* (in *Korrespondenzblatt* of Low German Dialect Society, xi., p. 23, *seq.*) HERMANN COLLITZ.

Platter (or **Plater**), THOMAS: See the Appendix.

Platte River: a stream formed in Lincoln co., Neb., by the union of the North and South Forks. The former rises in the North Park, Col., receiving the Sweetwater, the Laramie, and other streams. The South Platte flows from the South Park of Colorado, and in its upper course is extensively utilized in irrigation and as a source of water-power. The united stream flows E., and reaches the Missouri at Plattsmouth. It is the widest affluent of the Missouri, but neither the largest in volume nor the longest. Its mouth is over 1,000 yards wide, but it is so shallow that it can nowhere be navigated with much success. Its valley is generally very fertile. The drainage area is estimated at 7,500 sq. miles. The Loup Fork and Elkhorn are the chief tributaries. Length of the main stream, 900 miles.

Platteville: city; Grant co., Wis.; on the Little Platte river, and the Chi. and N. W. and the Chi., Mil. and St. P. railways; 18 miles N. N. E. of Dubuque, Ia. (for location, see map of Wisconsin, ref. 7–C). It is in an agricultural and lead-mining region, contains a State normal school, a national bank with capital of $50,000, and two weekly newspapers, and has several flour- and planing-mills, foundries, etc. Pop. (1880) 2,687; (1890) 2,740; (1900) 3,340.

Plattsburg: village; capital of Clinton co., N. Y.; on the Saranac river at its entrance into Cumberland Bay, a part of Lake Champlain, and on the Chateaugay and the Del. and Hudson railways; 20 miles N. W. of Burlington, Vt., 155 miles N. of Albany (for location, see map of New York, ref. 1–J). It has an excellent harbor, good water-power from the lake, and a large lake commerce and lumber-trade. There are 4 national banks with combined capital of $400,000, a daily, 2 monthly, and 2 weekly periodicals, U. S. Government building, the finest U. S. army barracks in the Union, a State normal school, academy, 2 libraries, and woolen-, flour-, and saw-mills, several large pulp-mills, and 3 foundries, sewing-machine factory, and machine-shops. Plattsburg is becoming noted as a summer resort. It is the home of the Roman Catholic Summer School of America, an institution on the plan of Chautauqua. In Sept., 1814, Commodore McDonough gained a victory over a British fleet in Cumberland Bay, and Gen. Macomb repulsed a superior British force on land. Pop. (1880) 5,245: (1890) 7,010: (1900) 8,434. W. H. FERRELL, EDITOR OF "THE PRESS."

Plattsmouth: city (site acquired by the U. S. Government by treaty with the Indians in 1854, incorporated as a town in 1855); capital of Cass co., Neb. (for location, see map of Nebraska, ref. 10–H); at the confluence of the Platte and Missouri rivers; on the Burlington Route and the Mo. Pac. railways; 22 miles S. of Omaha. It is engaged in the grain-, cattle-, and lumber-trade, and has 4 cigar-factories, brick- and terra-cotta works, carriage- and wagon-factories, and the principal shops of the Burlington Route Railway. There are 11 churches, 8 public-school buildings, including a high school that cost $25,000; court-house that cost $80,000; opera-house that cost $50,000; gas and electric light plants; improved water-works; new sewerage system; a national bank with capital of $50,000, and 2 State banks with capital of $100,000; and 3 daily and 3 weekly newspapers. Pop. (1880) 4,175; (1890) 8,392; (1900) 4,964. EDITOR OF "HERALD."

Platyp'tera [Mod. Lat., from Gr. πλατύς, broad + πτερόν, wing]: the order of insects which includes the white ants and which is also known as Isoptera. See ENTOMOLOGY and TERMITES.

Plat'ypus: See DUCKBILL and ORNITHORHYNCHIDÆ.

Plauen, plow'en: town; in the kingdom of Saxony, Germany; on the Elster; 78 miles by rail S. of Leipzig (see map of Germany, ref. 5–F). It has many good educational institutions, and large manufactures of paper, leather, muslin, cambric, jaconet, and other woolen and linen goods. Pop. (1890) 47,007.

Plau'tus, TITUS MACCIUS: play-writer; b. about 254 B. C. at Sarsina, in Umbria; went early to Rome, where he found employment with the actors; saved some money and started a business of his own, but failed; worked afterward at a hand-mill at Rome, and wrote, while thus employed, three comedies, which he succeeded in selling to the managers of the public festivals. They were well received, and from this time till his death, 184 B. C., he lived as a play-writer. The plots, and also generally the characters, of his plays he took from the Greek comedians, as Menander, Diphilus, Demophilus, and Philemon, but both underwent a very free treatment and a thorough Latinization, which may be in-

ferred from the general character of his dialogue; it is not only fluent and witty, but racy and taken fresh from the lips of the people. In his handling of the meters he shows great skill and versatility. While Terence, who was much more elegant, but also a much closer imitator of the Greeks, complains that the audience ran away from his plays to look at some rope-dancer, Plautus remained a favorite with the Romans down to the time of Diocletian, and was appreciated not only by the masses, but also by the most fastidious people—e. g. Cicero. According to Gellius, there existed 130 plays which bore his name, but the number of those unquestionably genuine Varro limited to twenty-one, which are doubtless those extant, namely, *Amphitruo*, *Asinaria*, *Aulularia*, *Bacchides*, *Captivi*, *Casina*, *Cistellaria*, *Curculio*, *Epidicus*, *Menæchmi*, *Mercator*, *Miles gloriosus*, *Mostellaria*, *Pœnulus*, *Persa*, *Pseudolus*, *Rudens*, *Stichus*, *Trinummus*, *Truculentus*, and *Vidularia*. Of the last of these, only fragments remain in the Ambrosian palimpsest. The great progress made in Plautine criticism in the nineteenth century is due largely to Ritschl and his school. The great critical edition begun by him was completed by Loewe, Goetz, and Schoell (Leipzig, 1871–94). A notable contribution also is Studemund's *Plauti fabularum reliquiæ Ambrosianæ* (Berlin, 1889). See also Ussing's complete edition with Latin notes (5 vols., Copenhagen, 1875–86). The Plautine literature is very extensive. Of annotated editions of separate plays may be mentioned *Captivi*, *Trinummus*, *Miles*, and *Menæchmi*, by Brix (Leipzig); *Miles*, *Mostellaria*, and *Pseudolus*, by Lorenz (Berlin); *Captivi*, by Hallidie; *Miles*, by Tyrrell; *Amphitruo*, by Palmer; *Rudens* and *Mostellaria*, by Sonnenschein; *Pseudolus*, by E. P. Morris. There is an English translation by Thornton and Warner (5 vols., 1767–74); another by Riley (2 vols., 1852).

Revised by M. Warren.

Playa: a name adopted from the Spanish (meaning, literally, shore or strand), for barren mud-plains, left by the evaporation of temporary lakes in arid regions. Typical examples occur in many of the desert valleys of the Great Basin, between the Rocky Mountains and Sierra Nevada. The winter is there the rainy season, and water collects in the valleys, forming shallow lakes, or "sinks," which are sometimes 200 or 300 sq. miles in area, but do not overflow. These lakes usually evaporate to dryness during the succeeding summer, but in other instances exist for a series of years, and are desiccated only during seasons of exceptional dryness. These "playa-lakes" are always alkaline, and of a yellowish color, owing to the exceedingly fine silt held in suspension. The deposits they leave on evaporating become so hard that the wheels of a heavy wagon leave but a slight impression on them. Their surfaces shrink and crack so as to resemble a tessellated pavement of cream-colored marble. In some instances the playas become coated with efflorescent salts during the summer, and then appear as if covered with drifting snow. Excavations made in the playa-earth fail to reveal a stratification of the deposit. In some instances land- and fresh-water shells are washed into the playa-lakes, and bones of land-animals and other stream-borne *débris* may be contributed by the streams which feed them. The valleys of the Great Basin are filled to the depth of many hundreds of feet with playa-deposits, and in some instances, judging from the character of the nearly buried mountain-peaks in the centers of broad deserts, the depth of filling must be measured by thousands of feet. Playa deposits bear a striking similarity to the loess of Asia, and seem to indicate the mode in which that deposit was formed. (See Loess.) Consult *Lake Lahontan*, *Monograph No. 11, United States Geological Survey*, and *Subaërial Deposits of the Arid Region of North America*, in *Geological Magazine*, vol. vi. (London, 1889).

Israel C. Russell.

Playfair, John: scientist; b. at Benvie, Forfarshire, Scotland, Mar. 10, 1748; educated at the University of St. Andrews, where he was distinguished for his attainments in natural history; became a minister of the Scotch Church 1772; held the living of Benvie 1773–82, when he resigned, removed to Edinburgh, and became a private tutor; was appointed assistant Professor of Mathematics in the University of Edinburgh 1785, Professor of Natural Philosophy 1805, and became in the same year general secretary of the Edinburgh Royal Society. He was a frequent contributor to the *Transactions* of that body, as well as to *The Edinburgh Review*; published *Illustrations of the Huttonian Theory of the Earth* (1802) and *Outlines of Natural Philosophy* (2 vols., 1812–16), containing the substance of his university lectures. Prof. Playfair was one of the precursors of the geological discoverers of the nineteenth century, and traveled in search of geological data in France, Switzerland, and Italy; left incomplete at his death an interesting *Dissertation on the Progress of Mathematical and Physical Science*, prepared for the supplement to the *Encyclopædia Britannica*. D. in Edinburgh July 19, 1819. A collected edition of his works was issued at Edinburgh (4 vols., 1822).

Revised by G. K. Gilbert.

Playfair, Lyon, Baron, K. C. B., F. R. S., LL. D.: scientist and statesman; b. at Meerut, in Bengal, May 21, 1819; educated at St. Andrews, Scotland, and the Andersonian University, Glasgow; studied chemistry under Graham and Liebig; engaged in industrial chemistry; became in 1843 Professor of Chemistry in the Royal Institution, and was in 1844 appointed on the commission constituted to examine into the sanitary condition of the large towns and populous districts of Great Britain; was appointed special commissioner in charge of the department of juries at the London exhibition of 1851, and in 1858 took the chair of Chemistry in the University of Edinburgh; became in 1868 a Liberal member of Parliament for the Universities of Edinburgh and Aberdeen; postmaster-general 1873–74; and held many other public positions of importance. He was made a K. C. B. in 1883 and raised to the peerage as Baron Playfair of St. Andrews in 1892. Together with W. Gregory he edited Liebig's *Chemistry in its Application to Agriculture and Physiology*, and is the author of numerous scientific memoirs—*Science in its Relation to Labor* (1853); *On the Food of Man in Relation to his Useful Work* (1865); *On Primary and Technical Education* (1870); *On Teaching, Universities, and Examining Boards* (1872); *Universities in their Relation to Professional Education* (1873); *Science in Relation to the Public Weal* (1885), and a variety of minor papers. D. in London, May 29, 1898.

Playing-cards: a kind of cards used for playing games. In modern times, and for the most common games, a pack of cards numbers fifty-two, and consists of four suits, two red (hearts and diamonds) and two black (clubs and spades), each suit comprising thirteen cards—three picture-cards, the king, queen, and knave; and ten pip-cards numbered from one, the ace, to ten. Chinese packs have only thirty cards—three suits of nine cards each, and three single cards, which rank higher than the others. In India and other countries there are various other kinds of playing-cards, and in Europe and America innumerable games require cards made especially for them.

The traditional history of European playing-cards derived them, like chess, from Asiatic sources. In one account it is asserted that the Saracens first introduced them into Spain and Italy, and that thence they spread to the rest of Europe, while other authorities attribute their origin to China and to India; but later investigations have thrown much doubt on all previous theories, and it is claimed that playing-cards originated in Europe itself, probably in the fourteenth century. Prior to their invention, cards with emblematic pictures were used in fortune-telling. The first packs for playing-purposes varied in the number of picture cards, but pip-cards were from the first divided into four suits. The modern hearts, diamonds, clubs, and spades were designated in Italy and Spain by cups, money, clubs, and swords, and in Germany by hearts, bells, acorns, and leaves. All symbolic meanings attached to these devices are fanciful.

The fifty-two card pack has existed substantially as at present since the fifteenth century. Indicators, or small indexes placed at the corners of the cards, were introduced in 1860. The modern production of playing-cards is enormous; the number of packs made annually runs up to the tens of millions. Their manufacture is a Government monopoly in Russia, and in Great Britain and the U. S. forms a subject of special taxation. The first games played were chiefly of chance, but the tendency has generally been toward those that require greater skill. See E. S. Taylor's *History of Playing-cards* (1865); Willshire, *Descriptive Catalogue of Cards in the British Museum* (1877); Van Rensselaer, *The Devil's Picture-books* (New York, 1890). For a description of the most common games, see Whist, Cassino, Euchre, Seven-up, etc.

S. A. Torrance.

Plea [M. Eng. *plee*, *plai*, *plait*, from O. Fr. *plait*, *plaid* < Lat. *pla'citum*, judgment, opinion, decision, liter., that which is pleasing to one, deriv. of *place're*, please]: in the common-law system of pleading, strictly, the first defense

or statement of fact interposed by the defendant in an action at law. (See PLEADING.) The term plea is also used as a name for an action or suit, as in the expression *court of common pleas* (see COURTS); also in the expression *pleas of the crown*, used to designate the criminal cases in England, in which the crown is the nominal PROSECUTOR (*q. v.*), although in fact the prosecutor is usually a private person.

F. STURGES ALLEN.

Pleading [deriv. of *plead* < M. Eng. *pleden*, *plaiden*, from O. Fr. *plaidier*, deriv. of *plaid*, plea. See PLEA]: in law, the making of the written allegations of the parties to an action, by which they state their respective claims and defenses and finally arrive at an issue of fact or of law, the decision of which will determine the judicial controversy between them; also (in the pl.) the allegations themselves. The pleadings of an action are a part of the steps comprehended under the general term PROCEDURE (*q. v.*), and, like the other parts of procedure, they are marked in the early stage by a rigid and excessive formality which is unsuited to the needs of our modern civilization. This early excessive formality and the subsequent modifications to meet the needs of changing circumstances can be noted here only as it has taken place in the law of England and the U. S. Only pleading in civil actions will be here treated of, since, although the terminologies in civil and criminal pleading differ, the principles are the same; thus, an *indictment* in a criminal action corresponds to the *declaration* or *complaint* of a civil action. Prior to the comprehensive reforms effected by statute there had long existed in England and the U. S. three different types or species of pleading—*common-law* pleading, *equity* pleading, and pleading by *allegation* (in the admiralty and ecclesiastical courts).

Common-law Pleading.—The common-law method prevailed exclusively in the courts of law. At a very early period the parties to a suit appeared in open court and made oral statements of their claims and defenses in the actual presence of the judges, which were at once written down by an officer of court; and this official transcript constituted the record of the proceedings. This oral mode seems to have continued until about the middle of the reign of Edward III. The common-law system, as it was subsequently perfected, arose from the substitution of written allegations in the place of these oral ones; and such writings, instead of being presented to the judges themselves sitting in court, were filed by the attorneys in the offices of the proper clerks.

The first pleading by the plaintiff was the *declaration*, which contained a statement of the cause of action made in a highly artificial, formal, and technical manner, and in language which differed widely from the English of ordinary narrative, and also indicated the particular form of action which the plaintiff had adopted.

If the defendant admitted the truth of the facts set forth by the plaintiff, but denied that in law they constituted the cause of action against him, his pleading was termed a *demurrer*. If, however, he desired to present an issue of fact, his pleading was styled the *plea*. The pleas by the defendant, and all subsequent pleadings in the suit by either of the parties, were separated into two classes—those by way of *traverse*, which directly denied all of the essential statements of fact contained in the preceding pleadings of the adverse party; and those by way of *confession and avoidance*, which admitted such statements to be true, but alleged other and new facts obviating and destroying their legal effect. If the defendant's plea was a traverse, an issue of fact was formed at once; if it was in confession and avoidance, the plaintiff must interpose a *replication* or a demurrer. In this manner the alternate allegations were conducted until either an issue of law was presented by a demurrer or an issue of fact by a direct affirmation on the one side and a denial thereof on the other; in actual practice, however, the series seldom was extended beyond the replication.

The rules which governed the common-law system and regulated the manner of making the averments were exceedingly refined, precise, and formal, and litigations were often decided upon the most technical questions, without reference to the merits of the controversy.

Equity Pleading.—In a case in equity the complainant's case was stated in a *bill of complaint* and the defendant's in an *answer*, and these ordinarily constituted the only pleadings, although a few particular defenses were set out in a form known as the *plea*. The parties were not subjected to the technical rules of the common law, but used a more natural mode of statement. The pleader averred not only the principal facts constituting the ground for relief or the defense, but also the evidence by which these facts were substantiated, so that the cause could often be decided upon these averments alone.

Pleading by Allegation.—The mode of pleading in the court of admiralty and the ecclesiastical courts was substantially identical, in respect to the matters required to be stated, with the equity method, and differed from that simply in the external form of the averments. Each important fact, together with the detail of evidence concerning it, was contained in a separate paragraph, technically termed an *allegation*, so that the LIBEL (*q. v.*) of the complaining party, which corresponded to the declaration and the bill of other courts, was separated into a number of distinct paragraphs or allegations, each relating to a single fact or occurrence.

Code Pleading.—The injustice and delay occasioned by these formal and cumbersome methods of pleading led to the series of reforms which have created the systems of code pleading. In the U. S. the Legislature of New York began the reform in 1848 by effecting for that State a radical change in these modes of pleading by the adoption of the Code of Civil Procedure; the reform thus inaugurated has extended into most of the States and Territories of the U. S. In England the first decisive step in this direction was made by the Common-law Procedure Act of 1854; but the system of code pleading was not fully adopted there until the Judicature Acts of 1873 and 1875 consolidated all the common-law and equity courts, and abolished the distinction between legal and equitable suits and the rules which governed the common-law pleading. The parties in all actions are required to state the facts constituting the ground of relief or the defense as they actually existed, in ordinary language, without any technical formality, and without any averments of evidence or of legal conclusions. In some of the States the first pleading by the plaintiff is denominated the *complaint*, in others the *petition*, while in England it is called the *statement of claim*. The only pleading of fact by the defendant is styled the *answer* in all of the several States, but in the English practice the *statement of defense*. Under certain circumstances the plaintiff must put in a *reply*, but the pleadings of fact can seldom extend beyond this point. The defendant may demur to the plaintiff's complaint, petition, or statement of claim, and to his reply; and the plaintiff may demur to the defendant's answer or statement of defense. The underlying principle of this reformed system is natural, correct, and at the same time truly scientific, but in its practical application there is yet much to be learned. See the works of Stephen, Chitty, Story, and Gould on *Pleading*; Odgers's *Principles of Pleading* (in England); Bishop's *Code Practice in Personal Actions* (in New York); and the *Reports of the Royal Commissioners on Practice and Pleading* (1829–34 and 1851–60); also the *American and English Encyclopædia of Law*.

JOHN NORTON POMEROY.
Revised by F. STURGES ALLEN.

Pleas of the Crown: See PLEA.

Pleasonton, ALFRED: soldier; b. in the District of Columbia, Dec., 1823; graduated at the U. S. Military Academy 1844; assigned to First Dragoons; captain Second Dragoons Mar., 1855; major Second Cavalry Feb., 1862. He took part in the war against Mexico, and served on frontier duty as acting assistant adjutant-general. In the civil war he served throughout the Virginia Peninsular campaign of 1862; appointed brigadier-general of volunteers July 16, 1862, he commanded in September the division of cavalry following Lee's army. He was engaged at Boonsboro, South Mountain, Antietam, and Fredericksburg; at Chancellorsville his action was most effective in checking the further advance of Stonewall Jackson's corps, which threatened to carry all before it. Promoted to be major-general in June, 1863, he was engaged in the actions preceding Gettysburg, where he also commanded in chief the cavalry; transferred to Missouri in 1864, he drove Gen. Price from the State. He received the brevets of lieutenant-colonel, colonel, brigadier- and major-general for gallantry in the field. Mustered out of the volunteer service Jan., 1866, he in 1868 resigned his commission in the regular army, and became U. S. collector of internal revenue. He was appointed major U. S. army Oct. 19, 1888; retired 1888. D. in Washington, D. C., Feb. 17, 1897.

Pleasure: See PAIN.

Plébiscite, plā'bi-seet' [Lat. *plebiscitum*]: in modern France, a decree of the whole nation obtained by universal suffrage, a proceeding which both Napoleon I. and Napoleon III. used in order to legitimize their *coups d'élat*. After the dissolution of the Directory, Nov. 9, 1799, Napoleon I. appealed to the nation in this way, and Napoleon III. did the same after the dissolution of the National Assembly, Dec. 2, 1851, the first *plébiscite*, in May, 1804, giving a majority of 3,572,399 votes; the second, in Nov., 1852, giving a majority of 8,157,752 votes. In the Roman republic a *plebiscilum* was a law passed at the *comitia tribula* by the *plebs* or commons on the rogation of a tribune, and was different from a *lex*, which was passed at the *comitia centuriata* by the *populus* or patricians on the rogation of a consul or other senatorian magistrate.

Plebs and Plebeians: See PATRICIAN.

Plecop'tera [Mod. Lat., from Gr. πλέκειν, twist + πτερόν, wing]: that order of insects which contains the so-called stone-flies (*Perlidæ*), and which receives its name from the fact that the broader hinder wing is folded, when at rest, beneath the other, much as in the grasshoppers. The larvæ are very abundant in fresh-water streams, where they crawl about beneath stones, etc., and furnish a considerable element in the food-supply of many fishes. In Europe several species are used for bait in fishing, one being called "yellow Sally" and another "willow-fly." See ENTOMOLOGY.

J. S. KINGSLEY.

Pledge: See PAWNBROKING and MORTGAGE.

Pleiade: name assumed by a group of seven Greek poets of the third century B. C., and in imitation of them by seven French poets of the sixteenth century, who, inspired by the revival of the study of classical letters, strove to renew French language and literature in their image. They were Pierre Ronsard, who came to be the leader of the movement, Joachim du Bellay, Remi Bellau, Jean Daurat, Pontus de Thyard, Antoine de Baif, and Étienne Jodelle. A. G. C.

Ple'iades, or **Plei'ades** [= Lat. = Gr. Πληιάδες and Πλειάδες; cf. πλεῖν, to sail, their rising indicating the beginning of the time of safe navigation]: in astronomy, a group of stars in the shoulder of Taurus, called "the seven stars," though to most eyes only six are visible, while keen eyes can see eleven. There are, however, hundreds of telescopic stars in the group, and Herschel has shown that they are, physically, closely related to each other. In Grecian mythology the seven stars were seven daughters of Atlas and Pleïone, one of whom (Sterope) became invisible from shame, because she had been embraced by a mortal. S. NEWCOMB.

Pleistocene Period [*pleistocene* is from Gr. πλεῖστος, most + καινός, new]: the latest division of geologic time, or the division succeeding the Neocene period and preceding historic time. The terms Quaternary era, Post-tertiary period, Glacial period, and Ice-age are synonyms. Most of the geologic periods are distinguished one from another by means of their faunas and floras, but the Pleistocene is primarily distinguished by peculiarities of its climatic history. The climate of the earth, or of a large part of it, was then colder than it had previously been for several geologic periods, and colder than it is at present.

Extent of Glaciation.—The most striking feature connected with this lowered temperature was the growth of mountain glaciers and the creation of immense ice-fields where none had existed before. The evidence of these changes is found not only in certain deposits of peculiar composition, but in equally peculiar types of topographic form. In unglaciated regions streams descend over successively gentler slopes from head to mouth. Lakes are of rare occurrence, being confined for the most part to deltas and to interior basins. In glaciated regions there is relatively little continuity of slope, lakes are abundant, and the courses of streams are irregular. In unglaciated regions the soil results from the disintegration and decomposition of the rock beneath, except that the alluvium along streams consists of gravel and finer particles brought down by the streams. In glaciated regions the soil is never derived directly from the rock beneath, but consists of material transported from a greater or less distance. This material, known as DRIFT (*q. v.*), differs from alluvium in that some of its bowlders are of great size, in that its transportation has not been simply down the slope, in that its materials are not generally rounded and sorted, and in other ways. Beneath the drift the bed-rock lies undecomposed, and its surface is usually polished or covered with parallel scratches and grooves. Deposits made by water are in general smooth of surface, and slope in the direction of the depositing current. Deposits from ice are of uneven surface, abounding in knolls and undrained hollows. By the aid of such data as these the following general facts have been learned with reference to the distribution of the Pleistocene ice. In North America the small glaciers of the Rocky Mountains and the Sierra Nevada, and the greater glaciers of Alaska, were all expanded, descending the mountain slopes to greater distances. Glaciers were also formed on many mountains where they no longer exist. The glaciers of the Alaskan mountains and the western mountains of British America extended so as to coalesce and fill the intervening valleys, producing an ice-field comparable with that of Greenland. At the same time a much larger field was formed in Northeastern America. Its northern limits are not yet determined, but it extended eastward to the Atlantic Ocean, westward nearly to the northwestern field just mentioned, and southward over the Great Lakes into the U. S. (See GEOLOGY, map No. 2.) New England was completely buried, nearly the whole of New York, and parts of New Jersey and Pennsylvania. The Ohio river was reached near Cincinnati, and the Missouri at many points. Indeed, the present courses of the Ohio and Missouri were largely determined by the position of the ice-front. In Europe the glaciers of the Pyrenees, Alps, and Caucasus were greatly extended. Those of Scandinavia not merely coalesced, but spread to immense distances eastward, southward, and southwestward, making an ice-field several times greater than that of Greenland. A large part of Russia, Poland, Denmark, and Holland, and parts of Germany and Belgium were covered, as also were the North Sea, the whole of Scotland and Ireland, and all but the southern extremity of England. In the Himalayas, Tian Shan, and other high mountains of Asia the local glaciers were increased. The combined ice-fields of Europe and North America were then equal to the present great ice-field of the Antarctic continent.

In the southern hemisphere the changes were equally significant, although less in areal extent by reason of the smaller ratio of land to water. It is believed that the Antarctic ice-field was extended. The mountain-glaciers of Patagonia were expanded, becoming confluent and overrunning the greater part of the peninsula, so as to produce a field little inferior to that of Greenland. The southern island of New Zealand was largely overrun by ice, and a few glaciers were created in Australia and South Africa.

Associated Phenomena.—Where the glaciers reached the ocean they broke up into icebergs, which distributed the detrital matter widely over the bottom of the sea, and some portions of this sea-bottom have since been lifted into land. Elsewhere ice-tongues served as dams, obstructing the free drainage of valleys and creating temporary lakes, by means of which iceberg drift was transported. Some of the most important of these occupied the basins of Lake Winnipeg and the Laurentian lakes, but instead of discharging to Hudson Bay and the Gulf of St. Lawrence, found outlet southward to the Mississippi and Ohio, and eastward to the Hudson. (See AGASSIZ, LAKE.) In regions of interior drainage the cooler climate, by diminishing evaporation and possibly by increasing rainfall, caused the creation or expansion of lakes which left permanent record in the form of beach-lines and sediments. Great Salt Lake, Utah, Pyramid Lake, Nevada, and the Caspian and Dead Seas of Asia were all greatly enlarged. (See BONNEVILLE, LAKE, and LAHONTAN, LAKE.) Coincident with the greatest expansion of glaciers were local changes in the relative altitude of land and sea, and to some extent the connection of these has been definitely established. Thus certain gravels, sands, and terraces on the plains bordering the Atlantic and Gulf coasts of the U. S. have been determined to be of Pleistocene age.

As the temperature fell, animals and plants of polar and temperate zones gradually worked toward the tropics, and as the temperature again rose they slowly migrated poleward. At each locality, therefore, there was a series of life-changes corresponding to the climatic changes, and to some extent these are recorded by fossils in contemporaneous deposits. They are recorded also by a peculiar isolation of various species upon mountain tops. During the period of rising temperature the plants and animals favored by low temperature were able to adjust themselves to changing conditions not only by migrating poleward, but also by ascending mountain slopes; and thus many mountain tracts in temperate regions came to be inhabited by colonies of plants and animals belonging to distant latitudes and separated

from cognate floras and faunas by wide intervals whose present climate is a complete barrier to intercommunication.

Cause of Climatic Changes.—One of the vexed questions of geology is the cause of the Pleistocene cold. One theory ascribes it to variations in the quantity of heat radiated by the sun. This theory is adequate, and, as regards the earth, simple; but it has not been widely entertained, because no satisfactory explanation has been offered of the postulated variation in solar radiation. A second theory is based on secular variations in the relation of the earth to the sun. The eccentricity of the earth's orbit varies slowly and irregularly, and it is computed that two important maxima of eccentricity have occurred at late geologic dates. The theoretic effect of high eccentricity is to produce a glacial climate in one hemisphere and a mild climate in the other, the difference depending on the relation of the solstices to perihelion. When these relations are reversed through precession, the climates of the two hemispheres would be interchanged, and such interchange should theoretically occur many times during each period of maximum eccentricity. This theory has received more attention and is more widely entertained than any other. A third theory assumes that the axis of rotation has changed its position with reference to the earth's surface, or, in other words, that the pole has wandered, carrying with it glacial conditions. This theory seems adequate, but there is no independent evidence that the pole has thus wandered, and a competent cause for any permanent or large change of position has not been discovered. A fourth theory appeals to geographic changes, especially changes in the distribution of land and water. As large aqueous precipitation is necessary to the formation of glaciers, their present distribution is greatly influenced by the relation of bodies of warm water to bodies of cold land. Thus ocean currents are important factors. The directions of ocean currents are determined by the distribution of land and water. It can readily be imagined that the land and water of the globe might be so distributed as to prevent, on the one hand, or greatly increase, on the other, the polar accumulations of ice, and the theory appeals to this possibility; but it has not yet been ascertained that the actual arrangement of land and water in Pleistocene time was such as to produce the climates which then existed. A fifth theory ascribes Pleistocene glaciation to a general and great uplifting of the regions in which it occurred. This cause is probably competent, but it has not been shown that the glaciated districts actually had great elevation at the time when their glaciers were formed. In the presence of so large a number of theories deserving serious consideration, it is needless to enumerate less plausible explanations, of which a considerable number have been suggested. The body of known facts is of such importance, and the body of pertinent and obtainable knowledge is so vast, that we may feel assured a satisfactory explanation will eventually be found.

Complexity of Pleistocene History.—In many places glacial deposits are overlain by peat or other deposits which could not have been formed beneath the ice, and these in turn are overlain by other glacial deposits. In this way it is shown that mountain glaciers and lowland ice-sheets advanced and retreated more than once. In the opinion of some students, such advances and retreats were numerous and of great amount, so that there were in effect a considerable number of glacial epochs. In the opinion of others, there were two principal glacial epochs, separated by an interglacial epoch, when the climate did not differ greatly from that of the present time. A third opinion recognizes but one great climatic revolution, this being characterized by minor oscillations, causing the ice margin to advance and retreat over narrow areas. When this question has been settled, an important contribution will have been made to the question of cause, for the current theory, founded on the astronomic history of eccentricity and precession, implies a long alternation of glacial and mild climates in each hemisphere, while the theories of varying solar energy and geographic change can most plausibly be appealed to in explanation of a single great climatic event.

Closely related to the question of complexity is the question of synchrony. While there is much evidence to show that the ancient glaciation of different continents and different hemispheres occurred in the same general portion of geologic time, it is as yet impossible to say whether the great climatic changes of widely separated regions occurred at the same time.

Literature.—Although the Pleistocene is the shortest of all the geologic periods, its literature is by far the most abundant. This is due largely to the fact that the Pleistocene deposits, being last formed, overlie all others, and are exceptionally prominent and accessible. From these abundant data it is possible to derive some comprehension of the complexity of the physical history of the period, and the field for discussion thus opened has proved fertile and attractive. It may fairly be assumed that the histories of other geologic periods are equally complex, and appear simple only from the paucity of data for their determination.

Additional information in regard to glacial sculpture may be found in the articles Glaciers and Mountain. (See also Drift and Geology.) The question of the unity or diversity of the period is discussed by Wright and Chamberlin in *The American Journal of Science* for 1892 and 1893. The following books and papers discuss the causes of the glacial climate, and describe the more important of the American Pleistocene phenomena: Chamberlin's *Hypotheses as to the Cause of the Glacial Period* (*American Geologist*, vol. viii., 1891); *Terminal Moraine of the Second Glacial Epoch* (*Third Annual Report, United States Geological Survey*, 1883); *Rock Scorings of the Great Ice Invasions* (*Seventh Annual Report, United States Geological Survey*, 1888); Croll's *Climate and Time* (1875), *Climate and Cosmology* (1885); Dawson's *Later Physiographical Geology of the Rocky Mountain Region of Canada* (*Transactions of the Royal Society of Canada*, vol. viii., 1890); Geikie's *Great Ice Age* (1873), *Fragments of Earth Lore* (1893); Gilbert's *Lake Bonneville* (*Monograph I., United States Geological Survey*, 1890); Wright's *Ice Age in America* (1887).

G. K. Gilbert.

Pleonasm [from Gr. πλεονασμός, superabundance, deriv. of πλεονάζειν, to be more than enough]: the use of more words than are strictly necessary for the bare expression of an idea. It involves the use of words whose idea is already contained in some other part of the statement, generally in some part which is syntactically different. It represents, though logically inaccurate, a natural linguistic method of enhancing and enforcing an idea, or of giving it clearer definition, and appears in the greatest variety of usages; thus, *like as if*, *from henceforth*, *most unkindest*, φεύγειν φυγῇ, to flee in flight, *the reason why he did this is because*, etc.

Benj. Ide Wheeler.

Plesiop'idæ [Mod. Lat., named from *Ple'siops*, the typical genus; Gr. πλησίος, near + ὤψ, ὠπός, eye, face]: a family of fishes of the order *Teleocephali*. In external appearance they have some resemblance to the American sunfishes, the body being oblong, compressed, and covered with moderate scales; the lateral line is interrupted; the head rounded anteriorly; the opercula unarmed; the mouth has a lateral cleft, and the upper jaw is moderately protractile; teeth small, on the jaws as well as palate; branchial apertures continuous below; branchiostegal rays six; dorsal elongated, with the spinous portion longer than the soft; anal with its soft part opposite that of the dorsal, and armed with three spines; pectorals with branched rays; ventrals each with a spine and four soft rays. These fishes are especially recognizable by the development of only four soft rays in the ventral fins. They inhabit the salt water, and extend from the Red Sea to the Pacific Ocean. The scientific name alludes to the approximation of the eyes, resulting from the narrow frontal bones.

Plesiosau'rus [Mod. Lat.; Gr. πλησίος, near + σαῦρος, lizard]: a genus of large extinct marine reptiles, which were abundant in Mesozoic time, but had no representatives in the Tertiary. The skull was small, and the teeth were in distinct sockets. The neck was much elongated, and the tail comparatively short. The limbs were in the form of paddles, resembling those of the turtles, and were nearly of the same size before and behind. Some members of the group were of enormous size, and others quite small. The genus *Plesiosaurus* is not rare in European formations, but has not been found in America, its chief representatives there being *Pantosaurus* in the Jurassic, and *Cimoliosaurus* in the Cretaceous.

O. C. Marsh.

Pleskov: See Pskov.

Pleth'ora [Mod. Lat., from Gr. πληθώρη, fullness, plethora, deriv. of πλῆθος, multitude; cf. πλήρης, full]: among older medical authorities, the condition now commonly called full-bloodedness. This excessive richness in the quantity or quality of the blood was thought to be indicated by the redness of the skin and mucous membranes, the full, bounding

pulses, the tendency to hæmorrhages and palpitations, and other symptoms. Modern investigation, however, has shown that these symptoms are the result of peculiarly vigorous circulation and not of excess of blood.

Plethysmograph: See RECORDING APPARATUS, PSYCHOLOGICAL, in the Appendix.

Pleu'ra [Mod. Lat., from Gr. πλευρά, rib, side]: a thin membrane that lines the cavities of the chest, extending over the external surface of the lungs. It consists of two closed sacs. The portion lining the chest is distinguished as the costal pleura, and is a sheet of elastic cellular tissue loosely attached to the ribs, muscles, and adjacent parts. That lining the lungs, known as the pulmonary pleura, is composed of a superficial layer of fine cellular tissue and a second elastic layer of coarser fibrous tissue, which materially assists in expiration. Both portions of the pleura are covered inside with a delicate layer of endothelium, and the narrow spaces inclosed in each sac are known as the pleural cavities, and are kept constantly supplied with a serous fluid which enables the opposite layers to glide easily upon each other in the movements of respiration.

In *entomology* the pleura is the side of the stethidium between the thorax and pectus. Revised by W. PEPPER.

Pleurisy, or **Pleuritis** [*pleurisy* is from Fr. *pleurésie* < Lat. *pleu'risis*, for earlier *pleuri'tis* = Gr. πλευρῖτις, pleurisy, deriv. of πλευρά, rib, side]: inflammation of the PLEURA (*q. v.*), acute or chronic. It may be what is called dry, with little or no effusion, or it may be accompanied by effusion. Pleurisy may be caused by exposure to cold, injuries to the membrane itself (traumatism), or the communication of inflammation from adjacent structures. This latter head includes many causes, such as inflammation of the lung, of the chest-wall, of the diaphragm, and of the organs contiguous to the wall of the chest and the diaphragm. Besides these, a very common cause of pleurisy is tuberculosis; and in patients who have repeated attacks of pleurisy this is probably almost always the cause. Rheumatism is also a cause of pleurisy, and it may occur in the course of fevers, especially in smallpox and scarlet fever. Blood-poisoning (septicæmia) is quite a common cause of pleurisy, and so is disease of the kidneys.

In the dry form of pleurisy the first change visible is a clouding of the cells on the surface of the pleura, so that it loses its beautiful transparent luster and looks opaque, reddened, slightly roughened, and is marked by minute congested blood-vessels. This congestion sometimes causes a rupture of small vessels and the pouring out (extravasation) of small quantities of blood beneath the surface layer of the pleura. After this there often form on the surface of the pleura patches of organized lymph (plastic exudate) like adherent flakes. At this stage of pleurisy the exudate may be reabsorbed and the patient may recover perfectly, or it may remain as an organized deposit on either the lung pleura (visceral pleura) or the pleura covering the chest-wall (parietal pleura), or that of the diaphragm or mediastinum. This form of pleurisy may also result in adhesions between the opposite pleural surface and the formation of patches of adhesion or of bands, narrow but of appreciable length, limiting the movement of the lung in the thoracic cavity.

In pleurisy with effusion (hydrothorax) there is poured out more or less excess of the fluid which ordinarily merely lubricates the pleural surfaces. When this effusion is small it may cause no appreciable trouble, and indeed entirely escape detection; when it is extensive, it may press the lung into a very small space, and so seriously interfere with respiration and circulation as to cause death. A pleuritic effusion may become purulent by the multiplication in it of pus cells. This constitutes empyema, a condition which endangers life, not only by mechanical pressure on the lung, but also by the impairment of the constitution incident to the presence in the body of what is practically a huge abscess. An empyema may remain for some time without communication with the outer air, or it may burrow its way out through the walls of the chest or the diaphragm, or into a bronchial tube. In the latter case the pus is discharged by coughing.

The symptoms of pleurisy are fever, pain in the side, difficulty in breathing, and often a dry, unproductive cough. A patient often finds it easier to lie upon the affected side, because the motion of the side is thereby restricted. There are general symptoms of illness, by which the disease may be distinguished from neuralgia or rheumatism of the chest-wall. The physical signs of dry pleurisy are very slight, consisting chiefly in the sound of rubbing (friction sound) between the two roughened pleural surfaces. In the stage of effusion the sounds are those to be expected from the displacement of the air vesicles of the lungs by a fluid. Percussion over the former discloses resonance, while there is dullness or flatness on percussion over the area occupied by fluid, whether this be serous or purulent. In pleurisy there is always some impairment of the motion of the side of the chest affected, and evidences of interference with the function of respiration, such as shortness of breath and imperfect aëration of the blood, are often plainly discernible by the eye. Where there is much effusion there is bulging of the affected side, and obliteration of the lines of depression which normally exist between each pair of ribs. With such effusions there is sometimes displacement of the heart and even encroachment upon the opposite side of the chest. After the fluid of pleuritic effusion has been absorbed, or that of empyema has been carried off or discharged, the crowded lung sometimes fails to expand again and to occupy the full lung space of its side of the chest. This may be due to permanent contraction of the lung, or to the formation, when it is contracted, of adhesions to the chest-wall, which prevent the lung from resuming its former dimensions. In either case the thorax becomes distorted by depression of the chest-wall under the pressure of the atmosphere, especially in young subjects.

The treatment of pleurisy without effusion is usually simple, consisting in measures to promote excretion from the bowels, from the kidneys, and from the skin, with rest in bed and judicious diet. No medicines are needed except such as contribute to these ends or as are used to allay pain. Pleurisy with effusion requires more treatment and often surgical measures to rid the chest of its accumulated fluid. When the effusion is serous it may be removed easily and simply by the operation of tapping the chest. The most perfect form of tapping is that by means of an instrument called "the aspirator," invented by a French physician, Dieulafoy. In this, a suction pump, attached to a tube and a hollow needle, is used to withdraw fluid from the chest. When the effusion of pleurisy is purulent, the accumulation must be treated on the same principles as those that govern the treatment of abscesses elsewhere in the cavities of the body. So long ago as the time of Hippocrates such cases were treated wisely and skillfully by surgical operation—that is, by making an incision through the chest-wall and allowing the fluid to come away. In modern times such abscess cavities are treated by opening, emptying, washing out—especially with medicated fluids—and prolonged drainage by means of the insertion of tubes, or even by the removal of a portion of a rib or ribs.

In itself pleurisy is not a very dangerous disease, but if it be caused by constitutional disease like tuberculosis, or if it occur in a patient with a poor constitution, or if it be unwisely managed, it may end in death or permanent disability. CHARLES W. DULLES.

Pleurisy-root: See ASCLEPIAS and BUTTERFLY-WEED.

Pleurodel'idæ [Mod. Lat., named from *Pleuro'deles*, the typical genus; Gr. πλευρά, side, ribs + δῆλος, visible]: a family of salamanders chiefly inhabiting the Old World. The palatines bear teeth on the inner margins; prefrontals as well as pterygoids are present; the frontals are broad, and not embraced by the parietals; the occipital condyles are sessile; the parasphenoid has no dentigerous plates; the vertebræ are only concave behind; the carpus and tarsus are ossified. The typical species has the ribs protruding through the sides of the body, in allusion to which the name *Pleurodeles* has been given. J. S. KINGSLEY.

Pleurodi'ra [Mod. Lat.; Gr. πλευρά, side + δειρή (dial. for δέρη), neck]: according to some authors, a sub-order of the order *Testudinata*, or tortoises; distinguished by the neck bending sideways and the incapability of retraction of the head completely under the carapace, and thus contrasting with those tortoises in which the neck bends in a vertical plane. The pelvis is fixed to the carapace and plastron. The group embraces families peculiar to the southern hemisphere and related forms found in the early epochs of the northern. The generally recognized families are *Podocnemididæ*, *Chelydidæ*, *Hydraspididæ*, *Pelomedusidæ*, and *Sternothæridæ*. Revised by D. S. JORDAN.

Pleuronec'tidæ [Mod. Lat., named from *Pleuronec'tes*, the typical genus; Gr. πλευρά, side + νήκτης, swimmer]: a family of fishes including the ordinary flat-fishes, such as flounders, turbots, halibuts, plaice, etc. It belongs to the

order *Heterosomata*. The body is always much compressed, with one of its sides (which is upward when the animal is reclining on its side) dark-colored, and the other (which is downward) generally white; the scales are variously developed (sometimes ctenoid, sometimes cycloid, and sometimes wanting); the head compressed; both eyes are on the same side, one being on or near the forehead, the other comparatively low down; opercula normal, unarmed; mouth terminal, and with an oblique lateral cleft and of various extent; branchial apertures continuous below; branchiostegal rays five to eight; dorsal elongated, extending generally from about the rostral region to near the caudal fin; anal fin also elongated, and extending about as far back as the dorsal; both are composed almost solely of articulated rays; caudal fin distinct from the dorsal and anal; pectorals on both sides; ventrals jugular. The skeleton has numerous vertebræ; pyloric cæca are generally developed, but in small number. The species of the family thus defined are distinguishable into three sub-families—(1) *Pleuronectinæ*, in which the mouth is small, and the supramaxillary ends before or under the front of the eye; (2) *Hippoglossinæ*, in which the mouth is large, and the supermaxillaries extend more or less under the eye, and the ventrals are lateral; and (3) *Rhombinæ*, in which the mouth is large, and the ventral fin on the dark side inserted on the ridge of the abdomen. The species are numerous, and are found distributed in every sea, and some of them ascend rivers. They live chiefly on sandy bottoms, and rest with their white side below and the dark one upturned. Although almost all have the eyeless side white or colorless, a few have dull spots on that side, and in some species it is colored like the eyed side. The very young have the body vertical in the water and the eyes symmetrical. In the process of development the body becomes horizontal, and the head is twisted or modified so that the eye of the lower side is transferred around or through the head to the opposite side. In the U. S. the most common species in the markets of the Eastern States are the small-mouthed flounder (*Pseudopleuronectes americanus*), a large-mouthed flounder (*Paralichthys dentatus*), and the halibut (*Hippoglossus hippoglossus*). The American species are mostly different from those of Europe, and the true turbot, like the true sole, has never been taken in American waters. Revised by D. S. Jordan.

Pleuro-pneumonia: one of the names by which the ordinary type of pneumonia (croupous pneumonia) has been designated. It signifies that the pleura or covering of the lung is inflamed at the same time as the lung itself. This is always the case in croupous pneumonia; but exceptionally the pleural involvement is of such prominence that the term pleuro-pneumonia seems specially applicable. W. P.

Pleuro-pneumonia (of cattle), or **Lung Plague**: a contagious febrile disease of cattle, characterized by a progressive interstitial pneumonia, in which the inflammatory process usually extends to the pleura.

It has been known from the time of the first written records of the diseases of animals. It has often followed in the wake of European armies, having been spread by the cattle carried along for food. This disease has existed in all countries of Europe, with the exception of Norway and Sweden, and has been carried by cattle from these infected countries to Great Britain, Africa, Australia, and North America. Lung plague usually spreads rapidly among the cattle of a country into which it is introduced, unless restrictive measures are adopted to prevent traffic in diseased and possibly diseased animals. In 1839 cattle from The Hague carried this malady to Cork, Ireland, and from this point the British Isles became infected. A British ship landed a cow suffering with pleuro-pneumonia at Brooklyn in 1843. Many cattle in the adjacent districts became infected from this source, and the disease gradually spread until herds were infected in several of the Eastern States. Subsequently shipments of diseased cattle carried pleuro-pneumonia to Kentucky, Indiana, Illinois, and Missouri. The disease has, however, been completely stamped out in the U. S. by the bureau of animal industry. The symptoms of lung plague are fever, dry muzzle, accelerated pulse and respiration, depression, cough, and the altered sounds upon auscultation and percussion that indicate pneumonia and pleurisy. In about one-half of the cases death occurs in from two to four weeks after the beginning of an attack. Of the remaining cases about equal numbers become chronic and recover. After death the lungs have a peculiar "marbled" appearance, due to the exudation of yellowish serum into the thick layers of connective tissue which separate the dark colored and hepatized areas of lung tissue. In advanced cases the lung becomes broken down and caseous in spots that range in size from that of a walnut to that of a child's head. These areas are encapsulated in a fibrous membrane. It sometimes happens that cattle that have apparently recovered convey the disease to others after several months or years have passed, and this is explained by the fact that these capsules may break, allowing their semi-fluid contents to escape.

No therapeusis that has been tried is of any value, so efforts to cure have been abandoned, and governments have made regulations providing for the quarantine of diseased and suspected animals and for the slaughter of all that are regarded as dangerous to healthy cattle. It was by the enforcement of these measures that the U. S. freed itself from pleuro-pneumonia, and the same measures are (1894) being employed in England with good prospects.

It is estimated that for a long series of years the annual loss to Great Britain from lung plague amounted to £2,000,000. It is impossible to estimate accurately the amount of loss caused by this disease in the U. S., but it is known to amount to several million dollars. Leonard Pearson.

Plevna (Bulgarian, *Pleven*): town of Bulgaria; on the Vid; 26 miles S. of the Danube (see map of Turkey, ref. 3-C). Here the Ottoman army under Osman Pasha was besieged by the Russians from July 18 to Dec. 10, 1877, and, after a desperate resistance, was forced to surrender, 43,000 men being taken prisoners. This was the critical event of the Russo-Turkish war. Pop. (1888) 14,307.

Plin'y (full Latin name *Gaius Plinius Secundus*), generally called **Pliny the Elder**: author; b. at *Novum Comum*, 23 A. D., of a noble and wealthy family; served in the army under Domitius Corbulo and Pomponius Secundus in Germany, where he composed *De Jaculatione Equestri* and began a history of the wars in Germany (*Bellorum Germaniæ libri xx.*); was in Rome again in 52; studied jurisprudence and began to practice. During Nero's reign he composed his *Studiosus*, in 3 books, and *Dubius Sermo*, in 8 books. According to a Greek inscription found in Arados, which Mommsen refers to Pliny, he served in the Jewish war in Syria in 70 and was afterward *procurator Syriæ*. We know also that he was procurator in Spain under Vespasian, and that he must have been in Gaul and Africa, but it is impossible to date his journeys. In Rome he lived in great intimacy with the Emperors Vespasian and Titus, and was suffocated by the eruption of Vesuvius in 79. There is a detailed and very interesting account of his death by his nephew, Pliny the Younger, in a letter to Tacitus (*Epist.*, vi. 16). He was a very prolific writer, but of his works only the *Historia Naturalis*, in 37 books, is extant, edited in 20 vols. by Panckoucke, with commentaries and notes (Paris, 1829–33), by Sillig (8 vols., Gotha, 1851–58), and by Detlefsen (6 vols., Berlin, 1866–73); translated into English by Philemon Holland (London, 1601), and in Bohn's Classical Library (6 vols., 1855).—His nephew, Gaius Plinius Cæcilius Secundus, generally called Pliny the Younger, b. 61 or 62 A. D. in Novum Comum, was adopted and educated by his uncle; served in the army in Syria; held several high offices (consul 100), but devoted most of his time to literary studies and the practice of law. He was an intimate friend of Tacitus and Trajan. According to Mommsen, he was legate proprætor of Bithynia, with consular power in 111 and 112 or 112 and 113, persecuting the Christians there in 112. There is no trace of him after this time. His *Panegyricus* and his *Epistolæ*, 10 books, were edited, with notes, by G. H. Schäfer (Leipzig, 1805) and G. E. Gierig (Leipzig, 1806); best critical ed. by Keil (Leipzig, 1870); *Epistolæ*, translated into English by Melmoth (1746), Lord Orrery (1759); summary in *Ancient Classics* (1872). See also Mommsen in *Hermes* (vol. iii., pp. 31–139). Revised by M. Warren.

Pliocene Period [*pliocene* is from Gr. πλείων, more + καινός, new]: the division of geologic time following the Miocene Period and preceding the Pleistocene. In the chronological system adopted by the U. S. Geological Survey for the geologic atlas of the U. S., the Miocene and Pliocene periods of earlier classifications are included in the Neocene Period (*q. v.*).

Pliohippus: See Horse, Fossil.

Ploce'idæ [Mod. Lat., named from *Plo'ceus*, the typical genus, from Gr. πλοκεύς, weaver, braider, deriv. of πλέκειν, twist, braid, weave]: a family of small finch-like birds, com-

prising the weaver-birds which in the tropical regions of the Old World hold the place of the finches of the temperate zone. The bill is strong and conical, the culmen advancing backward on the forehead and arched to the tip, which is entire; the wings are somewhat rounded, with the first quill remarkably short; the tarsi with long scutellæ in front. The family contains about 250 species. See WEAVER-BIRD. F. A. LUCAS.

Plombières, plōn'bi-ār': a small town in the department of Vosges, France; 14 miles S. of Épinal (see map of France, ref. 4–H). It is beautifully situated in the valley of the Angronne, a tributary of the Saone, and is noted for its thermal springs, much recommended for diseases of the liver, the digestive organs, and the skin. The springs have been used for medicinal purposes since the times of the Romans, but the present elegant bathing establishments were founded by Napoleon III. Pop. (1891) 1,869.

Plot'idæ [Mod. Lat., named from *Plo'tus*, the typical genus, from Gr. πλωτός, floating, sailing]: a family of water birds belonging to the order *Steganopodes*, and containing the darters. See DARTER.

Ploti'nus: philosopher; b. at Lycopolis, Egypt, about 205 A. D.; went to Alexandria in 232, and spent there ten years under the tutelage and instruction of Ammonius Saccas. In 242 he accompanied the Emperor Gordianus on his expedition against the Persians, in order to make himself acquainted with the philosophy of Persia and India; but the emperor was murdered in Mesopotamia in 243, and Plotinus repaired by Antiochia to Rome. Here he applied himself to the teaching of philosophy, attracted immense audiences, gained numerous disciples, and enjoyed great respect and confidence. In 269 he retired into solitude. D. at Puteoli, in Campania, the following year. The most famous of his disciples, Porphyrius, collected his works and wrote a biography of him. The collection comprises a great number of treatises on different subjects—on beauty, the immortality of the soul, the supreme good, the genesis of ideas, against the Gnostics, etc.—arranged in six divisions, each consisting of nine books, for which reason they are called *Enneads*. Parts have been translated into German and English (by Thomas Taylor into English, namely, six books of the first *Ennead*, two of the second, four of the third, four of the fourth, five of the fifth, and three of the sixth), the whole into French by Bouillet in 3 vols., with full commentary (Paris, 1857).

The philosophy of Plotinus is a vision rather than a system. The center of all that exists is the One, which is above intellect, if not above the good; in short, a God that does not create in any proper sense; the intellect "emanates" from it, not as its creation. The intellect in turn is of a divine nature, though secondary, and it alone is the creator of lower orders of being. From God emanates the soul of the world; from the soul of the world emanates the soul of man; and in this way the divine descends from sphere to sphere, forming itself into time and space and building up its own body, until at last it arrives at matter. The divine can form matter, but not penetrate it so as to prevent it from collapsing and returning into chaos. Matter is the seat of imperfection and evil; and the aim of life is to return from the polluting contact with it into the One. The connection between the soul and God is much deeper and more intimate than that between the soul and the body. In the third *Ennead*, book viii., chapters iii. and iv., is found the original of those fine poetic sayings attributed to Schelling and Oken, that reason dreams in the plant, feels in the animal, and thinks in man. Although the soul, with its power of vegetative, sensitive, intellectual, and rational life, actuates the body even in the most minute details of life, still it does not form one with it. Otherwise with respect to its union with God. "We move round him like a choral dance; even when we look from him we revolve about him; we do not always look at him, but when we do we have satisfaction and rest and the harmony which belongs to that divine movement. In this movement the mind beholds the fountain of life, the fountain of mind, the origin of being, the cause of good, the root of the soul. There will be a time when this vision shall be continual, the mind being no more interrupted nor suffering any perturbation from the body." For it is the body which disturbs that contemplation of God in which our soul unites with the universal soul, a union which can not be effected by the reason, as the reason is incapable of grappling immediately with things divine, but which must be effected by an immediate intuition, by an ecstasy, in which "the soul sinks into a deep silence and all around her the tumult of the senses and the agitations of the body grow still." It is this doctrine of a unity transcending the intellect that constitutes the weakness of the Neoplatonistic philosophy. It professes to derive this doctrine from Plato, but it is Plato's merit to have identified God with absolute reason. It is a lapse out of Hellenistic philosophy proper into Orientalism which holds the Absolute to be empty being or unity.

Revised by W. T. HARRIS.

Ploug, plowg, PARMO CARL: poet; b. in Kolding, Denmark, Oct. 29, 1813. Like Hostrup, he began as a students' poet, but later developed into one of the warmest and most effective champions of Scandinavianism and the Danish spirit in Southern Jutland. His influence for these causes was exerted both through his poems and his work as editor of the patriotic paper *Fædrelandet* (1841–87). He was also for many years a member of the Rigsdag, and played an important part in the drafting of the constitution (1848). His first collection of poems, *Poul Rytters Viser og Vers* (Paul Rytter's Ballads and Verses, 1847), appeared anonymously, and was followed by *Samlede Digte* (Collected Poems, 1861), containing a number of patriotic poems, and *Nyere Sange og Digte* (Later Songs and Poems, 1869). D. Oct. 27, 1894, D. K. DODGE.

Plough, or **Plow** [O. Eng. *plōh*: Germ. *pflug*: Dutch *ploeg*]: an implement for breaking up the soil; used, though in a primitive form, as far back in ancient time as history reaches. The Old Testament speaks of ploughs with shares shod with socks of iron or bronze. The Greeks knew the wheel-plough. The modern plough, with its mould-board to turn over the broken-up soil, was invented in the Netherlands in the seventeenth century, but has since been much improved. The first steam-plough was worked in England in 1832.

Plover [from O. Fr. *plovier*, liter., rain-bird; cf. Lat. *pluvia*, rain; so called, perhaps, because it makes its appearance in wet weather, or because its piping cry was thought to portend rain]: a common name for any member of the family *Charadriidæ*, a group of wading birds of the order *Limicolæ*. Plovers have a bill much like that of a pigeon, hard at the tip, covered with soft skin toward the base, reticulate tarsi, long pointed wings, tail of moderate length and usually twelve feathers, toes slightly webbed, the hindermost lacking or very small. The head is rather large and full, neck short, body plump. There are nearly a hundred species distributed pretty much over the world

The golden plover.

The golden plover (*Charadrius dominicus*), a typical and well-known species, is named from its plumage, which in summer is black above, spotted with golden yellow and white; beneath, as well as the sides of the head, about the base of the bill and eyes, black. In winter it is much grayer, for, in common with many other species, there is a considerable difference in the plumage at different seasons. This bird is remarkable for the extent of its migrations, breeding in Arctic North America and moving S. in winter nearly or quite to Patagonia. The European golden plover is *Charadrius pluvialis*. The gray plover (*Charadrius*—or *Squatarola—helvetica*) is another wide-ranging species, for it breeds in the northern parts of America, Asia, and

Eastern Europe, and occurs at other times as far S. as Tasmania. The thick-knees (*Œdicnemus*) are the largest members of the group, measuring about 14 inches in length. Their plumage of reddish or brownish gray harmonizes well with the barren tracts which they seem to prefer, and the young, when surprised, often escape detection by crouching flat among the pebbles. The killdeer (*Ægialitis vocifera*), so named from its note, is the type of a small group of pretty plovers distinguished by black breast-bands. The killdeer is brown above, but the piping plovers belonging to the same genus are light gray, their plumage blending in with the sand and pebbles of the sea beaches. The crook-billed plover (*Anarhynchus frontalis*) of New Zealand is a small species noteworthy from the fact that it is the only bird whose bill is decidedly bent sideways. Some of the large plovers of the genus *Lobivanellus* and allied genera have a well-developed sharp spur on the bend of the wing which forms a rather formidable weapon. The plovers have been made the subject of a monograph by Seebohm (London, 1887). The CROCODILE-BIRD, DOTTEREL, and LAPWING (*qq. v.*) are also plovers. F. A. LUCAS.

Plowden, EDMUND: law reporter; b. in 1519 at Plowden, in Shropshire; began the study of law in the Middle Temple in 1539, then studied in Cambridge and Oxford, in which latter place he was admitted (1552) to practice surgery and physic; in 1557 again studied in the Middle Temple, and was made sergeant-at-law Oct. 27, 1558. He was a strict Roman Catholic, and this alone is said to have prevented him from promotion to high office. He was treasurer of the Middle Temple during the rebuilding of the Great Hall, in one of the windows of which his arms, with the date 1576, still remain. D. Feb. 6, 1584, and was buried in the Temple church. His *Commentaries or Reports* of law cases, which were originally in law French, cover the period from 3 Edward VI. to 22 Elizabeth (1550–80), and rank among the best reports of any age. Plowden's grandson was made "Earl Palatine, Governor, and Captain of the province of New Albion in North America." See Wallace, *The Reporters* (Boston, 1882). F. STURGES ALLEN.

Plum [O. Eng. *plūme*, from Lat. *prūnum*, later *prūna* (whence Eng. *prune*, viâ Fr.) = Gr. *προῦνον*, earlier *προῦμνον*, plum]: any tree of the genus *Prunus*, family *Rosaceæ*; characterized by a smooth, usually glaucous fruit (also called plum), with a more or less elongated stem and a flat or flattish stone. The botany of the plums is more complex than that of any other fruit of the northern part of the U. S. The origin of the common plum is itself a matter of dispute, but the fruit was probably originally native to Persia and Anatolia. It is known to most botanists as *Prunus domestica*, but some writers hold that two or more species are concerned in its origin. The only other European or Western Asian species of plum in common cultivation in the U. S. is the myrobalan, or cherry plum, *P. cerasifera* (or *P. myrobalana*). This is used mostly as a stock upon which to bud other plums, although there are two or three fruit-bearing varieties of it. This plum is distinguished from *P. domestica* by a somewhat slower growth, smaller and thinner leaves, very early small flowers, and small, round, cherry-like fruits which have a soft, watery, sweet flesh. It is possible that this myrobalan plum is really of the same species as *P. domestica*, and that it represents a nearer approach to the aboriginal type. The varieties of plums (*Prunus domestica*) are numerous, and several classifications of them, by form or color, have been suggested. It is customary to divide them into plums proper and prunes, although there are no constant differences between these two groups. (See PRUNE.) The damsons are sometimes held to be a distinct type, or even species, but they are simply very small firm-meated plums. In North America these common or European plums (*P. domestica*) thrive best in the States and provinces from Pennsylvania north and east, and westward to Lake Michigan, and upon the Pacific coast.

Another type of plum which is now attracting much attention is the Japanese group, the offspring of *Prunus triflora*, which is supposed to be native to China. This species first reached the U. S. in 1870, when Mr. Hough, of Vacaville, Cal., procured several trees from Japan. A variety was generally introduced or distributed about 1883, under the name of Kelsey, in memory of John Kelsey, of Berkeley, Cal., who first recognized the merits of the fruit, and who first obtained ripe specimens. This variety is adapted only to the warmer portions of the U. S.; but other varieties of this type thrive as well in the North—at least ten are hardy and productive in New York. The Japanese plums differ from those of the *Prunus domestica* type in a more robust growth, longer, thinner, and glabrous obovate, or broadly oblanceolate leaves, flower buds usually in threes, fruit heart-shaped and often unequilateral, with a very firm flesh and often a thick, tough skin. Most of the Japanese plums are very handsome, and keep long after being picked. They are very valuable for commercial cultivation in the U. S., and appear to thrive equally well where any of the common orchard fruits can endure the climate, and in this respect they are greatly superior to the varieties of *P. domestica*. Their nomenclature is much confused.

A third important group of plums comprises the native types, the offshoots of several indigenous species. The first of these plums to attract wide attention was the Wild Goose, which was introduced from Tennessee about 1850. About 200 varieties have been described, the greater number being chance varieties found in woods and copses. These native plums belong chiefly to three species: *Prunus americana*, characterized by dark, rough growth, large obovate, and more or less jagged dull leaves, and red or red-marked, mostly flattened fruits, with a very heavy bloom, tough skin, and sweet, firm flesh; *Prunus hortulana* (Wild Goose type), with a smoother and more peach-like growth, narrowly ovate or lance-ovate, smooth, shining, finely toothed leaves, and very bright, slightly speckled slender-stemmed red or yellow fruits with a soft, juicy flesh and a very thin bloom; and *Prunus angustifolia*, the Chickasaw plums, with a slender, zigzag growth and narrower conduplicate leaves, and fruit much like that of the Wild Goose type. As a whole, these native plums are adapted to almost every climate in the U. S. The varieties of *P. americana* thrive in all the Northern States, even in the Dakotas, and also as far S. as Delaware, and some varieties are recommended even for Texas. The Wild Goose, or *P. hortulana* type, is adapted to the Southern and Middle States, and some forms thrive in New York and Illinois. The true Chickasaws are not adapted to cultivation much N. of Mason and Dixon's line. Other native plums in cultivation are the beach-plum (*P. maritima*), the sand-plum of the plains (*P. watsoni*), and the Pacific coast plum (*P. subcordata*). The native plums are inferior to the *P. domestica* and *P. triflora* types, but their great hardiness and adaptability strongly recommend them.

The Simon or Apricot plum (*Prunus simonii*) is a distinct Chinese species, which was introduced into the U. S. by way of France about 1880 or a little earlier. It is peach-like in botanical characters, the fruit being closely sessile and the leaves long. The fruit is maroon red and very handsome, flattened endwise, with a strong suture. The habit of the tree is very strict, and the leaves are strongly conduplicate. In the eastern parts of the U. S. the tree is unproductive, and the fruit usually has an unpleasant, bitter-almond flavor; but upon the Pacific slope the species has distinct commercial value.

Plums thrive best, as a rule, upon rather heavy soils, particularly upon those containing clay. All varieties can be budded upon the peach, although this method of propagation is not common in the northern parts of the U. S., except perhaps for the Japanese type. The commonest stock is the myrobalan, but because of its slow growth it tends to dwarf the tree, and it suckers badly from the root. The ideal stock for the common plum is undoubtedly its own seedlings, particularly the seedlings of the half-wild and consequently little variable forms. The buds are usually set in the second summer following the sowing of the seed, and the trees are ready for sale when the tops are two or three years old.

The chief insect depredator of the plum is the curculio, the same insect which infests the peach, apricot, and cherry. The beetle lays its eggs under flaps or crescents, which it raises on the surface of the young fruits, and the larvæ are the "worms" of the stone fruits. The only accepted method of fighting the insect is to jar the beetles on to sheets in early morning, before they begin to fly.

Plums are attacked by many kinds of fungi. One of the most serious is the shot-hole fungus or leaf-blight, which perforates the leaves and causes them to fall. This disease is held in check by spraying with Bordeaux mixture. (See FUNGICIDE.) Another fungus causes PLUM POCKETS (*q. v.*). The fruit-rot, which causes the death and decay of the fruit while it still hangs on the tree, and which may also kill the fruit-spurs, is kept in check by the use of Bordeaux mixture aided by the destruction of diseased fruits. The black-knot,

or pluin-wart, is a fungous disease affecting the branches or even the trunk. (See PLUM KNOT). In some of the U. S. laws for the suppression of this disease have been passed.

Some of the leading varieties of plums are the following:

Prunus domestica.—Lombard, Bavay Green Gage, Bradshaw or Niagara, Coe's Golden Drop or Silver Prune, French and Shropshire Damsons, German Prune, Fellenberg, Gueii, Moore's Arctic, Green Gage, Prune d'Agen, Hungarian Prune, Copper, Jefferson, Imperial Gage, Quackenbos, Yellow Egg, Washington, French Prune.

P. triflora.—Kelsey, Burbank, Abundance, Satsuma, Chabot, Maru, Ogon, Red Nagate.

P. americana.—Weaver, Wolf, Quaker, De Soto, Rollingstone, Purple Yosemite, Forest Garden, Deep Creek, Chency.

P. hortulana.—Wild Goose, Golden Beauty, Missouri Apricot, Morcman, Reed, Roulette, Wayland, Miner.

P. angustifolia.—Newman, Arkansas Lombard, Caddo Chief, Lone Star, Jennie Lucas, Pottawattamie, Robinson.

L. H. BAILEY.

Plumbago: See GRAPHITE.

Plumbing [deriv. of *plumb*, liter., seal or repair with lead, from Lat. *plum'bum*, lead]: the art of casting and working in lead or other metals and applying them to various purposes connected with buildings, especially to purposes of water-supply and drainage. In the earlier ages lead was the material most used for these purposes, on account of the facility with which it can be worked by simple means. The progress of the arts has taught the ready manipulation of iron, and it has to a great extent supplanted the softer metals in works of this nature. Lead pipes were used by all the celebrated nations of old. In the ancient cities of Asia, Egypt, Greece, Syria, etc., they were used for conveying water under pressures too great for pipes of earthenware. In the earlier ages lead pipes were made from sheets of lead rolled into the form of cylinders and soldered at the edges. They were rarely subjected to pressure. Ancient cities were usually supplied with water by aqueducts, and the distributing pipes seldom rose above the ground floor. The Romans, however, used lead pipes in their aqueducts in some cases in crossing deep valleys where bridging was difficult. Several pipes were generally put in, of small size, so that they could be more easily made to withstand the pressure, and in such a way that a break in one of them would not entirely cut off the supply. Corfield cites a case where there were ten of these leaden siphons in one aqueduct. He cites cases where the pressure was about 200 lb. per square inch.

The perfection of pumping-machinery, and especially of that class of pumping-machinery designed to pump against heavy pressures, modern high buildings, and the modern system of fire-protection, unite to modify the ancient methods of plumbing. Distributing-pipes are now often subjected to a pressure of 100 to 200 lb. per square inch. In a majority of cases distributing-pipes are continuously under a pressure, and no reservoir is needed. In some districts the pressure is periodically raised so as to fill the pipes, and tanks are necessary to maintain a constant supply. In some cases where the street-mains are under a high pressure, pressure-reducing valves are inserted in the service-pipes to modify the pressure on the pipes within the houses.

Street-mains are now usually constructed of cast iron with leaded joints: into these cast-iron pipes are screwed brass stopcocks to which the service-pipes supplying buildings are attached. Service-pipes are usually made of lead or wrought iron. The capacities of different sizes of service-pipes in gallons per minute are given in the following table, compiled by J. N. Tubbs:

DIAMETER IN INCHES.	HEAD IN FEET.									
	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.
⅜	0·92	1·30	1·59	1·84	2·06	2·26	2·44	2·61	2·76	2·91
½	1·89	2·68	3·27	3·78	4·23	4·63	5·00	5·34	5·67	5·98
⅝	3·30	4·68	5·72	6·61	7·39	8·09	8·74	9·34	9·91	10·44
¾	5·21	7·37	9·03	10·42	11·65	12·77	13·79	14·74	15·64	16·48
⅞	7·66	10·84	13·27	15·32	17·13	18·77	20·27	21·67	22·97	24·23
1	10·70	15·13	18·53	21·40	23·92	26·20	28·30	30·26	32·10	33·83
1¼	14·36	20·31	24·87	28·72	32·11	35·18	38·00	40·62	43·08	45·31
1½	18·68	26·43	32·29	37·37	41·70	45·77	49·44	52·85	56·06	59·09
1¾	23·72	33·54	41·08	47·43	53·03	58·09	62·75	67·08	71·15	75·00
2	29·48	41·65	51·06	58 96	65·92	72·22	78·00	83·38	88·44	93·23

The average amount of water supplied to each consumer per day in cities of the U. S. is about 100 gal., this excessive use being due to wastefulness. In European cities the supply is usually less than 50 gal. The practice in Germany is to allow 40 gal. per day per person. In Great Britain it is customary to allow 34 gal. The waste of water can be best checked by meters set in the supply-pipe of each consumer.

The purposes for which water is used in buildings are constantly increasing, and as a consequence the plumbing is constantly becoming more intricate. An ordinary modern dwelling is usually supplied with water-closets, urinals, bathtubs, laundry-tubs, slop-sinks, washstands, hot-water boiler, etc.

The distributing-pipes within buildings should be arranged so that by means of a stop and waste cock they can be completely emptied. To accomplish this it is necessary that the main pipe and each branch pipe taken off from it shall be continuously ascending. If there are pockets or depressions in the system they will retain water, and when the building is unoccupied the pipes will be liable to injury from freezing.

Whenever the water-supply is used for flushing water-closets, urinals, etc., or for any purpose where a back flow of water might contaminate the supply used for drinking and culinary purposes, the water should first be received into a special tank or the pipes otherwise disconnected, so that a back flow will not be possible.

House-drainage.—In the arrangement of pipes and appliances for house-drainage or the removal of water which has been fouled (sewage), more care and ingenuity are required on the part of the plumber than in the pipes and fixtures pertaining to water-supply; for sewage is a constant menace to health.

In the system of pipes intended for the removal of sewage from buildings a complete barrier should be interposed against the passage of air currents into the building. To maintain a proper barrier at all times and under all conditions of use and disuse is a somewhat difficult matter. The method in use, and about the only practical one, is by traps or depressions in the pipe, whereby the passage of air is opposed by a head of water. The head is necessarily slight, however, and it is necessary to protect the traps from pressure and from siphonage by ample vents which maintain the pressure within the pipes at the normal atmospheric pressure. The fouled water should be immediately and completely removed from the vicinity of the building. Any system which contemplates the retention of any portion of it for any length of time is imperfect. The main drain for buildings should be from 4 to 6 inches in diameter, except in extreme cases, and laid with as much descent as possible. The inclination should not be less than one in fifty. The method of connecting the main drain with the soil-pipe depends on the method of ventilation. The simplest method is to extend the main drain upward and out through the roof, unbroken by a trap in any portion. In this case it serves the double purpose of soil- and ventilating-pipe, and the air which passes into the street sewers at manholes supplies the draft upward along the street sewers and out through the house ventilating-pipes and their upward extensions. In this case the isolation of the interior of buildings from sewer air depends solely upon the trap under each fixture. When the street sewers are properly constructed on the "separate" system (see SEWERAGE) and properly cared for, this method has proved entirely satisfactory. It has advantages in simplicity and facility of arrangement. Where the sewers are built on the combined plan a trap on the house sewer combined with a fresh-air inlet is to be preferred. This diverts the foul-air currents from the interior pipe and provides a supply of fresh air for the upward current through the soil and ventilating pipe. If the street sewers are not properly ventilated at frequent intervals, either by the upward extension of exterior or interior unobstructed pipes or otherwise, there may be reason to believe that an isolated one may draw from too wide a territory and prove offensive. In this case it is advisable to dispense with any vent-pipe communicating directly with the sewer.

The main drain within or under the house and for a few feet outside of it should be of iron, with lead-calked joints. It is better to fasten it along the wall by iron brackets or hangers above the cellar bottom, giving it as great an inclination as is possible. Fixtures in the basement should be avoided. Removable hand-holes or brass cleaning-screws should be provided at intervals through which obstructions can be removed. All iron pipes and fittings should be thoroughly coated outside and inside with coal-pitch varnish applied hot.

It is customary to make waste-pipes, particularly short ones, of lead, for the reason that it is much more easily

manipulated than iron. The proper method of connecting lead pipes to iron is by means of a brass thimble soldered to the lead pipe and calked into a hub on the iron pipe.

It is best to have soil-, waste-, and ventilating-pipes exposed as much as possible. When inclosed within partitions they are not readily accessible for inspection or repair. Plumbing fixtures should be confined to the bath-room, where special means of ventilation can be employed, and to the kitchen, laundry, and similar rooms. A fixture rarely used is a greater source of danger than one used frequently.

Particular care should be used in arranging the ventilation of a building so that the air currents tend to pass outward from the group of rooms containing plumbing fixtures, fresh air being admitted to other portions of the building. The facility with which this can be accomplished, and also the proper grouping of the fixtures and the simplicity of the system of pipes, will depend largely upon the architect. Ample means should be provided for flushing all portions of the soil- and waste-pipes and all fixtures. This is most effective when special flushing cisterns are supplied. Every fixture should be provided with a trap, and since the object of the trap is to isolate the fouled interior surface of the waste-pipe from the air of the room, it is evident that the trap should be as close to the fixture as possible. Notwithstanding many efforts to introduce a trap whose seal can not be broken by siphonage, and which will be self-cleansing, the plain running trap of uniform bore is still in general use. This trap is liable to have its seal broken by siphonage, and to prevent this it is necessary to resort to a back air-pipe which is connected with the crown of the trap on the downward side and passes to the roof independently of the ventilating-pipe proper, or is connected with it above the highest fixture. This back air-pipe should be of ample capacity to preserve the normal air-pressure when considerable quantities of water are flowing down the soil-pipe. The system of back air-vents is open to the following objections: It considerably complicates the system of piping, especially when fixtures are not closely grouped. There is a possibility of the pipes being fouled at their junction with the crown of the trap. It adds to the expense. Back air-vents tend to increase the interior circulation of air considerably. This is beneficial so far as the purity of the interior of the pipes is concerned, but it also increases the evaporation from traps. This will do no harm if the fixtures are in constant use. On the other hand, if special anti-siphoning traps are used there will be little circulation of the outer purifying air through the waste-pipes.

When the soil-, waste-, and ventilating-pipes are all in position, and before the fixtures are put in place, a test of the thoroughness of the work should be made. This can be done as follows: Close up the main drain where the iron pipe terminates outside the house wall, also the exposed ends of all pipes where fixtures are to be connected, and the fresh-air inlet if there is any. The ends of lead pipes should be left somewhat longer than necessary, so that this can be conveniently done by flattening them and closing with solder. When all openings in the entire system of pipes are tightly closed below, fill the system of pipes with water nearly to the top and mark the height at which the water stands. The entire work should be inspected while under pressure, and joints recalked where necessary.

If roof water is admitted to the sewers the rain-water leader should connect with the main soil-pipe directly above the main trap. No waste- or soil-pipe should be connected with the rain-water leader. The following table gives the requisite size of house drains for roof areas of the dimensions given (calculated by Robert Moore):

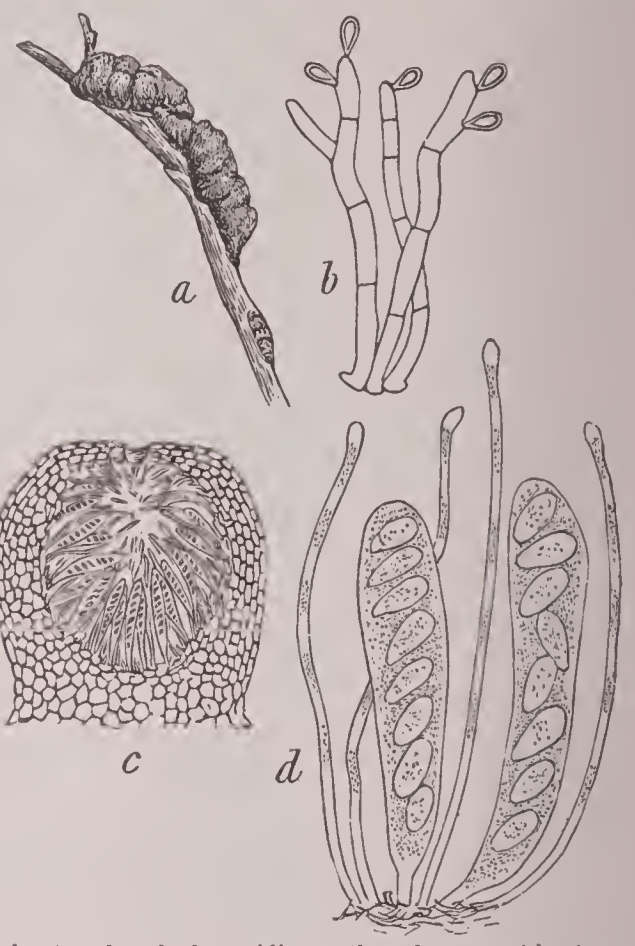
SIZE OF LOT IN FEET.	FALL PER HUNDRED.				
	1·0.	1·5.	2·0.	2·5.	3·0.
	Diameter in Inches.	Diameter in inches.	Diameter in inches.	Diameter in Inches.	Diameter in inches.
20 × 150.....	3·5	3·12	3·0	2·87	2·75
25 × 150.....	3·74	3·5	3·25	3·12	3·0
30 × 150.....	4·0	3·75	3·5	3·37	3·25
35 × 150.....	4·25	4·0	3·75	3·62	3·5
40 × 150.....	4·5	4·25	3·87	3·75	3·62
45 × 150.....	4·75	4·37	4·12	4·0	3·87
50 × 150.....	5·0	4·5	4·2	4·12	4·0
60 × 150.....	5·37	4·87	4·62	4·37	4·25
70 × 150.....	5·62	5·25	4·87	4·75	4·5
80 × 150.....	6·0	5·5	5·25	5·0	4·87
90 × 150.....	6·25	5·75	5·5	5·25	5·0
100 × 150.....	6·5	6·0	5·75	5·5	5·25

In nearly all cities plumbing is governed by rules and regulations defining specifically the class of work to be done, sizes of pipes of various kinds for particular purposes, class of fixtures, etc. The work is permitted to be done by licensed plumbers only, and in the larger cities they are under the surveillance of expert inspectors in the employ of the city.

GEORGE S. PIERSON.

Plumes: See FEATHERS.

Plum Knot: the *Plowrightia morbosa*, a parasitic fungus of the order *Pyrenomyceteæ* and family *Dothidiaceæ*, which lives upon twigs of plums and cherries, producing black, knot-like masses, 2 to 4 inches long and ½ to ¾ inch in diameter (*a*, reduced). The threads of the parasite penetrate the living tissues of the host in spring and early summer, producing a considerable swelling of the tissues. The surface of the young knot now becomes covered with a velvety coating of dark-colored vertical threads, which produce minute spores (conidia, *b*). As winter approaches other reproductive



a, plum knot, reduced; *b*, conidia on threads; *c*, perithecium, with spore-sacs; *d*, spore-sacs and spores (*b*, *c*, *d*, much enlarged).

structures develop: the surface becomes covered with minute hollow, wart-like bodies (perithecia) within which are produced a number of spore-sacs, each with eight ascospores (*c*, *d*). Plum knot may be reproduced from the conidia or the ascospores, but it is often perennial, the parasitic threads growing down each year from the old knot into previously unaffected tissues.

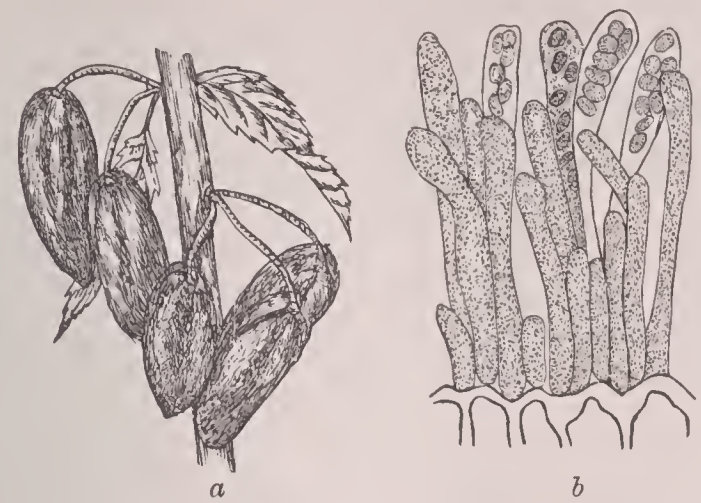
This disease is sometimes quite harmful. All knots should be cut off and burned as soon as they appear. The thorough washing of the tree in early spring with poisonous solutions, as of copper or iron sulphate, will doubtless destroy many spores and tend to prevent the spread of the disease.

CHARLES E. BESSEY.

Plum Pockets: a disease of plums in which they are swollen, hollow, and distorted (*a*). It is caused by a parasitic fungus, *Exoascus pruni* (family *Gymnoasceæ*), which penetrates the tissues of the young plum and finally produces spore-sacs upon the surface. Each spore-sac at maturity contains about eight ascospores (*b*).

"The pockets make their appearance soon after the flowers have fallen, attain full size, and drop from the tree toward the middle or last of June. At first they are more or less globular in shape, but as they grow older they become oblong or oval, and frequently more or less curved. They vary in size, but as a rule are from 1 to 2 inches in length and from ½ to 1 inch in diameter. When young they are nearly smooth, and can be distinguished from the healthy fruit by their pale-yellow or reddish color. As they grow older the color changes to gray, the surface appearing

as though it had been sprinkled with fine powder, and at the same time the pockets become wrinkled. Finally they turn black or dark brown, and rattle like bladders when brought in contact with any hard substance. They remain



a *b*

a, plum pockets ; *b*, a mass of spore-sacs, highly magnified.

on the tree in this condition for two or three days, then fall to the ground and perish."—*Galloway*. This disease may be considerably reduced by the early removal and destruction of all the diseased plums. For an exhaustive account of plum pockets and the fungus producing the disease, consult B. T. Galloway's paper in the *Annual Report of the Department of Agriculture* for 1888. Charles E. Bessey.

Plump'tre, Edward Hayes, D. D.: clergyman and author; b. in London, Aug. 6, 1821; was educated at University College, Oxford; became fellow of Brasenose College 1844; chaplain at King's College, London, 1847; Professor of Pastoral Theology in that institution 1853; prebendary of St. Paul's 1863; professor of exegesis of the New Testament 1864; rector of Pluckley 1869; vicar of Bickley 1873, and Dean of Wells 1881. He was preacher at Lincoln's Inn and Boyle lecturer (1866–67), and was one of the Old Testament company of revisers. Author of several volumes of sermons, addresses, and classical translations—*King's College Sermons* (1859); *Lazarus, and other Poems* (1864); *Sermons on Theology and Life* (1866); *Christ and Christendom* (1867); *Biblical Studies* (1870); *Respice, Aspice, Prospice, and the Law of Progress in Theology* (1876); *St. Paul in Asia Minor and at the Syrian Antioch* (1877); *A Popular Exposition of the Epistles to the Seven Churches of Asia* (1877); translations of Sophocles and Æschylus; *The Spirits in Prison, and other Studies on the Life after Death* (1885), etc.—of many articles in Dr. Smith's *Dictionary of the Bible*, of *Biblical Studies* (1870), and editor of the *New Bible Expositor* (1875). His latest work was a *Life of Bishop Kerr* (1886). D. at Tunbridge Wells, Feb. 1, 1891.

Revised by W. S. Perry.

Plunket, William Conyngham, Baron: orator and statesman; b. at Enniskillen, Ireland, in July, 1765; graduated at the University of Dublin; studied law at Lincoln's Inn; was called to the Irish bar 1787. He became king's counsel 1798; was elected to the Irish Parliament in the same year; was in 1803, as solicitor-general, prosecuting attorney in the trial of Emmet; was attorney-general for Ireland 1805–07. He sat in Parliament 1807–22, where he favored Catholic emancipation; became again attorney-general for Ireland 1822; chief justice and baron 1827, and was lord chancellor of Ireland 1830–41. D. in County Wicklow, Jan. 4, 1854.

Pluralism [from Lat. *plus*, *plu'ris*, more]: in canon law, the possession of more than one ecclesiastical benefice by the same person at the same time. In the earlier times of the Christian Church pluralism was considered unlawful, and it was forbidden by many councils, as, for instance, by those of Chalcedon (451) and Nicæa (787). Later, however, it became one of the most common and most vicious practices in the Roman Catholic Church, and in order to screen its unlawfulness very subtle distinctions were made by the canonists. Benefices were divided into compatible and incompatible—that is, such as could be held together and such as could not. Incompatibility might arise, for instance, from the duty of residence; thus it would be impossible for the same man to be Bishop of Palermo and Trondhjem at the same time, because it was a bishop's duty to reside in his diocese; but then the pope could grant a dispensation from the duty of residence, and thereby the two benefices became at once compatible. At one time it was very common to find Italian clergymen living at the court of Rome and enjoying the revenues of different benefices in Spain, France, Germany, and Scandinavia. In modern times this evil has disappeared almost entirely in the Roman Catholic Church.

The English law before the Reformation in the main coincided with the canon law, and the legislation of Henry VIII. generally preserved the same spirit, only substituting the dispensing power of the crown for that of the pope. By 13 and 14 Victoria, c. 98, it is provided that no incumbent of a benefice shall take and hold together with it another benefice—the word "benefice" in this sense comprising any perpetual curacy, endowed public chapel, parochial chapelry, or district chapelry—unless the churches are within 3 miles of one another by the nearest road and the annual value of one of them does not exceed £100; nor can two benefices be held together if the population of one exceeds 3,000 and that of the other 500. A dispensation or license can be obtained from the archbishop, however, so as to allow two benefices to be held together; and if the archbishop should refuse his license, the party may appeal to the privy council. A special provision prohibits the head ruler of any college or hall in the Universities of Oxford and Cambridge from taking any cathedral preferment or any other benefice. If any person holding a benefice accepts another benefice contrary to the statute, the first benefice becomes *ipso facto* void. Pluralism has almost died out in the Church of England. It does not obtain in the other branches of the Anglican communion. In Ireland no dispensation to hold two benefices can be granted. In Scotland no minister of the Established Church can hold two or more charges, but it is possible for a minister also to hold a chair as professor in a university provided that his charge is in the same city as the university. If a country minister accepts a chair as professor, he must resign one of the offices within a certain time after the appointment.

Revised by W. S. Perry.

Plush [from Fr. *pluche*, *peluche* : Ital. *peluzzo* < Late Lat. **pilu'ceus*, hairy, shaggy, deriv. of Lat. *pi'lus*, hair]: a fabric which differs from velvet in not being shorn, and in having a long pile or shag. It is sometimes all worsted, sometimes worsted with a mohair pile, and most frequently of cotton with a silk pile. This kind last mentioned is used for hat-making. The loops of the pile are cut with a long needle-like knife.

Plutarch (in Gr. Πλούταρχος): Greek biographer and essayist; b. at Chæronea in Bœotia, 46 A. D. He belonged to a wealthy and distinguished family, and lived a long life of study and of honorable employment both in the service of the empire and in the service of Bœotia. A model husband and father, he practiced the noble doctrines that he preached. There was no more amiable character in the history of his times, no more sympathetic and generous soul. D. about 120 A. D. His works, which are many, fall into two classes, historical and ethical, the latter dealing with philosophical, moral, and miscellaneous subjects and commonly referred to roughly as *Moralia*. Of his historical works the most famous is the collection of *Parallel Lives* (Βίοι παράλληλοι), forty-six lives in twenty-three pairs, a Greek life being set over against a Roman. Nineteen of the pairs are followed each by a comparison. Besides these *Parallel Lives* four isolated lives have been preserved. Plutarch is not an historian, he is a moralist, and thinks more of the lesson conveyed by the facts than of the facts themselves. Everything is welcome to him that will illuminate the character he is drawing, that will point to the moral he is teaching. Anecdote, jest, quotation, nothing comes amiss; and while the free and easy handling of his material gives many problems to historical critics, Plutarch has been the delight of all succeeding generations, and is still to be reckoned among the greatest of biographers. His treatises called *Moralia* have not been so popular as they deserve to be, especially of recent years, but they are full of interesting anecdotes, happy quotations, fine reflections, odd bits of recondite learning, a perfect treasure-house of wisdom and knowledge. Plutarch is not a philosopher of the first order any more than he is an historian of the first order; he is not a consecutive thinker; he is not a vigorous writer, nor a soaring genius, but he is a man of sweet and pure nature, whose vast reading is lighted up by true humanity.

Editions.—The text with Latin translation most conven-

iently accessible is in the Didot collection (5 vols., Paris, 1846–55); Reiske (Leipzig, 1774–82). The *Lives* were edited by Koraës (6 vols., Paris, 1809–14); *Morals*, by Wyttenbach (8 vols., Leipzig, 1796–1834). There is a critical edition of the *Lives*, by Sintenis (Leipzig, 1852–55), in the Teubner collection, and of the *Morals* in the same by Bernadakis. Dr. Holden's editions of Plutarch's *Demosthenes* and of the *Gracchi*, of *Nicias*, *Sulla*, and *Timoleon* are very serviceable. A famous old English translation after the French of Amyot is by North (1579). There is a later rendering by the Langhornes (1770), revised by Clough (1859). An old English translation of the *Morals* by several hands has been revised and corrected by W. W. Goodwin (5 vols., Boston, 1870). See *A Popular Introduction to Plutarch*, by Archbishop R. C. Trench (London, 1873), and R. Volkmann, *Plutarch* (Berlin, 1869). B. L. Gildersleeve.

Pluto (in Gr. Πλούτων): the name used among the Romans for Hades (*q. v.*), though it originated with the Greeks, who called him by that name because, as the god of the lower world, he was lord over all wealth, both vegetable and mineral, that is concealed by the earth from which all wealth springs. J. R. S. S.

Plutus [= Lat. = Gr. Πλοῦτος, liter., wealth]: in ancient mythology, the personification of riches, much used by the poets and often represented by art, but never worshiped. Zeus is said to have blinded him in order that he might not bestow his favors on righteous men only, but that he might distribute his gifts blindly and without any regard to merit. At Thebes there was a statue of Fortune, at Athens one of Peace, and at Thespiæ one of Athene the Worker, and in each of these cases Plutus was represented as the child of those divinities, symbolically expressing the sources of wealth. He seems to have commonly been represented as a boy with a cornucopia. Revised by J. R. S. Sterrett.

Plymouth: town; in the county of Devonshire, England; on the northern shore of the sound of the same name; at the mouth of the Plym; 246 miles W. S. W. by rail of London, and 128 S. W. of Bristol (see map of England, ref. 15–D). Taken in its largest sense, it comprises what are called the "three towns"—Plymouth proper on the E., Stonehouse in the middle, and Devonport on the W. Beside the citadel, an obsolete fortification built by Charles II. at the eastern end of the bold headland called the Hoe, there is a chain of forts of great strength mounted with guns of heavy caliber, which form a complete line of defense by land and sea. The town is irregularly built, but great improvements have been made. Among the principal buildings are the new Guildhall, in the Gothic style, opened in 1874; the Proprietary Library, in which there is the Cottonian collection of pictures; and the Athenæum, which contains a library, lecture-hall, museum, and art gallery. The parish church of St. Andrew, in the Perpendicular style, dates originally from 1430, but was completely restored in 1875 by Sir Gilbert Scott. In 1888 the Marine Biological Laboratory was opened.

As a great naval station Plymouth owes its pre-eminence to the spaciousness and extent of Plymouth Sound, within which the whole British navy might anchor with safety. To protect the interior of this estuary the Plymouth breakwater was constructed. (See Breakwater.) The eastern harbor, Sutton Pool, is an anchorage for the shipping employed in the fisheries and general trade. The Great Western Docks include a floating basin of over 13 acres, a tidal harbor of 35 acres, and a graving-dock. The port has a considerable trade, and is used by lines of passenger steamers to South Africa, the East, and Australasia. There is also a large coasting trade. There are some manufactures of chemical compounds, biscuits, soap, manures, etc.

Plymouth was used as a port by the Black Prince, and in the reign of Elizabeth it was the principal port of England. In the wars with Napoleon it was the rival of Portsmouth in naval activity. Plymouth returns two members to Parliament. Pop. of Plymouth proper (1901) 107,509; with Stonehouse and Devonport (1891) 154,417. R. A. Roberts.

Plymouth: town; capital of Plymouth co., Mass. (for location, see map of Massachusetts, ref. 4–J); on Massachusetts Bay and the Old Colony division of the N. Y., N. H. and Hart. Railroad; 37 miles S. E. of Boston. It occupies a strip of 18 miles along the coast varying from 5 to 9 miles in width, is the oldest town in New England, and has a healthful climate, the heat of summer seldom being oppressive or the cold of winter intense. It has public waterworks and sewer system, gas, electric plant for light and power, electric street-railway, 2 national banks with combined capital of $410,000, 2 savings-banks with aggregate deposits of $3,276,892, a co-operative bank, 9 churches, public library, and 2 weekly newspapers. The industries comprise the manufacture of woolen cloth, cotton sail-duck, insulated wire, patent bedstead joints, boots and shoes, cordage, tacks, rivets, wire nails, stoves, hollow-ware, steel shanks, zinc and copper electrical supplies, and other articles. Plymouth is celebrated as the landing-place of the Pilgrim Fathers on Dec. 11 (Dec. 21, N. S.), 1620. The rock on which they first stepped is in Water Street, and is now covered with a fine granite canopy. Pilgrim Hall contains numerous relics of the Pilgrims, and many interesting antiquities. Cole's Hill and Burial Hill are points of much interest, because of the burial there of many of the Pilgrims. The corner-stone of a national monument to the Pilgrims was laid Aug. 1, 1859, and the structure was dedicated Aug. 1, 1889. It is 81 ft. high, cost about $150,000, and is surmounted by a statue of Faith, in granite, 36 ft. high, the largest granite statue in the world. Four immense monolithic statues, weighing about 16 tons each, and representing Morality, Law, Education, and Freedom, with beautiful marble bas-reliefs beneath each, are seated on the buttresses of this monument. Pop. (1880) 7,093; (1890) 7,314; (1900) 9,592.

C. C. Doten, editor of "Old Colony Memorial."

Plymouth: town; one of the capitals of Grafton co., N. H.; at the junction of the Pemigewasset and Baker's rivers, and on the Concord and Montreal Railroad; 50 miles N. by W. of Concord, the State capital (for location, see map of New Hampshire, ref. 6–E). It is in a region much frequented by tourists and widely known for its beautiful scenery, and contains the State Normal School (opened in 1871), the Holderness School for Boys (Protestant Episcopal), a national bank with capital of $75,000, a weekly newspaper, and manufactories of gloves, shoes, and leather. Pop. (1880) 1,719; (1890) 1,852; (1900) 1,972.

Plymouth: town, seaport, and capital of Washington co., N. C.; on Albemarle Sound; about 100 miles E. of Raleigh (for location, see map of North Carolina, ref. 3–J). It is in an agricultural region, ships large quantities of cotton, lumber, and vegetables, and contains a State normal school (opened in 1886), lumber and cotton mills, and a weekly newspaper, Pop. (1880) 836; (1890) 1,212; (1900) 1,011.

Plymouth: borough; Luzerne co., Pa.; on the Susquehanna river, and the Del., Lack. and West. Railroad; 4 miles S. W. of Wilkesbarre, the county-seat, 20 miles S. W. of Scranton (for location, see map of Pennsylvania, ref. 3–H). It is in a coal-mining region, and contains a high school, 4 public-school buildings, public-school property valued at over $50,000, a national bank with capital of $100,000, and 3 weekly newspapers. Pop. (1890) 9,344; (1900) 13,649.

Plymouth Brethren: a Christian body holding in the main Calvinistic views, but peculiar in that it rejects all ecclesiastical organization and insists on the complete parity of all believers. Hence it has no presiding officers in its public meetings, nor any clergy. It was started in Dublin in 1827, mainly through the exertions of John Nelson Darby, from whom the sect gets its best-known name, *Darbyites*; in 1831 it took a fresh hold at Plymouth, England, whence its name, *Plymouth Brethren*, again under Darby, and largely by his writings and personal service spread over the British Isles, the Continent, Canada, and the U. S. Darby was born in London, Nov. 18, 1800; graduated at Trinity College, Dublin, 1819; was first a lawyer, then a clergyman, 1825, but in 1827 he left the Established Church. He died at Bournemouth, England, Apr. 29, 1882. His writings were collected and edited by W. Kelly (32 vols., London, 1867–83). The brethren are now divided into several parties, but all agree in rejecting creeds, an ordained ministry, and a separate organization, and in meeting in halls or private houses instead of having churches. According to the census of 1890 there were in the U. S. four such parties, with an aggregate of 6,661 communicants. S. M. Jackson.

Plymouth Sound: an inlet of the English Channel on the southern coast of England, between the counties of Devon and Cornwall. It is 3 miles long, 4 miles broad, and forms, with the estuaries of the Plym and the Tamar, the harbors of Plymouth and Devonport, well known as one of the principal naval stations of Great Britain. See Devonport and Plymouth.

Plympton, George Washington: scientist; b. at Waltham, Mass., Nov. 18, 1827; graduated at the Rensselaer

Polytechnic Institute at Troy, N. Y., 1847; was Professor of Engineering and Architecture at Cleveland University 1852–53; of mathematics in the State Normal School, Albany, N. Y., 1853–55, and again 1858–60, and in the State Normal School, Trenton, N. J., 1860–63; became Professor of Physical Science at the Brooklyn Polytechnic Institute 1863, and of Chemistry and Toxicology in the Long Island College Hospital in 1864, and of Physics at Cooper Institute, N. Y., 1869. He was appointed director of the night schools of the Cooper Union in 1879. In the practice of engineering he was chief engineer of water-supply and drainage of Bergen, N. J., from 1867 to 1869; commissioner of electrical subways for the city of Brooklyn 1885 to 1889; and member of the board of experts to improve transportation over the East River bridge. He has been a member of the American Society of Civil Engineers since 1868. He is the author of *The Blowpipe* (1859), *The Starfinder* (1878), *The Aneroid* (1880), and translator of Jannetaz's *Determination of Rocks* (1877). He was editor of Van Nostrand's *Eclectic Engineering Magazine* 1870–86.

Pneumatic Dynamite Gun: See ORDNANCE.

Pneumatics [from Gr. *πνευματικός*, relating to wind or air, deriv. of *πνεῦμα*, *πνεύματος*, wind, air, breath, spirit, deriv. of *πνεῖν*, blow, breath]: that department of physics which deals with the properties of gases.

In this article the influence of pressure is particularly considered, together with the means of producing changes of pressure and of measuring the same.

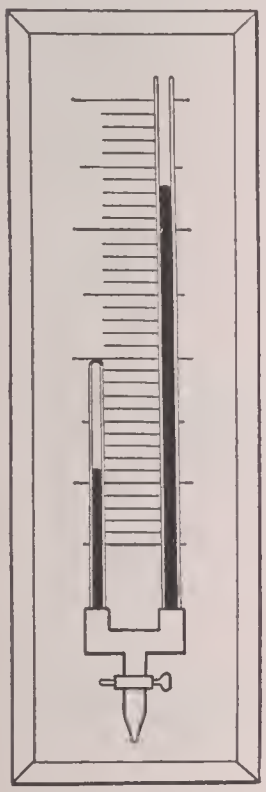


FIG. 1.

The principal phenomena of pneumatics depend upon what is known as the *law of Mariotte (or Boyle)*, a law which expresses the relation between the pressure of a gas and its volume. This law, which applies rigorously only to what is known as a "perfect gas," is given in the simple formula

$$v_o p_o = vp,$$

which states the fact that pressures p_o, p and volumes v_o, v are inversely proportional to one another.

For the verification of Mariotte's law the two pieces of apparatus, shown in Figs. 1 and 2 respectively, are commonly used.

Fig. 1, which gives the essential features of the apparatus for moderate pressures greater than one atmosphere, shows a glass tube with two arms, one of which, the shorter, is closed above, while the other is open.

When the open arm of the apparatus is partly filled with mercury, a certain amount of air is entrapped in the closed portion of the tube, and the volume of this air depends upon the pressure to which it is subjected. The pressure is measured by the difference in the height of the columns of mercury in the two arms, plus the barometric pressure. A stop-cock at the bottom of the tube facilitates the withdrawing of mercury.

The contents of the closed arm, per unit of length, having been carefully determined, pressure is applied by the introduction of mercury until the volume reaches a desired value. By further adjustment of the mercury and determination of the corresponding volumes, the law of Mariotte may be verified through a considerable range of pressures.

Below one atmosphere the apparatus is given the form shown in Fig. 2, in which C is a deep cistern of mercury into which an inverted tube of glass, t, previously nearly filled with the same liquid, is inverted. As the inverted tube is raised and lowered the column of air therein expands and contracts in accordance with the law under discussion. The volumes are determined by calibration of the tube; the pressures from the barometric pressure, minus the elevation of the mercury in the inner tube above the level of that within the cistern. The figure shows the apparatus with the inverted tube in three positions (Fig. 2).

Marked divergence from Mariotte's law occurs in the case of all known gases, as we approach a certain temperature (the so-called critical temperature) which is fixed for each particular gas. Hydrogen, nitrogen, oxygen, air, methane, and carbon monoxide have critical temperatures so low that they can only be reached by processes of artificial refrigeration. (See LIQUIDS.) They are known as the permanent gases, an appellation which is justified under all usual conditions, since they obey Mariotte's law approximately under whatever pressures may be brought to bear.

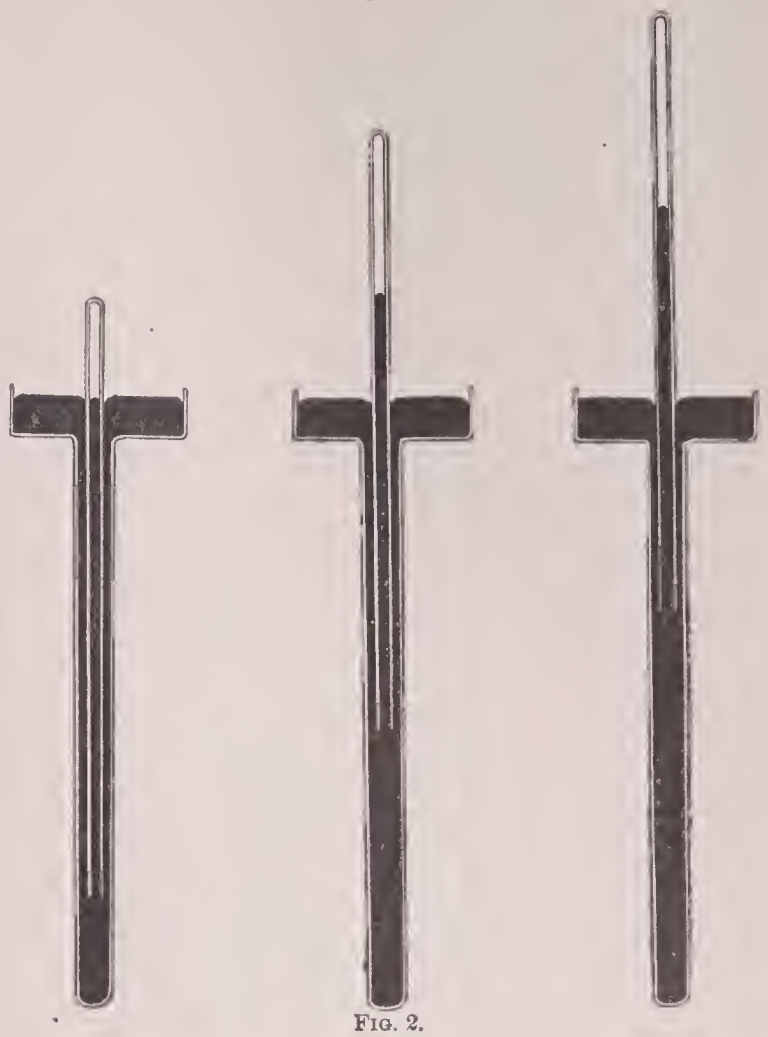


FIG. 2.

Gases, as sulphur dioxide, which have a critical temperature higher than the temperature of experimentation are capable of being liquefied by pressure alone. Such gases show a divergence from Mariotte's law which is always in the direction of too great compressibility. The presence of such vapors in admixture with a permanent gas will also cause appreciable deviation from the law on the part of the mixture.

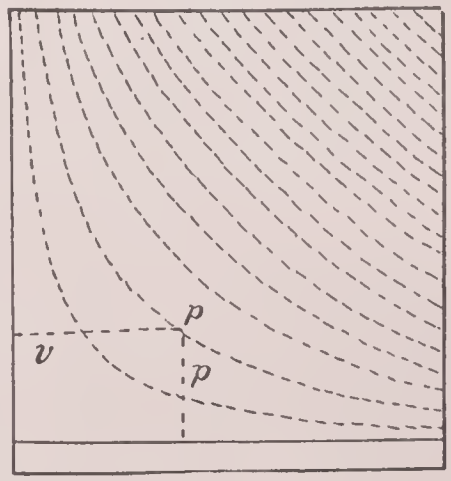


FIG. 3.

The behavior of a gas remote from its boiling-point, and consequently obedient to Mariotte's law, and that of a gas near the point of liquefaction, and therefore exhibiting deviations from the law, are shown graphically in the diagrams of Figs. 3 and 4, in which ordinates are pressures and abscissas are volumes.

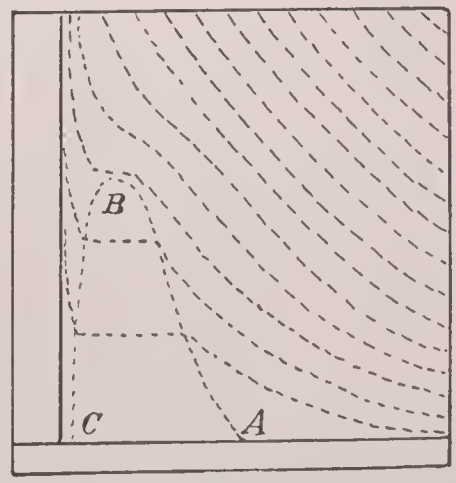


FIG. 4.

The peculiarity of the lines in the former diagram, which are hyperbolic, is that upon any line the product of the or-

dinates (vp) is a constant. Each line describes the changes of volume corresponding to the variations of pressure for a given temperature. The temperatures rise with increase in the ordinates. Fig. 4 gives the corresponding lines in the case of a vapor. At the highest temperature shown, those for the lines in the upper right-hand corner, the divergence from Mariotte's law is inconsiderable. For lower temperatures a tendency is developed which shows itself in double curvature of the lines. Finally, certain lines, those, namely, which cross the dotted area A B C, suffer discontinuity of curvature. Temperatures corresponding to these lines are below the critical temperature. The breaks in them indicate the points at which liquefaction begins and is completed.

Researches by Regnault, Amagat, Natterer, Cailletet seem to show that even the permanent gases do not fulfill the definition of a perfect gas mentioned above. The divergence from the law of Mariotte does not, however, consist simply in the exhibition of greater and greater compressibility with increasing pressure, as is the case with vapors. It is more complicated in character. Amagat, using a modification of the method of Cailletet, found for nitrogen the product pv, which for perfect gases should be constant, the following values all of which are referred to the value of that product at a pressure of one atmosphere.

TABLE I.

Pressures.	pv.	Pressures.	pv.
27·29 atm	0·9894	168·81 atm	1·0255
46·50 "	0·9876	208·64 "	1·0520
62·03 "	0·9858	251·13 "	1·0815
73·00 "	0·9868	290·93 "	1·1218
80·58 "	0·9875	332·04 "	1·1625
90·98 "	0·9893	373·30 "	1·2070
109·17 "	0·9940	430·77 "	1·2696
126·90 "	1·0015		

The values for this and for the other gases tested, with the exception of hydrogen, show a too great compressibility up to a maximum in the neighborhood of sixty atmospheres (corresponding to the minimum value of pv in the foregoing table). The compressibility then diminishes again, so that at the pressure of about 100 atmospheres the value of pv becomes unity and at higher pressures takes increasingly large values. Hydrogen alone shows for all pressure a degree of compressibility smaller than those demanded by Mariotte's law.

Of importance, likewise, are the densities of gases and their behavior when subjected to changes of temperature. The densities of some of the more important gases and vapors are given in Table II.

TABLE II.—DENSITY OF GASES AND VAPORS.

GAS.	Density (compared with air).	Weight of one liter, grammes.
Ammonia (NH_3)	0·589	0·761
Chlorine (Cl_2)	2·449	3·167
Hydrochloric acid (HCl)	1·259	1·628
Methane (CH_4)	0·553	0·715
Carbon monoxide (CO)	0·967	1·251
Carbon dioxide (CO_2)	1·51968	1·96503
Oxygen (O_2)	1·10521	1·42908
Sulphur dioxide (SO_2)	2·213	2·861
Nitrogen (N_2)	0·9701	1·2544
Hydrogen (H_2)	0·069234	0·089523
Steam (H_2O)	0·62182	0·80405
Air	1·0000	1·293052

Influence of Temperature.—This is expressed by the law explained in HEAT (*q. v.*), which may be written

$$pv = p_0 v_0 \left(1 + \frac{t}{273}\right).$$

Taking into consideration the deviations from Mariotte's law and analogous deviations from the law of Gay-Lussac, numerous attempts have been made to find an equation which will express completely the behavior of an actual gas. Van der Waals (1873) gave as the complete formula of condition,

$$\left(p + \frac{a}{v^2}\right)(v - b) = \frac{p_0 v_0}{273} T,$$

in which a and b are small constants and T is the absolute temperature.

The usual instrument for producing changes of pressure is the air-pump (invented by Otto von Guericke about 1650). The term is usually applied alike to pumps used for the production of a vacuum and to compression-pumps.

Vacuum-pumps, in their earlier forms, were modifications of water-pumps, and the forms still in use in the production of ordinary vacua are constructed with valves.

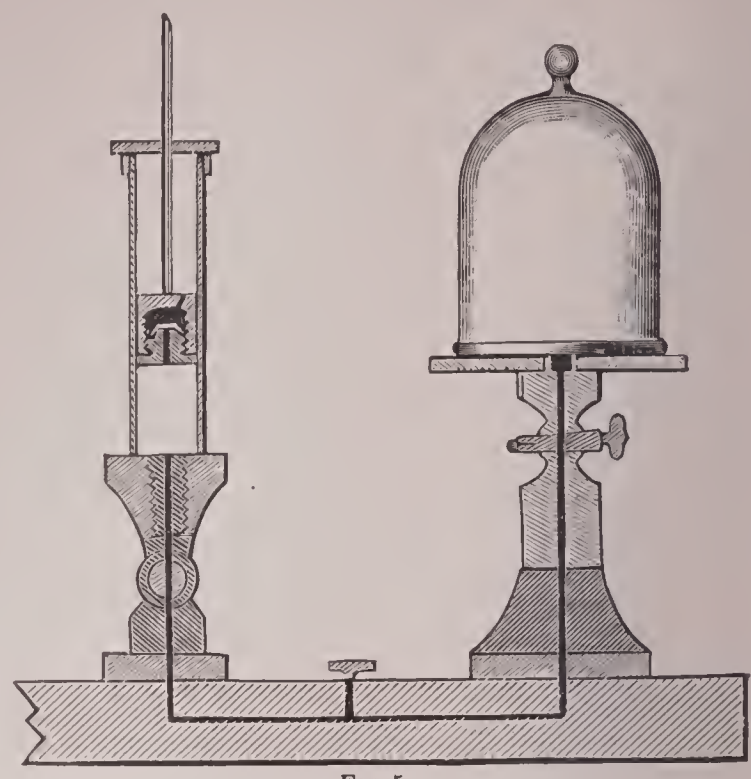


FIG. 5.

One of the simplest and best-known types of vacuum-pump is shown in Fig. 5. This pump contains only one

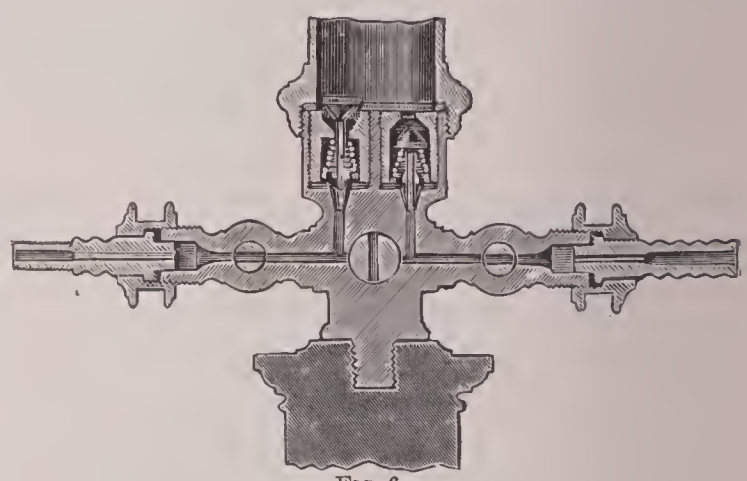


FIG. 6.

valve which is placed within the piston. Another form (that of Silbermann), Fig. 6, contains two valves, one working upward and the other downward, situated in the base of the cylinder. The piston is solid.

Many other varieties of the mechanical vacuum-pump have been devised. The general principles, applicable to all forms, are given here: (1) Since gases are of small density the volumes displaced should be relatively much larger than in the case of water-pumps. (2) The valves should be capable of action under the smallest possible differences of pressure. This point is of great importance where the production of high vacua is desired. (3) Joints must be as nearly perfect as regards the matter of gas-leakage as it is possible to make them.

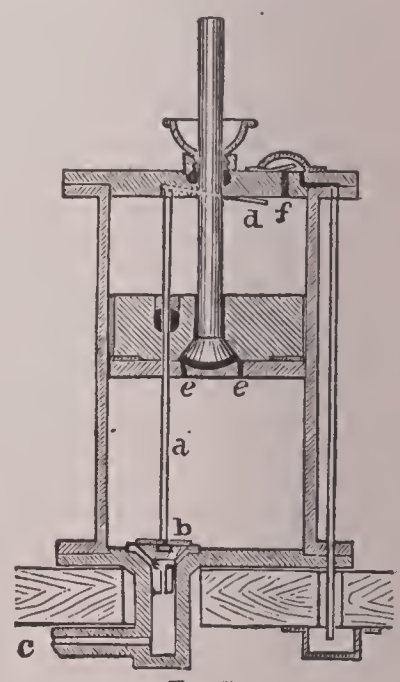


FIG. 7.

These two last factors limit the usefulness of air-pumps with valves, since the highest degree of exhaustion which can be obtained with such a pump is either that at which the valves cease to work or at which the rate of leakage equals the rate of exhaustion.

The latter is the more important, since the failure of valve-action may be remedied by supplanting the movements due to differences of pressure with movements which follow positively and at the proper instant those of the piston.

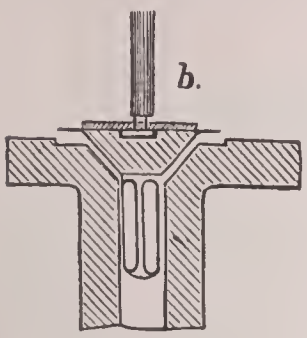


FIG. 8.

Fig. 7 shows such a device, by E. S. Ritchie. In these instruments the valve at the bottom of the cylinder is opened and closed by means of a rod (*a*) which is fitted to a stuffing-box in the plunger. The valve in the piston is also operated directly from the stroke, for which purpose the piston-rod is given the form shown in the figure. Thus *b* is opened and *e e* is closed at the beginning of the stroke without reference to the differences of pressure.

The arrangement of the lower valve in Ritchie's pump is shown in more detail in Fig. 8. It consists of a conical plug which is carefully fitted to the tapering end of the tube which leads from the exhausted receiver to the lower end of the pump-cylinder. This plug is attached to the end of a rod carried by the piston, as above described. A disk of oiled silk completes the closure.

Mercury Vacuum-pumps. — An important class of air-pumps are those used in the production of very high vacua, such as it is necessary to obtain in many scientific investigations, and commercially, in the manufacture of all forms of the electric glow-lamp, where an inert atmosphere is not used. Mechanical pumps of the forms just described can rarely be made to produce an exhaustion amounting to $\frac{1}{1000}$th of an atmosphere, whereas the pressure within the bulb of a properly constructed glow-lamp does not exceed $\frac{1}{20000}$th of an atmosphere. In physical research it is frequently necessary to obtain still higher vacua, amounting sometimes to $\frac{1}{1000000}$th or even to $\frac{1}{100000000}$th of an atmosphere. For such purposes one of the following forms of mercury-pumps is used:

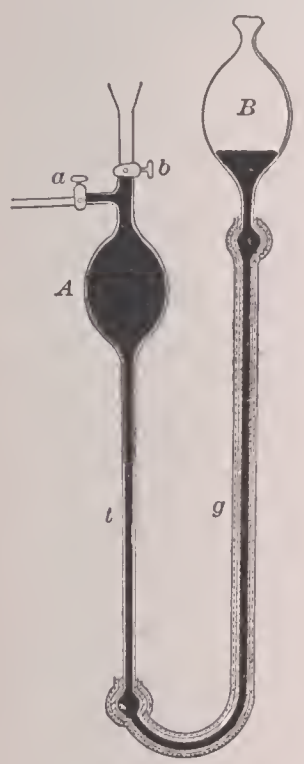


FIG. 9.

(*a*) *The Geissler Pump.* — This instrument, which has found extended application in the manufacture of electric lamps, is shown in one of its very simplest forms in Fig. 9. The essential parts are the two bulbs of heavy glass, each of which is capable of holding about two liters. These are connected by means of the long vertical glass tube *t*, which must somewhat exceed the barometric column in height, and the strong flexible tube *g* attached to the lower end of *t* and to the movable bulb B. There must be, further, two tubes connecting the fixed bulb A respectively with the outer air and with the vessel which is to be exhausted. These must be provided with stop-cocks.

The process of pumping with apparatus of this type consists (1) in closing the stop-cock *a*, which leads to the receiver and opening *b*, which gives egress to the outer air, the movable bulb B being raised to a height such as to cause the mercury to flow over into A, completely filling it, and driving the previously contained air out through the egress-tube. (2) This operation being completed the stop-cock *b* is closed; the bulb B is lowered to a position at least 760 mm. below the bottom of the bulb A and the stop-cock *a* is opened. The result of the second operation is an influx of air from the receiver to the bulb A, which is then expelled by a repetition of operation (1). By continued alternations of the two operations the pressure may be reduced to any desired point within a limit lying much below that attainable with valve-pumps.

In practice, there are attached to the Geissler pump various accessory parts not shown in the figure, such as drying-tubes between the vessel to be exhausted and the bulb A, and mercury-traps between the latter and the outer air.

The operation of the Geissler pump is a laborious one, since it involves the repeated lifting of a large mass of mercury through a vertical distance of about a meter. Where such pumps are in continual use, as in the pump-rooms of incandescent-lamp factories, it is usual to drive the mercury into and out of the bulb A by pneumatic pressure, leaving to the manipulator only the task of turning the stop-cocks.

In these cases the apparatus consists of a mechanical pump driven by power, and capable of maintaining a reduc-

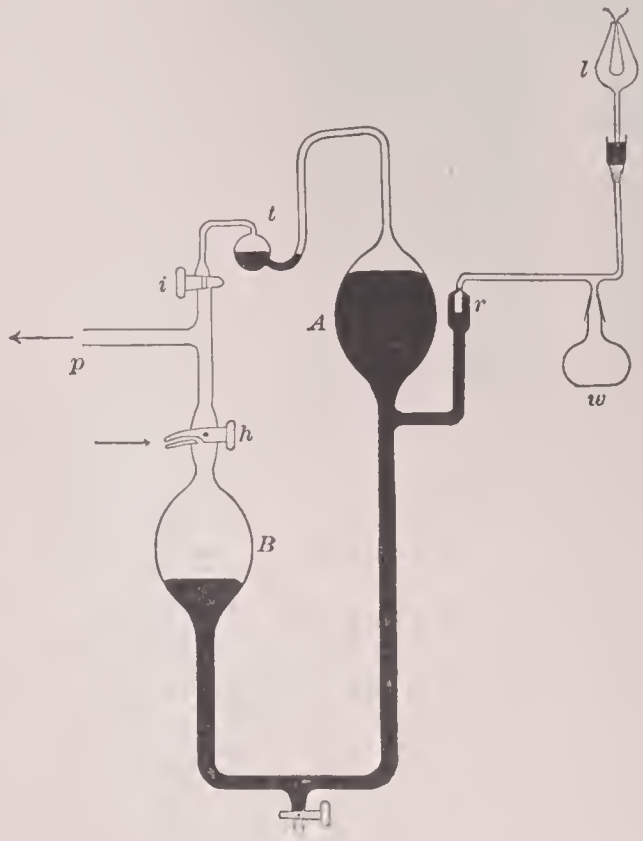


FIG. 10.

tion of pressure of 700 mm. The Geissler pump, also, is modified to suit the conditions of working. The bulb B is fixed, its position with reference to A being that shown in Fig. 10, which gives the arrangement of one of the simplest of this type of pumps.

In the use of such a pump the tube *p* is connected with the mechanical pump, and the stop-cocks *h* and *i* are turned so as to bring the atmosphere within B A, the connected vessel *w* (drying-flask), and *l* to the low pressure produced by the action of the latter. The two-way stop-cock *h* is then turned so as to admit air from without to B, whereby the mercury rises into A, driving the air before it through the mercury-trap *t*. A glass valve, *r*, rises upon the surface of the mercury during this operation until it closes the contraction in the tube, which it has been ground to fit. The restoration of the stop-cock *h* to its first position empties the bulb A, and produces further exhaustion of *l* in proportion to the additional space thus provided.

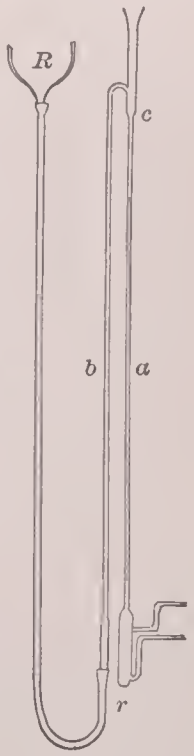


FIG. 11.

(*b*) *The Sprengel pump* is a mercury-pump based upon a different principle from that of Geissler. The principle was really due to Bunsen, who, in 1868, described a water-jet pump for hastening the filtration processes of the analytical chemist. Sprengel made use of a mercury column flowing downward through a vertical tube of small bore. Fig. 11 shows a simple form of the Sprengel pump, designed by Weinhold. The long vertical tube *a*, enlarged at *c*, is fed with mercury from the tube *b*, which is given the form shown in the figure to prevent loss of vacuum in case the supply of that liquid is not continuously maintained. The mercury flowing from the narrow tube, at a rate which is regulated by the height of the reservoir, R, forms drops in the wider upper portion of the pump-tube *a*. Each of these, as it falls into the contracted part, entraps a bubble of air and carries it down into the lower reservoir *r*, whence it escapes to the

outer atmosphere. This process is a continuous one, and when the apparatus is properly proportioned and clean, and when clean mercury is used, the pump will frequently continue in action until a pressure of less than the millionth of an atmosphere is attained. For vacua of a still higher order many special precautions must be taken.

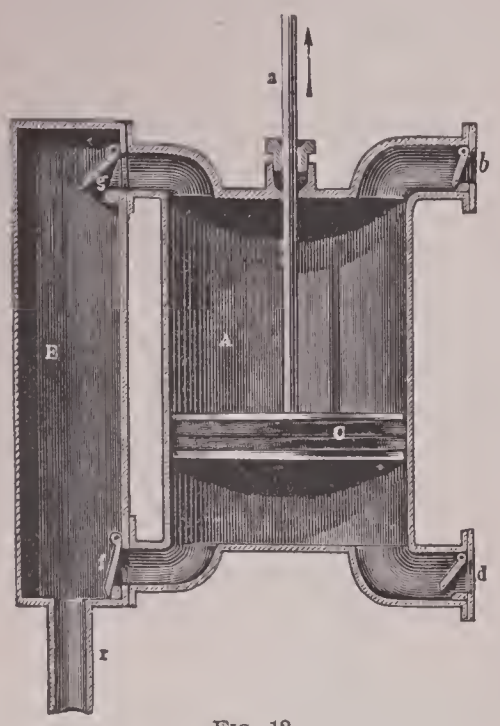


Fig. 12.

Compression-pumps.—This class of air-pumps is much easier to construct than are vacuum-pumps, since it is not necessary, generally speaking, to overcome all leakage, nor do the valves need to be brought to the same degree of delicacy. The characteristic features of compression-pumps, when used as blowers, are the large size of the cylinder and of the valves. There are, as a rule, two sets of valves, so that both the up and the down stroke are effective. When pumps are to be used for the production of high pressures, rather than for the supply of large quantities of air, they are made, as a matter of necessity, with thick walls and small apertures. Figs. 12 and 13 show typical pumps for the production of a blast; Fig. 14 a fan in which the rapid rotation of floats within a cylindrical compartment takes the place of the piston-motion, and, by centrifugal action, produces a continuous and powerful draught.

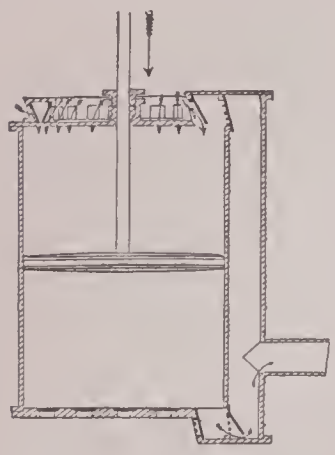


Fig. 13.

Measurements of gas-pressure are made by means of *manometers.* These instruments depend upon the balancing of the elastic forces of the gas by means of a column of liquid, usually mercury (open-tube manometers), upon the compression of a gas within a closed receiver (closed-tube manometers), or upon the direct mechanical action of the gas in distorting a flexible closed box or tube (pressure-gauges). The last-named class corresponds to the aneroid barometer, of which indeed it is only a suitable modification.

Fig. 15 shows the essential parts of an "open-tube" manometer for moderate pressures; Fig. 16 of a "closed-tube" manometer with cylindrical bore; and Fig. 17 an instrument of the same class in which the tube is conical. The object of this modification in which the scale will remain open is for high pressures. Fig. 18 presents the essential features of a well-known type of pressure-gauges.

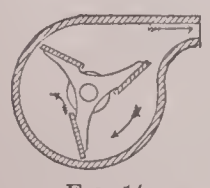


Fig. 14.

For the measurement of high vacua a special form of "closed-tube" manometer is used. This instrument, which is known from its inventor as the McLeod gauge, is shown in its essential features in Fig. 19. It consists of a bulb of glass mounted upon a glass tube somewhat longer than a barometer tube. Into the top of this bulb is inserted, by the glass-blower's process, a capillary tube, closed above, the contents of which, for each centimeter of its length, is known in terms of the contents of the bulb. A side-tube inserted below the mouth of the bulb connects the apparatus hermetically with the receiver the vacuum of which is to be measured. To the bottom of the long vertical tube an open reservoir of mercury is attached by means of a strong flexible tube similar to that used in the Geissler pump.

The process of measuring a vacuum with the McLeod gauge is as follows: During the exhaustion the reservoir of mercury is kept in a position so far below the bulb of the gauge that the manometric column formed by the atmos-

Fig. 15.

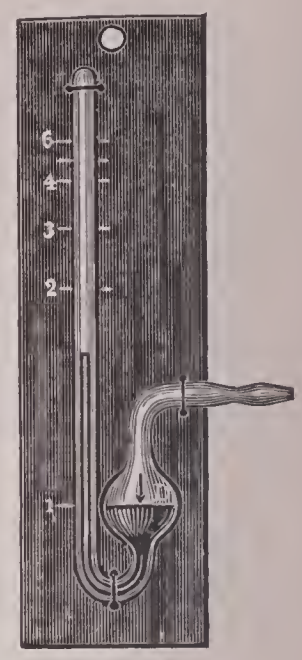


Fig. 16.

pheric pressure without will not reach the side tube. (See Fig. 19.) When it is desired to measure the vacuum, the reservoir is raised until the mercury reaches the side-tube,

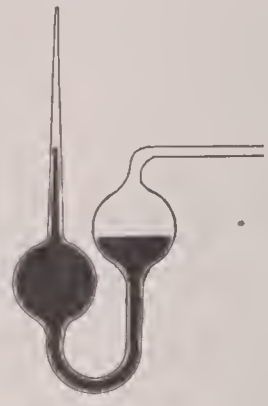


Fig. 17.

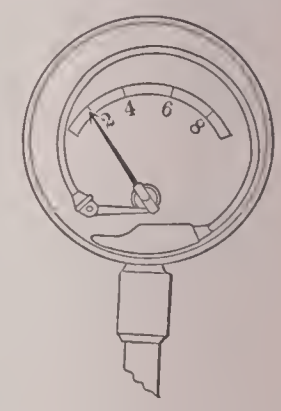


Fig. 18.

thus isolating the body of extenuated gas within the bulb. The reservoir is then raised still farther, and the air within the bulb thus caused to contract under the increasing pressure until, if the vacuum be one sufficiently high to be measured in this way, the mercury has entirely filled the bulb and has driven the air into the capillary tube. The final operations consist in adjusting the mercury within and without to the same height, and in observing the volume of the compressed air. A comparison of its volume with that at which it existed at the beginning of the experiment affords data for computation of the initial pressure.

Fig. 19.

Appliances based upon the behavior of gases under pressure are numerous. Within the limits of this article it is possible to refer very briefly only to a few familiar examples.

The properties of compressed gases afford a means of storage of energy. Sometimes this is for short intervals, as between the strokes of a force-pump, where the air compressed in the receiver maintains the velocity of efflux during the periods when there is no direct impulse. In other cases the storage is on a much

larger scale, as in the case of compressed-air motors. In the city of Berne, for instance, a street-railway is operated by means of the energy stored at a pumping-station at one end of the line, where a cylinder upon the car is filled with air at high pressure. One such filling serves to drive the car to the other end of the road and back again. On account of the thermal losses involved, such systems are never of high economical efficiency. They can be used to advantage only where power which would otherwise go to waste can be utilized, as in the case of abundant water-power.

Compressed air is extensively used in the building of bridge piers, of tunnels, and of foundations, where water or quicksand is to be excluded. It is also used for the transmission of small parcels, etc., through tubes, at high speed. (See PNEUMATIC TRANSMISSION.) The fact that pressure is transmitted through gases at a velocity equivalent to that of a sound-wave has led to the use of pneumatic systems of signaling, in which change of pressure at one point in a system of closed tubes is made to operate some signaling device at a distance. E. L. NICHOLS.

Pneumatic Transmission: a method of transmitting written messages and packages of goods through tubes by the pressure of the atmosphere or the action of compressed air. The operation of the apparatus may be illustrated by inserting one end of a small tube of glass or metal, containing a pellet of moistened paper, in the mouth. Upon forcing air into the tube the pellet will move from the experimenter, but if the air is drawn out of the tube the pellet will move toward the experimenter. These methods are used in all apparatus for pneumatic transmission, a compression or exhausting air-pump being used for controlling the air and a hollow piston of leather or other suitable material for containing and carrying the messages; but there is a variety of special apparatus for regulating the speed and for inserting and removing the piston with its freight of messages from the tube.

In 1687 Denys Papin first suggested the idea of apparatus for pneumatic transmission, but there is no evidence that his plan was tried. In 1792 *Le Dictionnaire Encyclopédique des Amusements des Sciences*, published in Paris, gave a graphic account of an experiment in pneumatic transmission, a round wooden box containing a paper being propelled by a powerful blast of air through an underground pipe for a distance of three-quarters of a mile. This, however, was only for amusement. The industrial aspect of pneumatic transmission was investigated in 1810 by Medhurst, a Danish engineer, who issued a pamphlet entitled *A New Method for Transporting Parcels and Letters by Air*. He followed this by another in 1812 entitled *Some Calculations and Remarks Tending to Prove the Possibility of the New Method for Transporting Letters and Parcels by Air*. Nothing practical was developed from the proposal of Medhurst. In 1824 Valloric proposed a wooden tube 6 ft. 6 in. in diameter for carrying passengers between London and Brighton; carriages were to be blown through the tube, but the suggestion was never carried out. In 1827 Medhurst again proposed a method of pneumatic transmission by means of a piston propelled in a tube by air-pressure, the piston being connected with a carriage exterior to the tube by means of a rod passing through a slot covered by a valve which the rod opened and closed as the piston moved forward. As the air-pressure was obtained from the atmosphere (the air being exhausted in front of the traveling piston and allowed to enter the tube behind it), this system was called the atmospheric railway.

Although Medhurst's proposals were not carried out practically, the idea of pneumatic transmission, by which the movement of the load transmitted was accomplished in carriages outside of the tube in which the piston moved, originated with him, and was in reality the first system which was commercially employed. Medhurst's invention has been made the foundation of upward of fifty British patents (ranging in date from 1827 to 1850), most of which relate to modifications of the valve covering the slit in the top of the tube, or to mechanism for opening and closing it. This system was first tried in 1842 on a half mile of line at Wormwood Scrubs, near London, and a speed of 30 miles an hour was obtained. This experiment led to the employment of the system on the Kingstown and Dalkey Railway, a line of 1¾ miles near Kingstown, Ireland, on which trains were run at the rate of 45 miles per hour. Several short lines were constructed in England, and in 1847 the line from Paris to St.-Germain was built. This road was worked on the pneumatic plan for over twenty years, and outlived all its pneumatic predecessors. At present there is no pneumatic transmission system using a slit tube and an exterior carriage.

In the system of pneumatic transmission employed in all the large cities of Europe and in many places in the U. S. the articles to be conveyed are always within the tube, which extends from one station to another. This method of pneumatic transmission was first carried out on a commercial scale by Latimer Clark in 1853 between the Central and Stock Exchange stations of the Electric and International Telegraph Company in London. The tube connecting the stations was 1½ inches in diameter and 660 feet long. Carriers containing a number of messages were sucked through (in one direction only) by creating a partial vacuum at the delivery end of the tube. C. F. Varley, in 1858, improved the system by using compressed air to force the carriers in one direction, a partial vacuum being used to draw them in the opposite; this is known as the radial system of pneumatic transmission, for the reason that a large number of tubes can radiate in all directions from a single station. This system has been brought to great perfection in connection with the telegraph department of the British post-office, with thirty-six tubes in London alone. Another method of working, used in Paris and other large continental cities, is called the circuit system. In this stations are grouped on circular or looped lines, around which carriers travel in one direction only. The pressure used in the tubes of the British post-office is 10 lb. per square inch of compression, or 7 lb. of vacuum, and the time of transit through a tube 2½ inches in diameter is 1 minute for a distance of 3,000 feet and 5½ minutes for 9,000 feet.

The first application of pneumatic transmission to the conveying of mails and parcels was made in 1863 by the Pneumatic Dispatch Company of London, which constructed a line of D-shaped tube (the convex side uppermost) beneath the surface of the ground from the terminus of the Northwestern Railway at Euston to the district post-office in Eversholt Street, a distance of about 1,800 feet. The dimensions of the tube were 2 ft. 8 in. wide and the same in height. The carriages were cradle-like boxes made to conform to the shape of the tube (although not touching it) and mounted upon four wheels. These carriages were made to travel in the tube at the rate of 17 miles per hour, and regularly transmitted fifteen mails per day each way. The result of the working of this line was so satisfactory that in 1872 a line with a pair of D-shaped tubes, 4 feet wide and 4 ft. 6 in. high, was laid from Euston station to the General Post-office, a distance of 14,214 feet. The time usually occupied in transit is 12 minutes, and 10 or 12 tons are drawn up grades of 1 in 14 without difficulty.

With a view of demonstrating the applicability of the principles of pneumatic transmission to passenger traffic, the Pneumatic Dispatch Company had constructed at the Crystal Palace, Sydenham, a brick tunnel about 10 feet high by 9 feet wide, capable of admitting the largest carriages used on the Northwestern Railway. This tunnel was 1,800 feet in length. The gradients were 1 in 15 (352 feet per mile) and the transit was made in 50 seconds with a pressure of but 2½ oz. per square inch. The motion was said to be smooth and agreeable, and stoppages were made gently and without jerk. In 1869 Alfred Beach began the construction of a pneumatic railway under Broadway, New York. The internal diameter of the tunnel was 8 feet, and the portion of the line completed extended from Warren to Barclay Streets. Some experimental work was done on this line, but the enterprise was abandoned owing to a variety of reasons not at all connected with the principle of pneumatic transmission.

Notwithstanding the success of pneumatic transmission in connection with the postal service of European nations, it was not until 1892 that the U. S. Government decided to give the system a trial, and a plant was laid down in Philadelphia, extending from the General Post-office at Ninth and Chestnut Streets to the sub-station on Chestnut Street between Third and Fourth Streets, a distance of 2,928 feet. There are two tubes of iron, bored to an internal diameter of 6⅛ inches and made in sections of 12 feet in length. This plant was put in operation on Feb. 17, 1893, and has been so successful that it is proposed to establish an extended system of pneumatic transmission covering the whole city. Pneumatic tubes have been used for many years by the Western Union Telegraph Company to convey messages from sub-stations in New York to the general office, and they have also been largely employed in commercial establishments to convey change from a central office to the

several sales-counters; but pneumatic transmission has not reached a development in the U. S. equal to that in Europe.
W. F. Durfee.

Pneumogastric Nerve [*pneumogastric* is from Gr. *πνεύμων*, lung + *γαστήρ*, stomach; so called from its distribution to the lungs and stomach]: the tenth cerebral nerve, though largely a spinal nerve. Its nucleus of origin is a mass of ganglion-cells lying deep in the posterior part of the medulla oblongata, in the floor of the fourth ventricle, and its fibers escape from the side of the medulla. It issues from the skull by the jugular foramen, at which point there is a ganglionic enlargement of the nerve. It then descends with the carotid artery to the chest, and after entering the thorax lies upon the œsophagus. Upon the lower part of the œsophagus the two nerves conjoin, pass through the diaphragm, and are distributed to the stomach and solar plexus. At the level of the jugular foramen the pneumogastric is joined by branches from motor nerves—the facial, hypoglossal, spinal accessory, etc. The branches of the pneumogastric are sent to the pharynx, to the larynx (superior laryngeal nerve, which is sensory, inferior laryngeal, which is motor), to the heart, lungs, œsophagus, and stomach. From its origin to its ganglion (analogous to posterior root of spinal nerves) the pneumogastric nerve is purely sensory, and its most important function—viz., the regulation of breathing by the transmission of sensations through its pulmonary branches to the medulla—is performed by that property. Below the ganglion it is a mixed nerve. The motor properties of the inferior laryngeal are derived chiefly from the branch of the spinal accessory nerve, and the pharyngeal branch derives its motor power from the nerves which join the pneumogastric below the ganglion. The action of the pneumogastric on the heart is checking or inhibitory, paralysis of the pneumogastric producing excessive rapidity of the heart's action (and slow respiration), while irritation of the nerve slows or stops the cardiac movements. The movements of the œsophagus and stomach are under the control of the motor fibers of the pneumogastric. Revised by William Pepper.

Pneumograph: See Recording Apparatus, Psychological, in the Appendix.

Pneumonia [= Mod. Lat. = Gr., deriv. of *πνεύμων*, lung]: inflammation of the lung, of the lining of the air-sacs, and of the interstitial framework of the lung. Pneumonia has been classified into (1) catarrhal pneumonia, when only the air-sacs are involved, filled with products of catarrhal inflammation, extending from the bronchial tubes; (2) croupous pneumonia, when the air-sacs are filled with solid lymph exuded from their inflamed walls; (3) interstitial pneumonia, a slow and chronic inflammatory infiltration and consolidation of the fibrous structures which surround the air-sacs and minute bronchial tubes. As commonly used, however, in Great Britain and the U. S., the term pneumonia means the croupous form only, an inflammation of the air-sacs, which are the functional elements of the lung for the oxygenation of the blood and the liberation of carbonic acid gas. This form, popularly known by the name of "lung fever," is usually confined to one lung and often to one lobe, though it sometimes attacks the lobes successively. Accordingly, it is further designated as "lobar pneumonia." Primary pneumonia in healthy persons occurs more often in the right lung, beginning, as a rule, at the base of the lung and progressing upward toward the apex. In old and feeble persons it may begin at the apex, but pneumonia when local or beginning at the apex is usually tuberculous in nature and the beginning of a chronic phthisis. Pneumonia is a disease chiefly of adults, and more often of males. It results from infection by a specific microorganism, the *Pneumococcus* or *Diplococcus pneumoniæ*, when the system is rendered susceptible by chilling, exposure, fatigue, and similar causes. Pneumonia is therefore an infectious disease, and to a degree it is also contagious. House and institution epidemics have frequently been observed. The disease is announced by a heavy chill, high fever, rapid respiration, frequent pulse, flushed cheek—on the side of the affected lung; in severe cases by delirium and symptoms of a typhoid nature. There is acute pain in the side, due to congestion of the pleura, and a duller, heavier pain or soreness of the side, with sense of weight, due to excess of blood and the solid products of inflammation in the lung. There is cough, with expectoration of mucus tinged with blood or rust-colored, and in grave cases brownish or dark sputa, resembling tobacco-juice or prune-juice, and indicative of a decomposed state of the blood, and the exuded elements filling the vesicles. The contents of the vesicles are gradually softened and expectorated, and the lung restored to its normal state. Acute pneumonia of adults, although grave in its symptoms, is usually curable, and, contrary to popular apprehension, seldom leads to subsequent consumption.

Pneumonia in children is usually acute catarrhal inflammation of the minute bronchial tubes and air-sacs, occurring in one or many lobules of both lungs. It is liable to leave portions of lung-substance inactive, collapsed, or consolidated, and develop the catarrhal form of phthisis; but many of the cases in which it is supposed that phthisis has followed catarrhal pneumonia are really *tuberculous catarrhal pneumonia* from the first.

Pneumonia is variously treated. Locally, cold water and ice-bags may abort or limit the inflammation at its beginning. When established, warm applications, as poultices, warm anodyne fomentations, cotton-batting, and oil-silk afford the greatest comfort and favor resolution and removal of the exudation from the air-sacs. Carbonate and muriate of ammonia are used as diffusive stimulants and to liquefy the exuded lymph; calisaya bark or quinine, alcoholic stimulation, and rich liquid diet to sustain strength are also employed. At the very onset bleeding is at times a useful measure of treatment. Revised by W. Pepper.

Po [Lat. *Padus*, or, poetically, *Eridanus*; Gr. *Ἠριδανός*]: the largest river of Italy. Rising on the east flank of Monte Viso, at a height of 6,560 feet above the sea, it flows N. E., receiving many affluents in its course, till its junction with the Dora Baltea near Chivasso, thence a little S. of E. to the Adriatic, into which it discharges by several mouths; length, 360 miles; drainage area, 27,000 sq. miles. In the first 20 miles of its course it descends 5,300 feet to a point near Revello, and though here a large stream its bed is sometimes left dry for a considerable distance. At Valenza, about one-third of the whole distance from its source to its outlet, it reaches the level of some 600 feet above the sea, and from this point it flows chiefly through its own alluvion to the Adriatic, and is navigable for vessels of 130 tons.

The Po is diked continuously from near Cremona to the marshes at its outlet. The levees do not follow the smaller windings of the river, but in many places leave a space of even miles between them. An embankment running along the margin of the channel is called *argine a froldo*, or simply *froldo*. When it recedes sensibly from the river it is called *argine a golena*. The *golene*, or spaces between the levee and the channel, are frequently protected by low dikes and cultivated, but in every considerable rise of the river the natural banks are overflowed and the *golene* submerged.

The river receives fully four-tenths of its volume from a chain of lakes lying at the foot of the Alps, extending E. and W. about 150 miles, and with a total area of more than 300 sq. miles. The mean discharge into the Adriatic is 60,745 cubic feet to the second, which appears to differ little from the delivery of the Rhône and of the Rhine, and equals about one-eleventh of that of the Mississippi. Its waters are usually at their lowest stage twice in the year, about the summer and winter solstices, and at their highest in May and October.

Besides its vast discharge proportionally to the extent of its basin, the enormous amount of mineral matter ground down to fine silt deposited by its waters at and near its outlet—a consequence of the fact that most of its tributaries are mountain-torrents—is a noteworthy feature in the physical character of the Po. In floods this is calculated to equal $\frac{1}{300}$th part of the total delivery in *volume*, or almost ten times the mean proportion of solid matter borne down by the Mississippi. The deposit extends the delta of the Po into the Adriatic at a rate of advance not greatly inferior to that of the Mississippi, or more than 200 feet per year, though the lateral spread of the sediment is less than at the mouth of the American river.
George P. Marsh.
Abridged by M. W. Harrington.

Pocahontas: daughter of Powhatan, a powerful Indian chief of Virginia; b. about 1595. According to the *True Relation* of Capt. John Smith, she in 1607 rescued the latter from death when he was taken prisoner by the Indians. The rescue, according to Smith's narrative, took place at Werowocomoco (now Shelly), Gloucester co., Va., near the junction of Carter's creek and York river. In 1609 she visited Smith with news of an intended Indian attack, and she several times supplied the hungry colonists of Jamestown with corn. In 1612 the chief Japazaws sold her to Argall, and her

father offered a ransom for her release, but could not agree with her captor on the terms. In 1613 she married Thomas Rolfe, afterward secretary and recorder-general of Virginia. She was baptized as Rebeeca, went to London, and was presented at court. D. at Gravesend, England, Mar., 1617, leaving a son, Thomas Rolfe, from whom the Randolphs, Guys, Hemmings, and other leading families of Virginia trace their descent. See Doyle's *English Colonies in America* (1882).

Pocock, Edward, D. D.: Orientalist; b. at Oxford, England, Nov. 8, 1604; graduated there in 1622; was fellow of Corpus Christi College in 1628, and devoted himself to the study of Eastern learning. He was chaplain to the English factory at Aleppo, Syria, from 1630 to 1636, when he returned to Oxford to take the professorship of Arabic, then just founded by Arehbishop Laud. After giving one course of lectures he went back to the Orient, and was in Constantinople from 1637 to 1640, collecting manuscripts and coins and ardently pursuing his favorite studies. He returned to England in 1640, and in 1643 his college gave him the living of Childrey in Berkshire, near Oxford. In 1648 he was appointed to the chair of Hebrew, and became canon of Christ Church the same year. A staneh though not intemperate royalist, he would have lost his professorships in the time of Cromwell but for the remonstrances of John Owen and John Selden. The restoration of Charles II. in 1660 multiplied and secured his honors. D. in Oxford, Sept. 10, 1691. He published, besides other works, *Version from the Syriac and Notes on the Epistles of 2 Peter, 2 and 3 John, and Jude*, omitted in the Peshito (1630); *Specimen Historiæ Arabum* (1648); *Porta Mosis* (1655); *Annals of Eutychius* (1658); *Arabic Version of Grotius de Veritate* (1660); *Abulfaragii Historia Dynastiarum* (1663); and English *Commentaries* on Micah (1677), Malaehi (1677), Hosea (1685), and Joel (1691). See his *Works and Life*, in 2 vols., by Leonard Twells (London, 1740).

Revised by S. M. Jackson.

Pococke, Richard, LL. D.: traveler; b. at Southampton, England, in 1704; graduated at Oxford in 1731; took the degree of LL. D. in 1733; traveled in the East 1737–42; published his *Description of the East and some other Countries* (2 vols. fol., with 178 plates: vol. i., *Observations on Egypt*; vol. ii., part i., *Palestine, Syria, Mesopotamia, Cyprus, and Candia*—part ii., *Islands of the Archipelago, Asia Minor, Thrace, Greece, etc.*) in 1743–45; a German translation appeared (Erlangen, 1754–55, 3 parts), and a Freneh one (Neuchâtel, 1772–73, 7 vols.). He was made Arehdeaeon of Dublin in 1745, Bishop of Ossory in 1756, and in 1765 Bishop of Meath, and died at Charleville, near Tullamore, on Sept. 15 of that year. He wrote his *Travels in Scotland* (edited from original MS., with memoir by D. W. Kemp, Edinburgh, Seottish Historieal Society, 1887), in *Ireland* (edited by G. T. Stokes, Dublin, 1891), and in *England* (2 vols., London, Camden Soe., 1888–89). He was the author of some papers in the *Philosophical Transactions* and in the *Archæologia*, but his fame rests upon his work on Palestine, whieh Robinson pronounces "one of the most important," although he knew but little Arabic and his seholarship was more classieal than biblieal.

Revised by S. M. Jackson.

Po'comoke River: a river whieh rises in the Cypress Swamp of Sussex co., Del., and flows 60 miles S. and S. W., mostly in Maryland, to Chesapeake Bay. The tide ascends 22 miles, and it is navigable 20 miles, to Snow Hill, Md.

Podes'ta [Lat. *potestas*, power]: a municipal magistrate in Italian eities. The name was formerly applied to the chief magistrates of Italian towns, appointed in troubled times with full dictatorial powers. He was usually a stranger to all the loeal factions, and during his term of offiee was prohibited by law from forming any intimate eonneetion with the citizens over whom he ruled. He was appointed for a term of years, but he sometimes beeame a permanent despotie ruler. The name was probably first given to the German magistrates whom Frederick Barbarossa appointed over the Lombard eities.

Podgoritza (eity under the hill): town; situated on the Moratcha in territory ceded to Montenegro by the Treaty of Berlin (1878); strategieally important as commanding Northern Albania. It was founded in the fifteenth century by Mohammed II., and built from the neighboring ruins of Dioclea, where Diocletian was born. Every Sunday a great bazar or market is held, thronged by Albanian and Montenegrin mountaineers when not engaged in war. It carries on a large trade in honey, skins, wax, and wool. Pop. 6,000.

E. A. Grosvenor.

Podiciped'idæ [Mod. Lat., named from *Podiceps*, the typical genus; Lat. *po'dex, po'dicis*, rump + *pes, pe'dis*, foot]: a family of swimming birds, including the grebes, distinguished by their rudimentary tail, flattened tarsi, broadly lobed toes, of which the outermost is the longest, and flattened nails. The body is short, plumage close and silky, legs placed far backward. The name is sometimes written *Podicipidæ*. See Grebe.

F. A. L.

Podiebrad, pōd-yā'brăd, George: King of Bohemia; b. in Apr., 1420, of a noble and wealthy Bohemian family belonging to the moderate section of the Hussite party; joined the Utraquists after the election of Albert of Austria to the Bohemian throne in 1438, and distinguished himself greatly by compelling Albert to raise the siege of Tabor. As leader of the whole Hussite party he became governor of Bohemia in 1444, during the minority of Albert's son, Ladislaus the Posthumous, and on the death of Ladislaus he was elected king himself, and crowned at Prague Mar. 2, 1458. It was his great aim to reconcile the Hussites and the Roman Catholics among his subjects, and he acted with wisdom, and with some success; but the pope excommunicated him as a heretic, preached a crusade against him in Germany, incited his son-in-law, Matthias Corvinus, King of Hungary, to attack him, and even instigated his own Roman Catholic subjects to revolt against him. Podiebrad suppressed the insurrection, routed the German crusaders, defeated the Hungarians several times, and, in order to strengthen the anti-papal and anti-Hungarian party in Bohemia, he induced his countrymen to elect Ladislaus, heir of the Polish crown, as his successor, while his two sons retired into the ranks of the nobility. D. Mar. 22, 1471. See Richter, *Georg von Podiebrad's Bestrebungen* (1863); Jordan, *Das Königthum Georgs von Podiebrad* (1869); and Baehmann, *Ein Jahr böhmischer Geschichte* (1876).

Revised by F. M. Colby.

Podo'lia: government of European Russia; bounded W. by Galicia (Austria) and S. by the Dniester. Area, 16,224 sq. miles. The surface is mostly level, the soil fertile, and the climate mild. Grain, hemp, flax, hops, and tobacco are grown, and the vine and the mulberry are extensively cultivated. Large herds of cattle and sheep are reared, and there are important manufactories of beetroot sugar, distilleries, and sugar-refineries. Pop. (1897) 3,031,040.

Podophyllum and **Podophyllin**: See May-apple.

Podu'ra [Mod. Lat.; Gr. *πούς, ποδός*, foot + *οὐρά*, tail]: a genus of insects of the order *Thysanura*, interesting from the fact that the scales with which the body is covered are sometimes used as test-objects for the microscope.

Poe, Edgar Allan: author; b. in Boston, Mass., Jan. 19, 1809; son of David Poe and Elizabeth Arnold, an English actress. His parents, who pursued the vocation of actors, having died in his early childhood, Edgar was adopted by a wealthy citizen of Richmond, Va. (John Allan), by whom he was sent to school at Stoke Newington, near London, England, from 1815 to 1820; entered the University of Virginia, at Charlottesville, in 1826, but was removed within a year, probably on account of addiction to the gaming-table. In 1827 he went to Boston, and issued there his first volume, *Tamerlane and other Poems*; enlisted in the U. S. army as a private under an assumed name, and was admitted a cadet at West Point 1830, but was dismissed Mar. 6, 1831. In 1833, while living at Baltimore, Md., he took a $100 prize by his story *A Manuscript found in a Bottle*, and this led to his appointment as editor of *The Southern Literary Messenger*, Richmond, Va. While occupying that position Poe married his cousin, Virginia Clemm, and led for two or three years a life of considerable regularity, devoting himself to study and writing many tales, reviews, essays, and brief poems. Having at length quarreled with his publisher, Poe removed to New York Jan., 1837; earned a precarious living for a year by writing occasional articles in several papers; published in 1838 his first prose volume, *The Narrative of Arthur Gordon Pym*; went to Philadelphia; was editor of Burton's *Gentleman's Magazine* from May, 1839, to June, 1840, and of *Graham's Magazine* from Apr., 1841, for about a year; published *Tales of the Grotesque and Arabesque* (2 vols., Philadelphia, 1840); gained a prize of $100 offered by *The Dollar Newspaper*, in 1843, with his tale *The Gold Bug*; removed to New York in the autumn of 1844, where the appearance of his best-known production,

The Raven, in Colton's *Whig Review* for Feb., 1845, gained him a wide reputation, and procured him the post of sub-editor on Willis's and Morris's *Home Journal*; was associated with C. F. Briggs in the management of *The Broadway Journal* 1845–46; contributed to *Godey's Lady's Book* May to July, 1846, the biographical and critical sketches entitled *The Literati of New York City*; resided about this time in a cottage at Fordham, Westchester County, and fell into such poverty that an appeal to public charity in his behalf was made by N. P. Willis in *The Home Journal*; lost his wife, who had clung to him with fond devotion, in Jan., 1847; delivered at the Society Library, Feb., 1848, a lecture, published soon after under the title *Eureka, a Prose Poem*. D. in Baltimore, Oct. 7, 1849. A monument to his memory was erected in the Westminster churchyard, Baltimore, Oct., 1875, by a subscription raised by the school-teachers of that city. The works of Poe have been repeatedly republished since his death, both in the U. S. and in England, and have attained an immense popularity in a French translation. They were first edited in New York (4 vols., 1850) by Poe's "literary executor," Rufus Wilmot Griswold, who prefixed a defamatory *Memoir*, many of the allegations of which have been successfully refuted by later biographers, such as Mrs. Sarah Helen Whitman in her *Edgar A. Poe and his Critics* (1860), John H. Ingram in a *Memoir* prefixed to Poe's *Works* (Edinburgh, 1874), and Richard Henry Stoddard in a memoir accompanying a new edition of the *Poems* (New York and London, 1875). The best biography of him is that written by George E. Woodberry and published in the American Men of Letters Series (1885). Revised by H. A. Beers.

Poe, Orlando Metcalfe: soldier; b. in Ohio, Mar., 1832; graduated at the U. S. Military Academy, and entered the topographical engineers July, 1856: captain of engineers 1863; colonel July, 1888. He was engaged upon lake-survey duty until the outbreak of civil war in 1861, when, after serving as chief engineer in the department of the Ohio and on the staff of Gen. McClellan, he was (Sept., 1861) appointed colonel of the Second Michigan Volunteers, and served with the Army of the Potomac until Dec., 1862, having been appointed brigadier-general Nov. 29, 1862; subsequently served as chief engineer of the Twenty-third Corps of the Army of the Ohio, and of Gen. Sherman's army in the invasion of Georgia and march to the sea, gaining the successive brevets from major to brigadier-general for gallant and meritorious services. Returning to duty with the Corps of Engineers at the close of the war, he was (1865–70) engineer secretary of the U. S. lighthouse board; in 1870–73 constructed the lighthouse on Spectacle Reef, Lake Huron. He was aide-de-camp on the staff of the general of the army 1873–84, member of the lighthouse board 1874–84, and had been since 1883 member of various engineer boards charged with the construction of river and harbor works on the northern and northwestern lakes, including the new lock at the Ste. Marie's Falls Canal. D. in Detroit, Mich., Oct. 2, 1895.

Pœcilop'oda [Mod. Lat., from Gr. *ποικίλος*, many-colored, manifold + *πούς*, *ποδός*, foot]: a term sometimes used as equivalent to Merostomata (*q. v.*).

Poetics: See Poetry.

Poet-laureate [*laureate* is from Lat. *laurea'tus*, crowned with laurel, deriv. of *lau'rea*, laurel (in both ancient and modern times a symbol of triumph)]: a title bestowed at universities and by sovereigns at various courts. The Greeks and Romans, in their public ceremonies, sometimes crowned their poets with symbolical chaplets of the bay-tree sacred to Apollo. It was in imitation of this ceremony that Petrarch was laureated on the Capitol in Rome, on Easter Day, 1341. The title, during the Middle Ages, was commonly an academic and not a courtly distinction; it was conferred by the universities for skill in Latin verse, and was of the nature of a degree. It was in that scholastic sense of the term that John Skelton was made *poeta laureatus* at Oxford in 1489.

The fact that the king united with the university in the bestowal of the honor indicates the way in which the laureateship finally became a regular court appointment. In Germany the custom of crowning poets with laurel was an imperial prerogative, but was sometimes delegated by the emperor to the counts palatine and the universities. In Spain the custom was established at the University of Seville. France was seemingly the only country of mediæval Europe in which the title was not known.

During the reigns of the Norman kings of England there had frequently been attached to the royal household an officer called the *versificator*, or king's poet, who celebrated his lord's achievements in Latin verse, and received an annual stipend. The circumstances under which the title of poet-laureate was transferred to these court poets are somewhat obscure. Robert Whittington, who received the laurel at Oxford in 1512, is described as the last of the university laureates. The first king's laureate of whom any mention is made was John Kay, who was poet to Edward IV. The second was Andrew Bernard, who held the title under Henry VII. and Henry VIII. He had a salary of ten marks. His *Epithalamia*, New Year's verses, and other official performances are in Latin, thus continuing the tradition of the university laureates. Then follow a number of poets who have been termed volunteer laureates. These were Richard Edwards, Edmund Spenser, and Samuel Daniel. They all held court appointments of one kind or another, and received grants of money or of land, but they were not officially styled poets-laureate.

Ben Jonson was the first in the line of officially appointed poets-laureate. He was appointed by James I. in 1616, at an annual salary of 100 marks (£67), which was raised by Charles I. to £100, with a tierce of canary wine. The written instrument granting this increase of pension is dated Mar., 1630, and is the first regularly issued patent for the office of poet-laureate.

After his death in 1637 the laureateship was conferred upon Sir William Davenant (Dec. 13, 1638). From the outbreak of the civil war and during the Commonwealth (1642–60) the office was in abeyance. Davenant was a royalist, was active in the king's cause, and was several times imprisoned by the Parliament. After his death in 1668 John Dryden succeeded to the laurel (1670), and was also made historiographer royal. The salary of the two offices amounted to £200, with the annual tierce of canary. His salary was shortly increased to £300, with a further annual pension of £100 to be dependent on the king's pleasure. He wrote no laureate odes, but composed an elegy, *Threnodia Augustalis*, on the death of Charles II. in 1685. James II. continued to Dryden the title and emoluments of the office, but omitted the butt of canary from his perquisites. In 1686 he was granted an additional pension of £100 a year. At the revolution of 1688 Dryden was deposed from his office, which was given to his old enemy, the "true blue" Protestant and Whig poet Thomas Shadwell, whom he had lampooned unmercifully in his satire *Mac Flecknoe*.

From the time of Dryden to the time of Southey the English laurel was worn by a succession of poetasters. Poets like Pope, Prior, Goldsmith, and Cowper were passed over, and the honor bestowed upon Tate, Eusden, and Pye. "The bays" became a sure badge of mediocrity and a target for universal scorn in lampoon, epigram, caricature, and parody. The names of these laureates and the dates of their incumbency are as follows: Thomas Shadwell, 1688–92; Nahum Tate, 1692–1715; Nicholas Rowe, 1715–18; Lawrence Eusden, 1718–30; Colley Cibber, 1730–57; William Whitehead, 1757–85; Thomas Warton, 1785–90; Henry James Pye, 1790–1813. Shadwell began the fashion, which was continued by his successors down to the time of Southey, of composing anniversary odes on the king's birthday and on New Year's Day. These were set to music by the court composer, and sung in the royal chapel or the state drawing-rooms. During the reign of Queen Anne the appointment of the poet-laureate was vested in the lord chamberlain; and Tate, who had served under William and Mary, was formally reappointed in 1714 by that functionary, in whose hands the bestowal of the office has remained ever since.

Of the eighteenth-century laureates, Tate is remembered chiefly by his (and Brady's) versions of the Psalms in meter, and Rowe by his edition of Shakspeare. Cibber, the manager of Drury Lane theater, was a man of wit and a successful playwright, but a small poet. Thomas Warton was a respectable appointment. He was an antiquary and critic, a scholar of elegant tastes, and a genuine though by no means a great poet. In Eusden and Pye the laureateship touched the lowest point in the history of the institution. On Cibber's death the laurel had been offered to Gray, who declined it. During Pye's tenure of office the annual tierce of canary was commuted for a money payment of £27.

In 1813 the laureateship, which had been offered Sir Walter Scott and by him declined, was given to Robert Southey, who made it a condition of his acceptance that he should be expected to write official odes only upon occasions

of his own choosing. A number of such performances, composed at irregular intervals, are among his writings. Southey's poems on public events are not of his happiest, and his unfortunate *Vision of Judgment*, composed on the death of George III., brought upon him a terrible punishment in the shape of Byron's wicked and brilliant satire of the same title. Southey was by no means the best poet in England, but his worth and abilities rescued the office of poet-laureate from the general contempt in which it was held.

After his death in 1843 the laureateship was most fittingly bestowed upon William Wordsworth, the first great poet who had received it since Dryden. It was expressly stipulated that nothing should be required from him in the way of official verses, and nothing of the kind came from his pen during the seven years of his incumbency.

On Wordsworth's death in 1850 the honor was conferred upon Alfred Tennyson, the foremost living English poet, who inherited, in his own words,

> This laurel, greener from the brows
> Of him who uttered nothing base.

As in the case of his two immediate predecessors, Tennyson's official verses were strictly voluntary. Among them may be mentioned the dedication of his *Idyls of the King* to the memory of Prince Albert, the dedication to the Queen of his 1851 volume of poems, and the *Welcome to Alexandra* (1863). The present poet-laureate is Alfred Austin. See *The Lives of the Poets Laureate*, by W. S. Austin and J. Ralph, London, 1853; *The Poets Laureate of England*, by Walter Hamilton, London, 1879. H. A. Beers.

Poetry [from O. Fr. *poëterie*, deriv. of *poëte* < Lat. *poe'ta* = Gr. *ποιητής*, maker, the creator of a poem]: according to Aristotle (*Poetics*, i., 1), the imitation, by means of rhythm, words, and melody, of the actions of men. To the modern inquirer, however, this definition seems somewhat far-fetched and decidedly inadequate. In trying to frame a better one there is an inevitable confusion, owing to the fact that the mind, as it strives to define, oscillates between realization of the process of poetic creation, or making, and recollection of what has in fact been created by poets. The creative arts are really closely akin, and the term "making" fits one almost as well as another; but we do not call painting and sculpture poetry, and although the prose novel is imitation of the actions of men, and often implies the act of making or creating, yet we do not denominate even this poetry. We are, in fact, even in the field of literature, forced back upon a purely empirical definition, and we can probably do no better than to adopt the test which is popularly employed for determining whether a literary work is or is not poetry. This is, and perhaps always has been, the presence of rhythm or meter.

It seems to be certain that this addition of rhythmical or metrical effect is what in the first place made any form of literature possible. Language first gained distinction and became something with an existence apart from the speaker through the imposition upon it of a form unused in ordinary intercourse between men. There were several ways in which this imposition could occur. One of the most primitive of human impulses is that to rhythmic motions of the body—i. e. to the dance; and it is inevitable that words uttered in accompaniment to the dance should partake of its rhythmic character. Then, modulated utterance, or song, may fairly be called instinctive in the human race, and this necessarily brings with it rhythm in the words sung. The extension of music to instruments, even the most barbarous, carries the same result. The very memory, with its demand for regularity in the form of what is remembered, tends in the same direction. Thus many forces must have co-operated to give to language at certain times and on certain occasions a quality which ordinarily it has not. Here was the beginning of poetry; and it was inevitable that in time all the sentiments and emotions, all the memories, traditions, and intellectual interests of mankind that are at all removed from the gross needs of daily life, should find utterance in poetical form.

The varieties of poetry are numerous and not rigidly distinguishable from one another. At the same time each has in a sense an organic life of its own, and corresponds with some accuracy to a human interest or function. The reader will find the character and history of the chief poetic forms discussed in the following articles: Ballad Poetry, Didactic, Drama, Epic Poetry, Epigram, Geste, Gnomic Poets, Hymnology, Lyric Poetry, Ode, Pastoral Poetry, Romances, Satire, Sonnet, and Theater. See also Fine Arts.

Of inquiries into the nature and function of poetry, Aristotle's *Poetics* is, despite its incompleteness, still the best. The *Ars Poetica* of Horace has a practical rather than theoretic purpose, and this is true of the numerous treatises that Horace has inspired—e. g. the *Ars poetica* of Vida, Boileau's *Art Poétique*, and Pope's *Essay on Criticism*. As a rule, however, poetry has been systematically discussed chiefly by writers engaged with some theory of æsthetics. These have rarely taken the trouble to base their conclusions on a careful investigation of the history of poetry in its several kinds. Two brief treatises in English in defense of poetry contain interesting hints upon the inner nature of the art. These are Sir Philip Sidney's *Defense of Poesy* and Shelley's essay with the same title. Wilhelm Scherer's *Poetik* (Berlin, 1888) and F. B. Gummere's *Handbook of Poetics for Students of English Verse* (Boston, 1885) are also helpful and suggestive.
A. R. Marsh.

Poge, Cape: See Cape Poge.

Pog'gendorff, Johann Christian: physicist; b. in Hamburg, Germany, Dec. 29, 1796; was educated at the University of Berlin, where he became Professor of Physics in 1834; attained great distinction as an observer of magnetic and electrical phenomena; published a *Treatise on Voltaic Electricity* (1821), and in 1824 became editor of the renowned *Annalen der Physik und Chemie*, and with Liebig edited the *Wörterbuch der Chemie*; wrote important works on biography and on the literature of the physical and mathematical sciences. D. Jan. 24, 1877.

Poggio, Bracciolini, pod'jō-braăt-chō-lee'nĕe, Giovanni Francesco: humanist: b. at Terranuovo, near Arezzo, Italy, in 1380; apostolic secretary 1403–53, in which year he was elected chancellor of Florence. D. in 1459. On his diplomatic missions he employed his leisure in looking for MSS., and his search was rewarded by the discovery of a complete Quintilian, seven speeches of Cicero, twelve hitherto unknown comedies of Plautus, Ammianus Marcellinus, Aratea, Silius Italicus, Manilius, Petronius, Columella, Frontinus, Nonius, Probus, parts of Lucretius, Valerius Flaccus, Priscian, Vitruvius, Statius's *Silvæ*, and it is due to his unflagging enthusiasm and perseverance that the *Dialogus* and *Germania* of Tacitus and the fragment of Suetonius, *De grammaticis et rhetoribus*, were rescued from destruction in a German monastery. Poggio also did good service in preserving the ruins of ancient Rome, and his collection of inscriptions, only rivaled in extent by those of his contemporary Kyriacus, prove him to have been fully alive to the paramount historical importance which attaches to epigraphic documents. See Voigt, *Wiederbelebung des class. Atterthums* (i., pp. 237–262, ii., 254, ff., 329–342); I. A. Symonds, *Renaissance in Italy* (ii., pp. 134, ff., 230–246); Henzen, in the *Corpus Inscript. Latin.* (vi., 1); W. Shepard, *The Life of Poggio* (2d ed. London, 1807). A. Gudeman.

Pogo'din, Mikhail Petrovich: writer and archæologist; b. in Moscow, Russia, Nov. 23, 1800. Even before graduating from the university he had begun to establish a reputation by his articles on *The Chronicle of Nestor* and by translations of German works. In 1823 he published his dissertation on *The Origin of the Russians*. In 1825 he was made instructor and in 1830 professor at the Moscow University, where he remained until 1844, when he resigned in order to devote himself entirely to his other tasks. During this time he attempted various kinds of literature, including translations from the German, an historical tragedy, *Marfa the Possadnitsa* (1831), stories (3 vols., 1833), and a dramatized *History of the False Demetrius* (1835), besides editing works of various kinds. He was one of the editors of the *Moscowskiĭ Vestnik* (Moscow Messenger, 1827–30) and the *Russian Observer*. His chief interest, however, was the early history of his country. He was an ardent Slavophil, though he defended the memory of Peter the Great, and he was one of the founders of the Moscow Slav Committee, which labored to prepare the way for Panslavism. Although he never completed his great history of Russia (1846–54, 7 vols., fragmentary disquisitions rather than a connected account), he wrote much of value. In 1841 he founded *Moskvitianin* (The Muscovite), an historical magazine that came out for fifteen years. D. in Moscow, Dec. 8, 1875. Among the best-known of his works are *The Character of Ivan the Terrible* (1828); *The Complicity of Godunov in the Murder of Demetrius* (1829); *The Historical Basis of Serfdom* (1858); and *The First Seventeen Years of the Reign of Peter the Great* (1875).
A. C. Coolidge.

Poinsett, Joel Roberts, LL. D.: statesman; b. at Charleston, S. C., Mar. 2, 1779, of a Huguenot family; spent his early childhood in England; educated at Greenfield Hill, Conn., under Timothy Dwight 1793–94; went again to England 1796; studied medicine at Edinburgh, and entered the military academy at Woolwich; returned to Charleston and studied law 1800; went again to Europe 1801; traveled in Asia Minor and in Russia; returned home in 1809; was sent to Chili by President Madison to report on the revolution in that country, and there acquired great popularity; was in Congress from South Carolina 1821–25; U. S. minister to Mexico 1822 and 1825–29, filling a position then very difficult and important; U. S. Secretary of War 1837–41; founded the Academy of Fine Arts, Charleston, S. C., and liberally endowed the National Institution; author of *Notes on Mexico* (Philadelphia, 1824) and of various published essays and discourses, and was a strong opponent of the extreme States-rights view. D. at Statesburg, S. C., Dec. 12, 1851.

Point Alphabet: See Blind, Education of the.

Point de Galle: a town of Ceylon. See Galle.

Pointe-à-Pitre, La: largest town and principal port of Guadeloupe, French West Indies; at the southwestern corner of the island of Grande Terre, near the narrow channel which separates it from Basse Terre (see map of West Indies, ref. 7–M). The harbor, sheltered by the two islands, is one of the best in the West Indies. The town is well laid out. There is a fine shaded promenade, and many of the dwellings are surrounded by beautiful gardens. The most important export is sugar. Pointe-à-Pitre was destroyed by an earthquake in 1843, and has suffered severely from fires. Pop. about 20,000. Herbert H. Smith.

Point Edward: See Sarnia.

Pointer: one of a breed of dogs much used by sportsmen; so called because they stop and *point* toward the game which they scent. This habit has been so developed by training and breeding as to have almost become an instinct. Pointers are short-haired dogs, and should have a wide head, with very apparent occipital crest; ears thin, soft, and long, hanging flat at the side of the head; deep chest, strong loins, and tapering tail, thick at the root. The pointer is one of the hound group, and it is believed the breed originated in Spain. See Dogs. F. A. Lucas.

Point Levi: See Levis.

Poison: See Toxicology, Jurisprudence, Medical; and Lead-poisoning.

Poison-ivy: See Rhus.

Poison of Serpents: a poison with which certain serpents are provided, and which is formed by a pair of glands which lie back of and below the eye on each side. Each gland discharges its secretion through a duct which leads to a reservoir and finally to the base of a hollow fang. When the mouth is closed the fangs lie in a horizontal position against the upper jaw, but when open and the serpent is about to strike, muscular fibers connected with the roots of the fangs contract and throw the latter almost at right angles to the jaw. When the prey is seized the fangs are driven into the flesh of the victim, and muscular fibers connected with the venom-reservoirs are simultaneously rendered active, so that the poison is forced through the gland-ducts and hollow fangs into the wound. The quantity discharged varies from a part of a drop to over a teaspoonful, depending chiefly upon the size and activity of the serpent, the climate and season of the year, and the lapse of time intervening since the last discharge.

The venom of all serpents is a thin yellowish (occasionally colorless) fluid which is composed chiefly of albuminous matters in solution, and bears certain general resemblances to the saliva of higher vertebrates. It contains about 25 per cent. of water, and when dried breaks up into bright translucent pieces which closely resemble crystals. Many attempts have been made to isolate its poisonous principles, which for a long time were believed to be of the nature of alkaloids, especially ptomaines, but Mitchell and Reichert, who were the first to isolate them, have shown that they are represented in the albuminous substances above referred to. These they have found may be divided into two classes, which they have termed *venom-globulins* and *venom-peptones*. Their researches render it probable that all venoms contain one or more representatives of each of these classes. In some as many as four venom-globulins and one venom-peptone have been isolated, thus proving the existence of as many as five distinct poisons in a single specimen. Venom belongs to the group of virulent poisons, a quarter of a drop being sufficient to kill a pigeon, and a few drops to kill a dog.

The effects are divisible into local and general, immediate and remote. The venom having been injected under the skin by the fang, the first effect is a general feebleness, in which the heart shares, and which is sometimes accompanied by nausea and vomiting. If the amount be large, the animal or man dies within a time which varies from a few minutes to hours; if the early depression passes over, recovery is often sudden, or else the creature poisoned enters the second stage of the poisoning. This is characterized by blood-changes, and by a general degradation in the nutrition of every tissue, so that all suffer in some degree. The series of changes begins with lessened or lost power of the blood to clot; at the same time the texture of the smaller vessels is so altered as to allow the escape of the incoagulable blood, which, if the animal survive long, finds its way into the tissue of nearly every organ, thus causing symptoms which vary according as the organ most affected is the brain, spinal cord, liver, lungs, or kidneys. These changes result, therefore, in bleeding from the mucous surfaces of the breathing and digestive organs, and in oppressed respiration, bloody stools, or bloody urine, and finally in coma or convulsions and death. The local symptoms vary with the snake, but vary in degree only. First, there is thrown out about the fang-track a vast amount of blood, which, as it can not clot, soaks through the tissues, and even stains the bones. The adjacent muscles soften, and at last inflammation comes on, with great swelling and pain, and finally local death of the part.

There is no antidote that is efficient when administered internally. A solution of permanganate of potassium and the liquor chloride of iron are powerful local antidotes; that is, when they are brought in contact with the venom in the wound they chemically destroy the poison and thus render it inert. The permanganate is for all venoms the better, since it destroys both globulins and peptones, while the chloride of iron is destructive only to the globulins, and but slightly impairs the toxicity of the peptone. The proper treatment of snake-bite is at once to tie a ligature above the part bitten (or, better, put an elastic bandage around the whole limb), immediately lay open the wound in the line of the fang-mark, and thoroughly wash out the part with a solution of permanganate of potassium, encouraging bleeding by pressure toward the incision. In case no antidote such as permanganate of potassium or chloride of iron is at hand, it is useless to apply any local dressing save to put the part in hot water, wash it, and provoke bleeding. Next, alcohol should be given until the heart is excited, when the ligature may be loosened a little, so as to admit to the general circulation some of the poison, which soon or late must reach it unless destroyed by some local antidote or removed by bleeding, etc. Should the heart begin to fail the ligature should be tightened again and more stimulant given, so that any poison that might remain may be fought in detail. Alcohol is an antidote of uncertain value. It is but a stimulant to carry a suddenly enfeebled system over a time of weakness. For the second stage there is little to do but to ease pain.

Rattlesnake-bite is rarely fatal; cobra-bite is often fatal, as is attested by the fearful death-rate in India from this cause. Cobra-bite is more deadly partly on account of the venom being a stronger poison, and partly because of the generally larger size of the snakes and of the speed with which in hot climates the serpents accumulate venom, the severity of the symptoms being, in a large measure, directly as the dose of the poison. Sewall has shown that animals subjected to repeated small doses of venom gradually acquire immunity from what would be under ordinary circumstances fatal doses. Snake-venom does not affect plants, but to all life above these it is fatal when inoculated in sufficient amount, although it does not seem to have much power to injure when swallowed, so that pigeons have even been fed on it to the extent of twenty or thirty drops a day for a week without harming them. Mixture with gastric juice alone does not destroy its power, but it is altered below the stomach, and seems unable to enter the blood in a virulent form by this channel. Warm-blooded animals die easily from venom—cold-blooded creatures slowly, unless kept very warm.

The authorities on serpent-venom are Fontana's *Poisons*;

Weir Mitchell, *Venom of the Rattlesnake*; Fayrer, *The Poisonous Serpents of India*; Weir Mitchell and Edward T. Reichert, *Venoms of Poisonous Serpents*; and Wall, *Indian Snake-poisons*. Revised by EDWARD T. REICHERT.

Pois'son, SIMÉON DENIS: physicist; b. at Pithiviers, department of Loiret, France, June 21, 1781; was educated at the École Polytechnique, and became professor in that school in 1802; member of the bureau of longitudes in 1808; counselor of the university in 1820; peer of France in 1837. D. Apr. 25, 1840. His principal works are *Traité de Mécanique* (2 vols., 1811); *Théorie nouvelle de l'action capillaire* (1831); *Théorie Mathématique de la chaleur* (2 vols., 1835–37); *Sur l'invariabilité des moyen mouvements des grands axes planétaires*, besides about 300 memoirs in scientific journals, mostly on mathematical physics.

Poitiers, Fr. pron. pwăă'ti-ā': chief town of the department of Vienne, France; on the Clain, at its junction with the Boivre (see map of France, ref. 5–D). It is old and irregularly built, but it has a celebrated lyceum, a theological seminary, a public library with 30,000 volumes and 400 MSS., and other educational institutions. The Cathedral of St. Peter was begun by Eleanor of Guienne in 1162, on the ruins of a Roman basilica, and completed in the fifteenth century. The Church of St. John, originally a baptistery (about 700), is the oldest Christian building in France. In 1882 the remains of an entire Gallo-Roman town were discovered here; they comprise a temple, baths, and streets, spread over 14 acres. Breweries, distilleries, spinning-mills, glass-works, and tanneries are in operation, and an active trade is carried on in grain, wine, hemp, wool, wax, honey, and leather. Called Limonum at the time of the Roman conquest, it took the name Poitiers, from the Pictones or Pictavi. Christianity was introduced in the third century, and St. HILARY (*q. v.*) was the first bishop. Near here Edward the Black Prince defeated and captured King John of France in 1356. Pop. (1896) 38,518.

Poitiers, Diana of: See DIANE DE POITIERS.

Poitou': an old province of Western France, now divided into the departments of Deux-Sèvres, Vendée, and Vienne. It became an English possession in 1152, on the marriage of Eleanor, the Countess of Poitou, and Henry of Anjou, afterward Henry II. of England. In 1204 Philip Augustus took it from England, and although it once more reverted to that country in 1360 by the Peace of Brétigny, it was soon after reconquered, and finally incorporated with the possessions of the French crown. It contains some of the most fertile tracts of French soil, and is remarkably well cultivated.

Poke: See GARGET-ROOT and POKEWEED FAMILY.

Poker: a game at cards, played with a full pack by from two to six persons. Five cards are dealt each player, one at a time. The eldest hand (*age*) deposits a certain number of chips (tokens which represent money, unless the game is played merely for amusement), called the *ante*; the others in turn either deposit twice this amount (i. e. *go in*), or withdraw from the hand (*pass*). If they all pass, the eldest hand takes back the ante and deals a new hand; otherwise he either doubles his original stake or withdraws, forfeiting his ante. (Another, more common, method is for all the players to go in each hand by contributing the ante.) The players who have gone in then in turn discard as many cards as they wish, and receive the same number of new cards from the pack. The player at the left of the eldest hand then bets any amount not exceeding a limit previously agreed upon, or passes out and forfeits the stake already in the pool. The next player either *sees* him (bets a like amount), *goes better* (bets in addition to this a sum not exceeding the limit), or passes out. This continues till one player forces the others out and takes the pool, or until all the other players in see the last raise (none going better), and *call*. They then show their hands and the strongest hand wins the pool.

Hands rank in strength as follows, beginning with the highest: 1, *straight flush* (sequence of five cards in the same suit); 2, *four of a kind* (accompanied, of course, by a card of different denomination); 3, *full*, or *full house* (a triplet and a pair); 4, *flush* (five cards of the same suit); 5, *straight* (five cards in sequence); 6, *triplet*, or *three of a kind*; 7, *two pairs*; 8, *one pair* (two cards of the same denomination, the other three being of different ones). The denominations of cards rank in value as in whist (except that in the straight and straight flush the ace may rank either above the king or below the deuce); as between two or more straights or straight flushes, the one beginning with the highest card wins. Four aces form the highest four of a kind, four deuces the lowest; and so for triplets and pairs. In deciding between two fulls, only the triplets are considered; between two hands each containing two pairs, only the higher pair in each, unless these are alike. As between flushes, that containing the highest card wins; if cards of the same denomination lead each, the cards second highest are considered, and so on. Sometimes it is necessary to decide between two hands, each containing (1) two pairs, pair and pair alike, (2) one pair of the same denomination, or (3) not even a pair. In this case the highest single card wins; of hands remaining tied in this respect also, each counts its next highest card (the highest winning), and so on.

The game above described is the simplest form of draw-poker. Variations from it, especially in the manner of forming the hand and of betting, are innumerable. In *straight poker* no discard is made, and all the players must stake the ante. In *whisky-poker* an extra hand is dealt, and the players strive to improve their hands by exchanging cards with it in turn.

Pokeweed Family: the *Phytolaccaceæ*; dicotyledonous herbs or shrubs, rarely trees, with alternate leaves; flowers mostly perfect; perianth regular, usually single; pistil one, simple or compound; ovules usually solitary; seeds with copious endosperm, and a large peripheral curved embryo. The species number about fifty-five, and are very widely distributed throughout sub-tropical and temperate regions. In the U. S. there are four species of *Phytolacca*, *Petiveria*, and *Rivina*. The common pokeweed or GARGET-ROOT (*q. v.*), *Phytolacca decandra*, is grown for ornamental purposes in Europe, as are also the other species indigenous to the U. S.
CHARLES E. BESSEY.

Po'la: town; near the southern extremity of the Peninsula of Istria, Austria; 54 miles S. of Trieste (see map of Austria-Hungary, ref. 9–C). It is the most important naval station of Austria-Hungary; it has a deep and spacious harbor, almost completely landlocked, an arsenal, docks, artillery stores, etc. The hills surrounding the harbor are crowned with forts and batteries. Pola has also a considerable shipping-trade, exporting fish, timber, and the sand used in making Venetian glass, and importing coal and provisions. Besides the citadel, which overlooks the town and the bay, the chief buildings are the cathedral (fifteenth century), the Franciscan convent (thirteenth century), and the infantry barracks. There is a naval observatory, founded in 1871, where twenty-eight planetoids were discovered (1874–80) by I. Palisa. In the suburb of San Policarpo there is a fine park with a monument to the Emperor Maximilian of Mexico. Pola occupies the site of the ancient *Pietas Julia*, of which it contains several interesting remains, a well-preserved amphitheater, which could accommodate 20,000 spectators, a triumphal arch, etc. Pop. (1890) 39,273. R. A. ROBERTS.

Po'land [*Pole*, Polack + *land*]: a former kingdom of Europe, the Polish *Polsko*. About the middle of the seventeenth century it extended from the Baltic to the Carpathian Mountains; was bounded on the W. by the Prussian provinces of Pomerania, Brandenburg, and Silesia, and on the N. and E. by the Russian governments of Livonia, Pskoff, Smolensk, Chernigoff, Poltava, and Kherson. Its area was about 282,000 sq. miles (a little larger than Texas). This territory belongs to the central plain of Europe, and is crossed by only one range of hills, which form a watershed between the rivers flowing into the Baltic and the Black Sea. Large tracts are covered with swamps, sand and forests, but generally the soil is a light loam, well suited for agriculture and pasturage. For many centuries large herds of cattle, horses, and swine have been reared here; and cereals, hemp, timber, honey, and wax have been produced. There are extensive mines of salt, and a few of iron, copper, and silver. The bulk of the present inhabitants consists of Poles, but there are several other races, including Germans, Lithuanians, and Jews, each of which numbers over 2,000,000. The Poles are chiefly Roman Catholics. The members of the Greek Church come next in numbers, and the Germans are mostly Protestants.

The Poles belong ethnologically to the Slavic family. They appeared first in history in the fifth century under the name of Poliani; they occupied the plain between the Oder and the Vistula along with other Slavic tribes, which in the course of time they partly subdued and absorbed. Their

history does not cease to be fabulous, however, until the time of Mieczyslas (962–992). He was converted to Christianity, and so brought his country in contact with the south and west of Europe. His son, Boleslas I. (992–1025), extended his frontiers to the Saale, the Dnieper, and the Danube, and received the royal crown from the pope. These rulers belonged to the Piast dynasty, which became extinct with Casimir III. in 1370. On the death of his successor, Louis of Hungary, the latter's daughter married Jagiello, Grand Duke of Lithuania, who united that country with Poland. In 1572 the dynasty of the Jagellons (*q. v.*) became extinct with Sigismund II., and Poland became an elective monarchy. This principle was one of the chief causes of the national downfall. The people saw in the elective monarchy a guarantee of their liberty, but overlooked the fact that it threatened their existence as a nation. There were other defects in their political organization, as, for instance, the *liberum veto*. By this principle the decision of the Polish Diet did not depend upon the majority but the unanimity of the votes, so that any one member, by his veto, had it in his power to render the diet's proceedings ineffective. Further, there were grave defects in the social organization. Trade and commerce were almost entirely in the hands of the Jews, who were avaricious and the objects of popular contempt; they never ranked as an important branch of the business of the people. Literature and art were the only serious occupations of the nobility. The nation consisted of two classes only—the nobles, who owned the soil and strove to gain an illusory freedom from the crown; and the serfs, who cultivated the soil to which they were tied. There was no third estate. In several cases the peasants sided with the oppressors of the Polish nation, and fell on their countrymen who were fighting for the freedom of their fatherland. In 1573 25,000 Polish noblemen assembled on the field of Wola to elect their new king. Henry of Valois, the most worthless of the candidates, was chosen, but shortly afterward fled from the country. Stephen Bathori (1575–86), voivode of Transylvania, one of Poland's best kings, followed. He organized the Cossacks into regiments, and fought successfully against the Russians. Then came three princes of the Swedish Vasa dynasty (1587–1668), Sigismund III., Ladislas IV., and Casimir John II. (*qq. v.*). Then followed Michael Wisniowiecki (1669–73) and John III., Sobieski (1674–96), and next two electors of Saxony, Augustus II. and Augustus III. (*qq. v.*). Every new ruler caused new wars with new enemies, and internal dissensions split the nation into as many parties as there were claimants to the throne, while bribery, intrigue, treachery, and violence flourished. On the death of Augustus III. in 1763 a party called monarchists or reformers, and headed by the Czartoryski family, desired to abolish the *liberum veto* and establish an hereditary constitutional monarchy, and with this object they secured the support of Catharine II. of Russia. With her aid they placed Stanislaus Augustus Poniatowski (*q. v.*) on the throne (1764). The work of reform began, but Catharine, seeing that in this way Poland would fall out of her grasp, changed her policy. There was another party, headed by the family of Potocki, who maintained the old oligarchical institutions. They had adopted the Polish principle of religious toleration, while the Czartoryskis were fanatical Roman Catholics. Catharine elected to support religious toleration, and, opposing her former favorite Poniatowski, had a number of his adherents exiled to Siberia. The Confederation of Bar (in Podolia) was now formed; an army was assembled, and an alliance made with the Turks. Catharine already had a large army in the country, and in 1772 Prussian and Austrian armies also entered Poland, when the first partition was effected. Russia took an area of 42,000 sq. miles, Prussia took Posen (*q. v.*) with an area of 13,000 sq. miles, and Austria took Galicia (*q. v.*) with an area of 27,000 sq. miles. The whole country was now aroused to a sense of danger. The *liberum veto* was formally suppressed and many reforms were made; but some of the nobles were discontented at the loss of their privileges, and formed the Confederation of Targovitza (1792). At their instigation Russian troops entered Poland again. Prussia now joined the Russians, and a fruitless resistance, headed by Joseph Poniatowski (*q. v.*) and Kosciusko (*q. v.*), resulted in a second partition. Russia took 96,000 sq. miles and Prussia 22,000 sq. miles. A general rising in all the Polish provinces was the consequence, and the Russians and Prussians were compelled to retreat; but at the critical moment Austria came upon the scene and turned the balance. Kosciusko was taken prisoner at the battle of Maciejowice, Warsaw capitulated to Suwarow, the king resigned his crown, and the third partition (1795) put an end to the political existence of Poland. Russia took 43,000 sq. miles, Prussia 21,000 sq. miles, including the capital, Warsaw, and Anstria 18,000 sq. miles. The subsequent wars of the French with the enemies of Poland and the promises of Napoleon rallied the Poles around him; but all that Napoleon accomplished was the formation of the duchy of Warsaw by the Treaty of Tilsit (1807), with a liberal constitution and the King of Saxony at its head. It was chiefly composed of the greater part of the Prussian and Austrian portions of the later partitions. By the Congress of Vienna in 1815 the division of Poland was re-arranged. The share of Austria was diminished, and Prussia received less than it had after the second partition. The greater part of the duchy of Warsaw was united, as the kingdom of Poland, to the Russian empire, but only by the bond of a common monarch. Thus finally Russia obtained 220,500 sq. miles, viz., the kingdom of Poland and the governments of Courland, Vitebsk, Grodno, Minsk, Moghilev, Volhynia, Kieff, and Podolia. Of these, however, Kieff had been conquered and held by Russia since 1669, while Courland had had no close connection with Poland since 1710. (See Biren.) The population of this territory, excluding the two latter provinces, in 1890 was about 19,000,000. Prussia obtained 26,000 sq. miles, viz., Posen and about half of East and West Prussia, with a population (1890) of over 3,000,000; and Austria obtained 35,500 sq. miles, viz., Galicia, Bukowina, and some small districts (see Cracow), with a population (1890) of over 7,000,000.

The so-called kingdom of Poland received from Alexander I. a constitution with a responsible ministry and a separate army; but there was still a spirit of discontent which developed into an insurrection in 1830. After several sanguinary engagements this was suppressed the following year, and in 1832 Poland was declared an integral part of Russia. After another unsuccessful insurrection (1863–64) Poland was deprived of its last remnant of independence. Finally, by a ukase of the emperor, dated Feb. 23, 1868, the government of Poland was incorporated with that of Russia, and since then its ten governments—Kalisz, Kielce, Lomja, Lublin, Piotrkow, Ploek, Radom, Siedlce, Suwalki, and Warsaw—have been grouped with those of Russia. Their area is 49,159 sq. miles, and their population, exclusive of the military, was, in 1897, 9,442,590. R. A. Roberts.

Poland, John Scroggs: See the Appendix.

Polar Circles: See Antarctic and Arctic.

Polar Clock: an instrument invented by Wheatstone, which, when accurately adjusted, indicates the apparent solar time within a very few minutes. It will operate even when the sky is overcast with clouds, provided there be an unobscured spot at the pole through which the blue sky may be seen. It applies the fact that the plane of polarization of sky light is always 90° from the sun.

Polarization [deriv. of *polarize*, deriv. of *polar*]: a term applied in optics to certain modifications in the character of the wave-motions to which light is due. These modifications arise under certain conditions from reflection, refraction, etc. They are the source of some of the most beautiful and interesting phenomena in the domain of light.

Polarization is a question, primarily, of the plane of vibration of light-waves. (See Light.) Light-waves possess a period of vibration so brief (509,000,000,000 vibrations per second for yellow light) that the shortest period of time which can be isolated and dealt with experimentally will contain millions of oscillations. Even the wave-length lies almost beyond the range of direct observation. Our knowledge of the motions which constitute light is therefore almost entirely indirect. There is an abundance of indirect evidence that the wave-motion is transverse, but in the case of ordinary light, as it comes to us from the sun or from artificial sources, there appears to be no plane of vibration which remains fixed long enough to enable us to determine its position. On the contrary, the ray behaves as though composed of components vibrating in every plane. This is an effect which might be produced, as was long since suggested by Fresnel, by a plane transverse wave, the plane of vibration of which revolves with a rotational period small in comparison with appreciable time-intervals. Such a ray is said to be *unpolarized*. Any process which will serve to give a ray a fixed plane of vibration is termed a *polarizing* process; the apparatus is called a *polarizer*.

Polarization by Double Refraction.—An important example of the production of polarized light occurs when a

ray is made to pass through any substance the elasticity of which is not in all directions the same. In such media the velocity of waves vibrating in a single plane depends upon the position of that plane. Many crystals possess the above property, and when a ray of light is transmitted by them it is resolved into two plane waves, which travel, in general, with different velocities. See MINERALOGY (*Optical Properties*).

The simplest method of attacking the problem is that adopted by Huyghens 200 years ago. This consists in finding the form of the wave-surfaces in the case of a wave emanating from a point within the crystal.

From the optical point of view, doubly refracting crystals may be grouped as follows:

(1) *Uniaxial negative* crystals (calcite, tourmaline, sodium nitrate, etc.).

(2) *Uniaxial positive* crystals (quartz, zircon, ice, etc.).

(3) *Biaxial* crystals (aragonite, selenite, potassium nitrate, sugar, and all crystals which do not belong to the cubic or the hexagonal systems).

In uniaxial crystals a ray from without, in the direction of the optical axis, suffers no double refraction, and therefore all waves due to vibrations at right angles to the axis travel with the same velocity.

If *o*, Figs. 1 and 2, be a center of radiation within a uniaxial crystal, two waves will be propagated. The first of these is due to vibrations always perpendicular to the axis, and its surface is a sphere. It is called the ordinary wave. The other wave is due to vibrations at various angles with the axis. Its surface is an ellipsoid of revolution. In negative crystals the directions of greatest velocity are those for which the vibrations are parallel to the axis. The ellipsoid of the wave-surface therefore has its major axis (*c d*, Fig. 1) perpendicular to the axis *a b*. The wave-surfaces of negative uniaxial crystals are the surfaces of revolution produced by the rotation of the sphere and ellipse in Fig. 1 upon the axis *a b*. The ellipsoid which forms the surface of the extraordinary wave incloses the sphere.

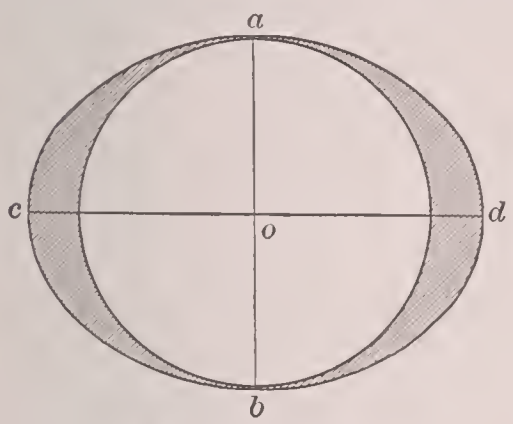


FIG. 1.—Wave-propagation in a negative uniaxial crystal.

In positive uniaxial crystals waves produced by vibrations parallel to the axis possess a minimum velocity. The ellipsoidal surface of the extraordinary ray has its major axis coincident with the optical axis of the crystal, and the two wave-surfaces are those generated by the revolution of the circle and the inscribed ellipse of Fig. 2. It will be seen that the extraordinary ray in negative crystals possesses the higher velocity, except in the direction of the axis, where it attains the velocity of the ordinary ray as a minimum limiting value. In positive crystals the velocity of the extraordinary ray, however, is always less than that of the ordinary, excepting in the axial direction, where it reaches its maximum value.

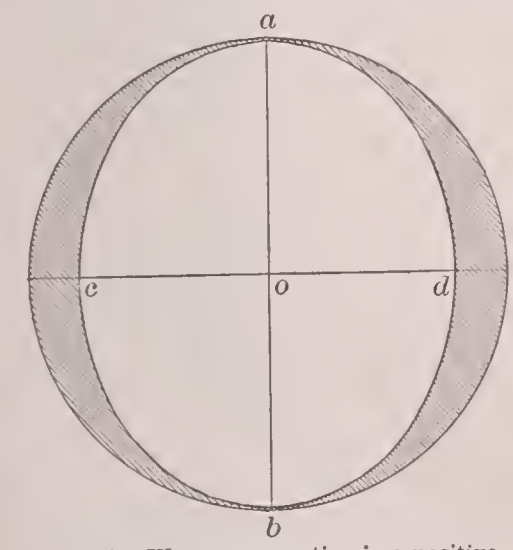


FIG. 2.—Wave-propagation in a positive uniaxial crystal.

The application of the above-described properties of anisotropic media to the case of a ray entering a uniaxial negative crystal, such as calcite, obliquely from without, is as follows:

A bundle of rays is represented by *a b*, *c d*, Fig. 3, of which the wave-surface is plane and normal to the direction-lines. Such a wave-surface, *b e*, impinges obliquely

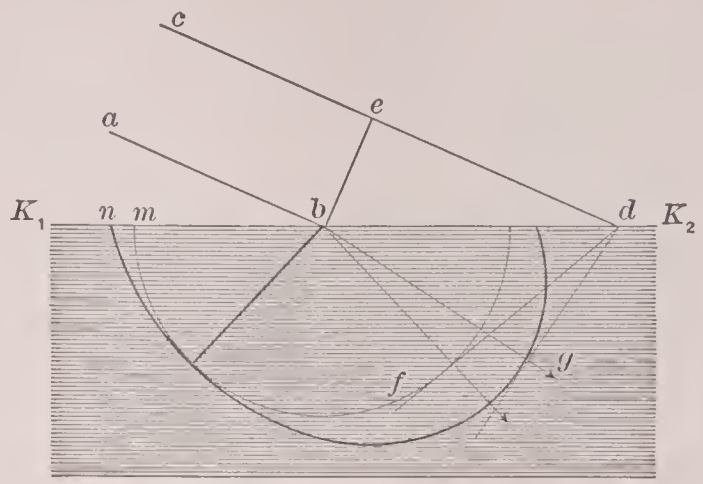


FIG. 3.

upon the surface of the crystal ($K_1 K_2$) at *b*. During the time in which the wave in air passes over a distance, *e d*, two waves within the crystal are being propagated. Of these, we need to consider only the elements which may be regarded as arising from the point *b*. The two wave-surfaces within the crystal having *b* as their origin will be a sphere and an ellipsoid, represented in the figure by the circle (*m*) and the ellipse (*n*), respectively. At the instant when the wave in air reaches *d* the position of the two waves within the crystal will be defined by the radius *b f* and radius vector *b g*, respectively. These have lengths determined by the relations of the velocities of the ordinary ray *b f* and the extraordinary ray *b g* to the velocity in air. The direction of the two rays is determined by drawing tangents to the circle and ellipse from the point *d*. The ordinary ray, being most retarded, is most bent from its course. The law of its refraction is that of Snell. See REFRACTION.

The passage of a ray through a rhombic piece of calcite is shown in Fig. 4, in which *i* is the incident ray and *o* and

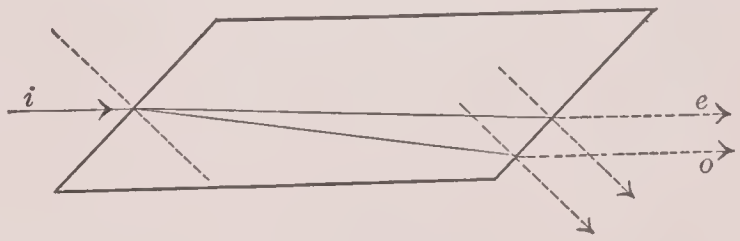


FIG. 4.

e are the emergent ordinary and extraordinary rays. It is evident, since these are completely polarized, that any device which would suppress one of them would afford a single ray of polarized light. Such a device is the Nicol prism, the best-known and most useful of polarizers.

The Nicol prism, described in 1841 by William Nicol, consists of a block of calcite (Fig. 5), cut through at right angles to its end-faces and cemented in the section by means of Canada balsam. The angles of the rhomb are such that the ordinary ray meets the cemented layer at an angle greater than the critical angle of total reflection, and is therefore entirely diverted to the side wall of the prism. To the ordinary ray, therefore, the Nicol prism is opaque. The extraordinary ray reaches the cemented interfaces at an

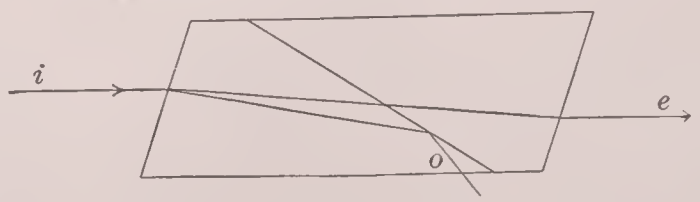


FIG. 5.

angle less than that at which total reflection begins. It, therefore, is transmitted. When we throw a beam of unpolarized light through the prism, we obtain after transmission a completely polarized ray, the intensity of which is equal to one-half that of the incident ray, less the sum of the losses by reflection and absorption.

The Foucault Prism.—Various modifications of the Nicol prism have been made, all of which, however, make use of the essential principle of the original form—the suppres-

sion of one component by total reflection. The best known of these modifications is that devised by Foucault, in which the layer of Canada balsam is supplanted by an air-space between the halves of the divided rhomb. See Figure 6.

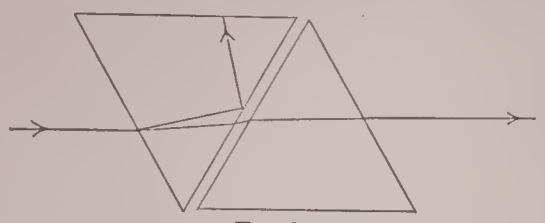


FIG. 6.

Polarization by Reflection.—The nature of the phenomena of polarization would lead one to expect that polarization of a ray might be obtained by causing the same to be reflected. If we consider an ordinary ray to be resolved into two components, vibrating at right angles to one another, and suppose the ray obliquely incident to a plane mirror so placed that one of the components will vibrate parallel to its face, it is evident that the two components will meet the mirror under different conditions. In point of fact the mirror does not reflect both components equally well, save when the incidence is normal, under which condition both rays are vibrating parallel to its surface. As the angle of incidence increases, the components whose vibrations make an angle with the mirror are less and less strongly reflected, whereby the resultant becomes *partially polarized*. At a certain angle, known as the *angle of complete polarization*, the above-mentioned component ceases to be reflected, and the reflected ray consists of completely polarized light, vibrating at right angles to the plane of incidence and reflection.

Brewster's Law.—The angle of complete polarization, as was pointed out by Malus, who discovered the phenomenon of polarization by reflection in 1810, depends upon the refractive index of the material of which the mirror is made. Brewster gave definite expression to the relation (1815), as follows:

The angle of complete polarization is the angle of incidence for which the reflected ray is perpendicular to the refracted ray.

In Fig. 7 we have from Snell's law $\frac{\sin i}{\sin r} = n$, which at the angle of complete polarization, when $i + r = 90°$, becomes $\frac{\sin i}{\sin r} = \frac{\sin i}{\sin (90° - i)} = \frac{\sin i}{\cos i} = \tan i = n$.

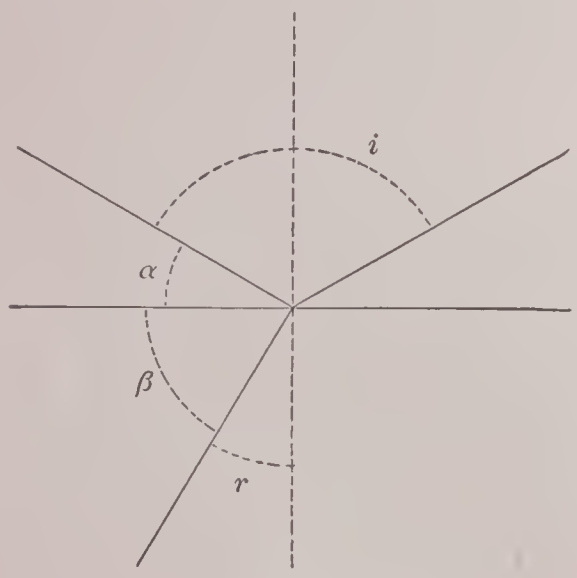


FIG. 7.

This affords another statement of Brewster's law, viz.:

The angle of complete polarization is that angle of incidence the tangent of which is equal to the index of refraction of the mirror.

The above statements refer to the reflection from the first surface, and not to internal reflection. They apply to non-metallic surfaces only. To obtain plane polarized light therefore by a single reflection we must use a non-metallic mirror, and must suppress all those rays which, entering the substance of the mirror, might be reflected from its second surface. The material commonly used is an opaque black glass.

Polarization by Ordinary Refraction.—An inquiry which follows directly upon the statement of polarization by reflection is that concerning the condition of the refracted ray. That component of the incident ray which ceases to be reflected at the angle of complete polarization we should expect to find transmitted by the medium as a refracted ray, unless the vibrations were destroyed at the surface with transformation of energy. Experiment shows that this polarized component always forms a part of the refracted ray, but never the whole of it, since the other component is partly refracted and partly reflected at every angle of incidence. By ordinary refraction, then, partial polarization in a plane perpendicular to that obtained by reflection is produced, the degree of polarization reaching a maximum at the angle of incidence for which $\tan i = n$. By passing this partially polarized ray at the proper angle through a series of parallel glass plates the unpolarized portion can be reduced indefinitely, so that by successive transmission an almost completely polarized ray can be obtained.

Polarization by means of Tourmaline.—The crystalline mineral tourmaline possesses a molecular structure which adapts it peculiarly to the production of polarization by transmission. A plate of this mineral, cut in such a manner that the principal axis of the crystal is parallel to the surface, will transmit only those vibrations which are perpendicular to the direction of the axis. To waves vibrating parallel to the axis such a plate is opaque. The objection to this method of obtaining polarized light is the strong selective absorption to which rays passing through tourmaline are subjected. The best specimens are far from colorless or transparent.

FIG. 8.

Polariscopes.—In the study of polarized light it is necessary, in addition to the production of a polarized ray, to be able to test the character of radiation as to the plane of its vibrations. To these ends two polarizing devices, such as the black glass mirror, the Nicol prism, or the plate of tourmaline, must be used together. Such a combination is called a *polariscope*.

The essential parts of a reflecting polariscope are two mirrors, M_1 M_2, Fig. 8, affording reflection from their first surfaces only. These are so mounted that the incident ray i will always strike M_1 at the polarizing angle, and the reflected ray r will strike M_2 at the same angle. The latter mirror (M_2) is called the *analyzer*, in contradistinction to the *polarizer* (M_1). The same terms are used to designate the corresponding parts of any polariscope.

The reflecting polariscope is frequently given the form shown in Fig. 9, an arrangement due to Nörremberg, in which the lower mirror is a plate of clear unsilvered glass. Rays of light reaching the mirror from the direction a are polarized by reflection, and thrown downward upon the mirror c, whence they are returned vertically upward through A B to the analyzer S, which is a mirror of black glass. The analyzer revolves within a graduated circle by means of which its position can be determined. An adjustable platform between the two mirrors supports objects the behavior of which when subjected to polarized light is to be studied.

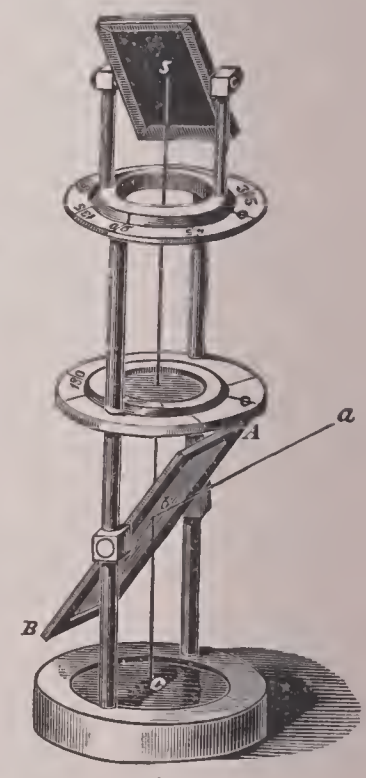


FIG. 9.

Since the angle of complete polarization depends upon the index of refraction, and since the latter is a function of the wave-length, it follows that no reflecting polariscope can give complete polarization excepting in monochromatic light. On that account and for other reasons polariscopes making use of double refraction are to be preferred. Such instruments consist of two Nicol prisms, or equivalent devices, mounted one behind the other in the path of the ray which is to be polarized and analyzed. The analyzer (A, Fig. 10), and sometimes the polarizer (P, Fig. 10) also, is free to revolve in the axis of the ray. Divided circles enable the observer to

ascertain the angle which their polarizing planes make with one another.

The performance of two Nicol prisms mounted as above follows directly from what has already been stated with reference to this method of producing polarized light.

Rays transmitted by P in the direction of the axis of the instrument will be completely polarized in the principal

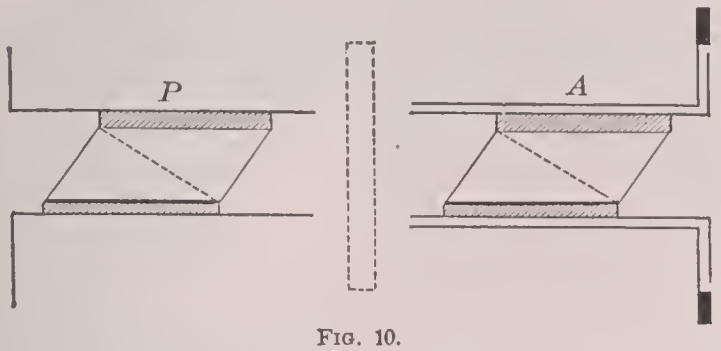


FIG. 10.

plane of the prism, with loss of something more than half of the initial intensity. The polarized ray upon entering the prism A will be resolved into two components vibrating at right angles to and in the principal plane of A. The former of these components, which is the ordinary ray, is suppressed by total reflection, while the extraordinary ray is transmitted.

The relative intensity of the two components depends upon the angle α between the principal planes of the prisms P and A, a relationship which may be expressed as follows:

$$I_o = I \sin^2 \alpha.$$
$$I_e = I \cos^2 \alpha \; . \; .$$
$$I_o + I_e = I(\sin^2 \alpha + \cos^2 \alpha) = I.$$

I is the ray incident upon A, I_o and I_e the ordinary and extraordinary components of the same. Losses by common reflection and absorption are neglected. It will be seen that the intensity of the transmitted ray, I_e, is proportional to $\cos^2 \alpha$. When the prisms are crossed ($\alpha = 90°$) no light is transmitted; when they are parallel ($\alpha = 0°$) A is transparent to the polarized ray, transmitting it without any losses other than those due to reflection and absorption.

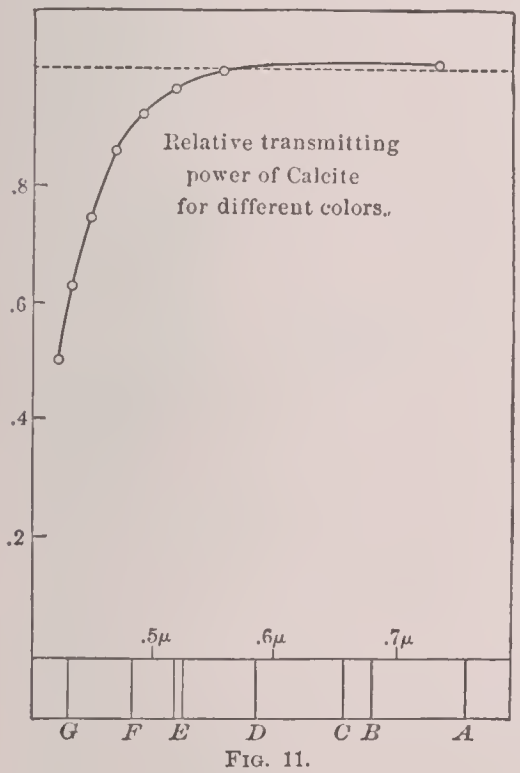


FIG. 11.

Polariscopes with Nicol prisms possess the advantage of affording complete polarization of all wave-lengths alike. They are indeed for most purposes the best of all types. The chief disadvantages are costliness of the material, calcite, of which the prisms are made, and the smallness of the apertures of the instrument. Small dimensions are a matter of necessity in Nicol prisms on account of the giving out of the supply of large crystals of transparent calcite. Prisms, like those exhibited by Spottiswoode at an exhibition of scientific apparatus in London, which had a clear aperture of 9 cm., are no longer to be obtained.

Another disadvantage in the use of calcite lies in its failure to transmit all wave-lengths of the visible spectrum with equal freedom. Measurements of the losses experienced by a ray of white light in traversing a pair of Nicol prisms were made by the writer and Prof. B. W. Snow in 1891 (*Philosophical Magazine* (5), vol. xxxiii., p. 379). The results, which are given graphically in Fig. 11, show diminishing transparency throughout the green and blue of the spectrum, until at wave-length 0·4 μ relatively less than half as much light is transmitted as at wave-length 0·6 μ.

Tourmaline Polariscopes.—The property which tourmaline possesses of absorbing one of the polarized components of rays traversing it at right angles to the principal axis makes it practicable to construct a simple form of polariscope out of two plates of that material. Two tourmaline plates (A B and C D, Fig. 12) placed one over the other with axes parallel will transmit light with losses due only to reflection and ordinary absorption; the latter source of loss is unfortunately an important one, greatly diminishing in optical work the usefulness of tourmaline. When placed with axes crossed as in Fig. 13 the plates A B, C D are completely opaque. The usual form of the tourmaline polariscope is that of Fig. 14. The two plates are mounted in a tongs-shaped clamp, with freedom of rotation upon a common axis. Specimens to be examined in polarized light are placed between them. Tourmaline plates also serve as eye-pieces in many forms of polarizing apparatus.

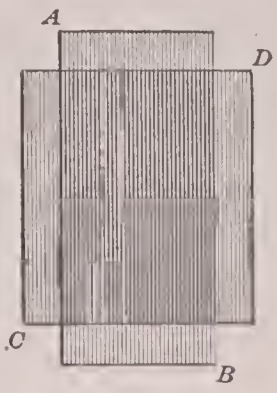


FIG. 12.

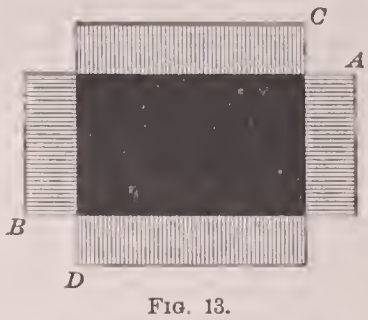


FIG. 13.

Polarization in Biaxial Crystals.—In the discussion of the passage of light through anisotropic bodies we have considered, thus far, crystals in which only a single direction could be found for which double refraction did not exist. All crystals of the *rhombic*, *monoclinic*, and *triclinic* systems, however, possess two such directions, from which fact they are called biaxial crystals. Polarization-phenomena in such crystals are necessarily more complicated than in crystals with one axis. They can be discussed only very briefly here. In biaxial crystals there is no ordinary ray. Neither of the two components into which rays traversing such crystals are divided follows the law of refraction for isotropic media. The two rays are polarized at right angles, and they travel at velocities depending upon the elastic structure of the crystal.

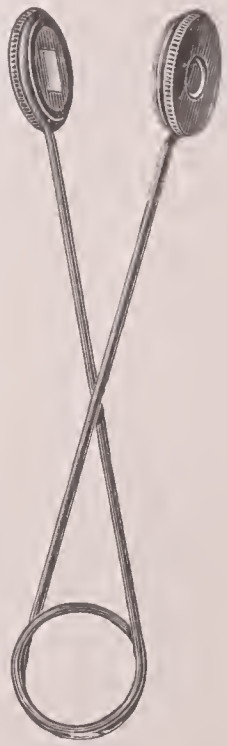


FIG. 14.

Fresnel's method of finding the wave-surface in a biaxial crystal, stated in a few words, consisted in establishing three axes (Fig. 15): one (a b) in the direction of greatest elasticity, one (c d) in the direction of least elasticity, and a third perpendicular to these. Upon these axes an ellipsoid is to be imagined, taking the length of each axis proportional to the elastic quality for light-vibrations in the direction in question. The velocity of the two light-waves propagated in any desired direction from a source at the center of the ellipsoid can be found by taking a plane section of the ellipsoid through the center of the same and at right angles to the line along which the velocities are required. The major and minor axes of the ellipse which forms the section of the ellipsoid, as mentioned above, give the velocities of the two waves. By means of this procedure the surface can be fully determined. This surface can be represented only by means of a three-dimensional model. Cross-sections of it in the planes a b, c d; a b, e f; and c d, e f, are shown in Figs. 16, 17, and 18.

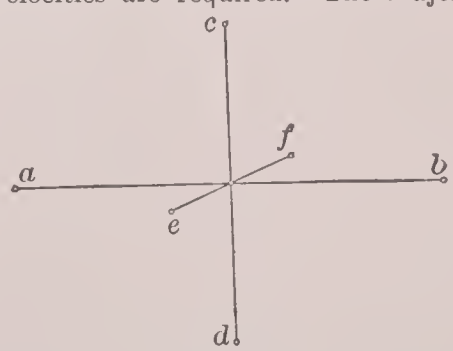


FIG. 15.

Applications of polarized light are made in the study of crystalline forms, in which field many very beautiful phenomena occur; in the microscopic detection of various cel-

lular structures, as, for example, in distinguishing between the various forms of starch; and, what is very important

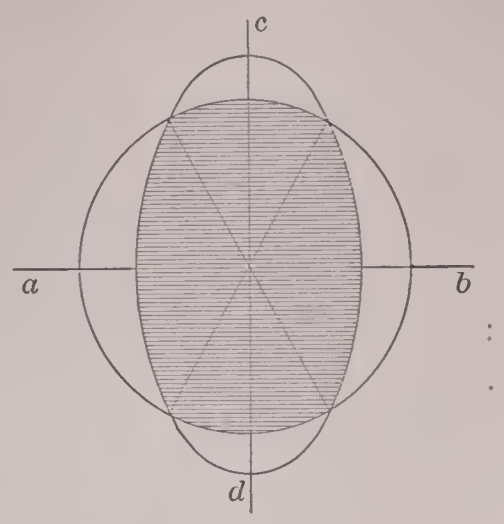


Fig. 16.

from an industrial point of view, in the determination of the strength of sugar-solutions. The last-named application has led to the development of a special class of apparatus and of special methods of work. See Saccharimetry.

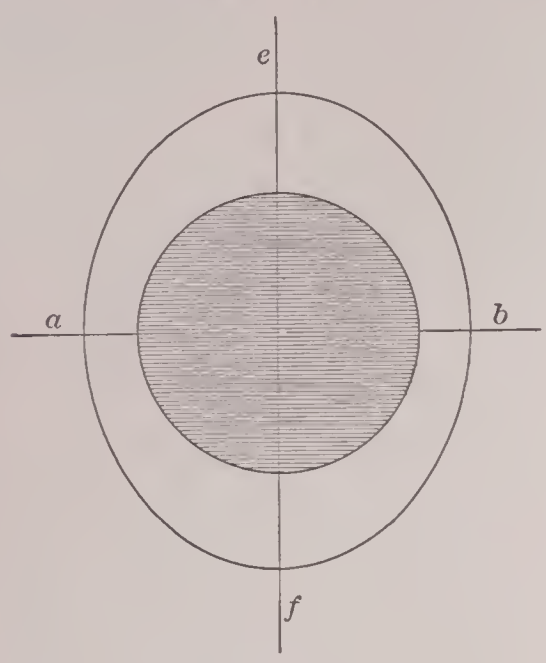


Fig. 17.

In the study of crystals under the polariscope the specimen is placed between crossed nicols, and is viewed by transmitted light. If double refraction takes place the result is the restoration of light to the hitherto dark field of

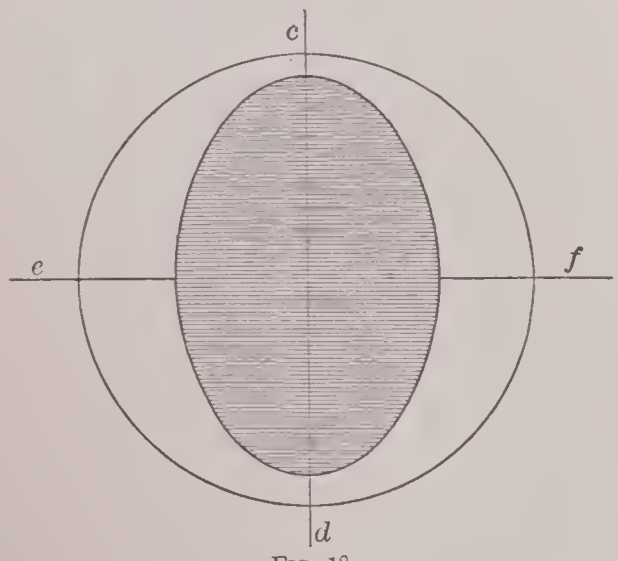


Fig. 18.

view and the production of color effects, the nature of which depends upon the character of the specimen and the kind of illumination to which it is subjected. The most important of these color effects may be classified as follows:

(1) *Thin plates of uniaxial or biaxial crystals* cut parallel to the axis or axes. When viewed by parallel rays between crossed nicols they show in general a brilliant color, which depends upon the thickness of the plate and the positions of polarizer, analyzer, and specimen with reference to each other.

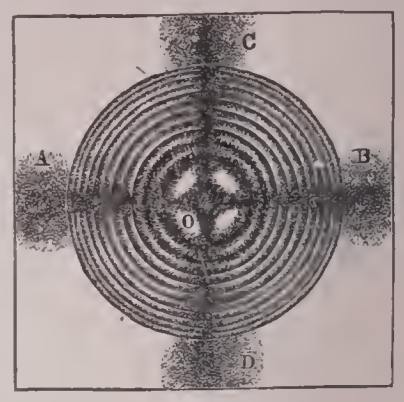


Fig. 19.

This phenomenon, which is the simplest with which we have to do in chromatic polarization, is due to the same causes as the more complicated cases to be mentioned later. The plane polarized ray from the first prism is, in general, resolved into two components within the specimen. These vibrate at right angles with one another, and, traveling at different velocities within the crystal, issue with difference of phase. In the second nicol each of these components is again resolved, and those components of each which move in the polarizing plane are transmitted. After passage of the second nicol we have then all the conditions necessary for the production of color by interference (see Interference and Thin Plates, Colors of), viz., two rays traveling along the same path, with difference of phase but with the same plane of vibration. A tint will therefore be produced, of which the intensity depends upon the relative amplitudes of the transmitted components, and the color upon the difference of phase. If the plate be of uniform thickness, the tint will be uniform over its surface; if wedge-shaped, it will be crossed by interference-bands, etc.

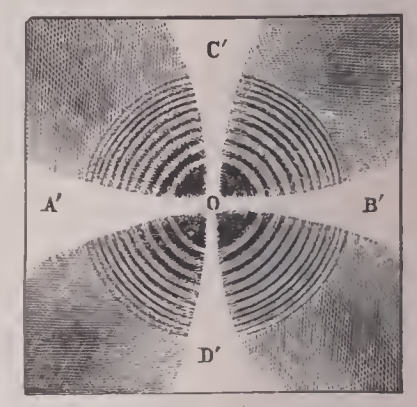


Fig. 20.

(2) *Uniaxial crystals cut perpendicularly to the axis, and viewed by convergent light between crossed nicols.* In this case, which can be tested in a simple manner by placing a properly cut piece between the plates of the tourmaline tongs and holding the same close to the eye, one sees a beautiful set of colored rings, either with a bright center and cut by a dark rectangular cross (Fig. 19), or with a dark center and bright cross (Fig. 20), according to the relative positions of the part of the apparatus.

Fig. 21.

(3) *Biaxial crystals cut at right angles to the median line and viewed by convergent light between crossed nicols.* The system of rings and brushes is that shown in Fig. 21, when the planes of the optical axes are at 45° with the polarizing planes of the nicols. This goes over into the pattern of Fig. 22 when the planes of the optical axes coincide with that of one of the prisms.

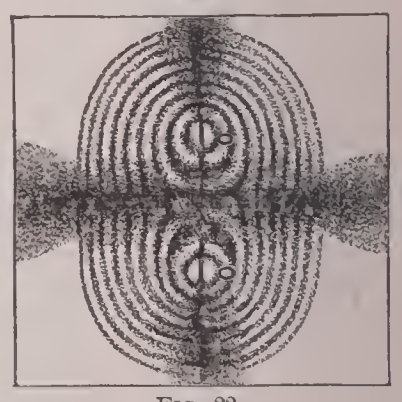


Fig. 22.

The above are among the most important of the numerous cases which the crystallographer has occasion to observe and to analyze. The color effects in all are due to the same cause, the interference of the polarized rays after emergence from the second Nicol prism.

Temporary and Artificial Double Refraction.—Isotropic media can be rendered doubly refracting by any process which produces internal strains. A rectangular block of glass, for instance, when placed between crossed nicols does not restore light to the field of view, but when pressure is

applied by means of a clamp, like that shown in Fig. 23, temporary double refraction is produced and color-effects

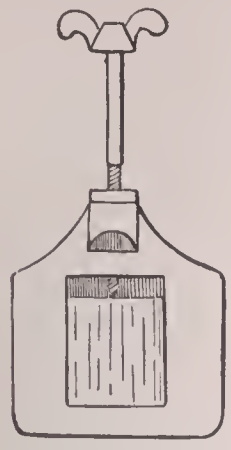


Fig. 23.

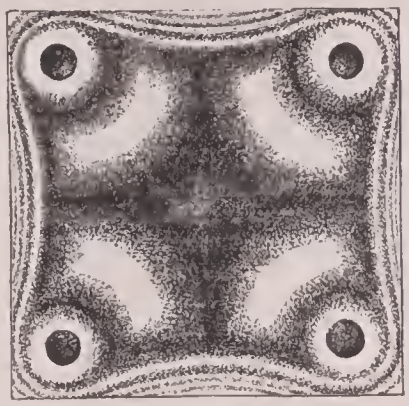


Fig. 24.

analogous to those in crystals occur. The sudden cooling of heated glass produces permanent strains, the presence of which gives figures of great symmetry and beauty. Fig. 24 shows such a pattern produced by polarized light in a rectangular plate of chilled glass.

In the foregoing account many phenomena have been altogether neglected. Such are those connected with the passage of light through quartz, the rotation of the plane of polarization in that substance and in various liquids, the rotation of the plane of polarization in the magnetic field, and the question of circular and elliptical polarization. For a discussion of these the reader is referred to the larger treatises on experimental optics and to the proper chapters in the manuals of physics. Among the best known of such books are Fresnel's *Œuvres*; Verdet, *Traité d'Optique*; Mascart, *Traité d'Optique*; Wüllner, *Lehrbuch der Physik*; Müller-Pouillet, *Lehrbuch der Physik*; Violle, *Cours de Physique*; Winkelmann, *Handbuch der Physik*; Preston, *Light*; Spottiswoode, *Polarization of Light*, a popular treatise.

E. L. Nichols.

Polar Research [*polar* is from Lat. *pola'ris*, pertaining to the poles, deriv. of *po'lus*, pole = Gr. πόλος, pivot, hinge, axis, pole, deriv. of πέλειν, move, go]: exploration of the regions about the poles of the earth, and investigation of the various questions concerned therewith. This is the greatest unsolved problem in geography, and on its solution turn many theories of terrestrial physics and even some of those of astronomy. The older attempts at its solution were only partial in design, being devoted to finding a northeast or northwest passage, or to reaching the geographic or magnetic pole. They were unsuccessful, except in finding the magnetic pole, and they did not add greatly to knowledge, although full of hardship and disaster. The later idea of residence in the polar region and gradual advance has proved so much more successful and less perilous that we may now safely reckon on eventual and complete success in the solution of all questions depending on polar research.

History of Arctic Exploration.—The different relations of the two poles to the distribution of land and water and to the zone of maritime and geographic enterprise have caused the exploration of the Arctic and Antarctic regions to follow quite different courses.

The earliest recorded attempt at Arctic research was one to find a commercial maritime route to China and India by the north of Europe and Asia. The first expedition was that of Sir Hugh Willoughby, who left the Thames with three ships in 1553. Two of the ships appear to have reached Kalguev island, but were never heard from afterward. The third reached the mouth of the Dwina, and its company crossed over by land to Moscow. As a result the White Sea was opened to British commerce. A later expedition under Stephen Burroughs reached Vaygach island, and in 1580 Pet and Jackman penetrated the Kara Sea. The expeditions so far were British; the work was now taken up by the Dutch. Under Barents an expedition reached Nova Zembla in 1594 and the Kara Sea in 1595. In 1596 Barents discovered Spitzbergen and reached a latitude of at least 80° N. In the seventeenth century Franz Joseph Land was apparently reached by a whaler named Roule. In the succeeding centuries many attempts, mostly by Russians and Norwegians, were made to penetrate along the northeast passage farther E. than Nova Zembla and the Kara Sea, but all were unsuccessful until in 1878–79, when the passage was successfully made by Nordenskjöld on the Vega.

Spitzbergen had probably long been known to hardy Russian and Norwegian fishermen, but, brought once to the attention of geographers by Barents, it became a point of departure for farther polar exploration, and in these explorations all the nations of Northern Europe have taken part. Departing from this archipelago in 1607 Hudson discovered Jan Mayen. It was soon found that the sea to the N. of Spitzbergen was usually blocked by ice, and numerous expeditions were undertaken on sledges. They have all been relatively unsuccessful, and the highest latitude reached in this way was 82° 45′ N. by Parry in 1827.

An easy access to the pole seems to be afforded by the great expanse of ocean between Greenland and Spitzbergen, but efforts in this direction have been especially barren of useful results. This part of the Arctic Ocean is encumbered by ice apparently brought down by a current from the N. The east coast of Greenland is more inhospitable than the west coast.

The greatest activity in Arctic exploration has been to the N. of the American continent in the Arctic Archipelago, and especially along the west coast of Greenland. This coast had long been known to the Northmen, and was apparently visited by Nicolas and Antonio Zeno, two Venetian noblemen, in the fourteenth century. It also offered the problem of the northwest passage, corresponding to that of the northeast, already described. Sebastian Cabot unsuccessfully searched for this passage in 1498, and was followed in 1576 by Frobisher. The search was actively continued by Davis, Hudson, Ross, Parry, Richardson, Franklin, and others until, on his return in 1833, Ross announced that a practicable northwest passage could not exist. Nevertheless in 1845 Franklin was sent out with two ships and 168 men under instructions to find this passage at all hazards. As time passed and nothing further was heard from this expedition, intense interest in its fate was aroused throughout the civilized world, and expedition after expedition was sent under the auspices of Great Britain and the U. S. in its search. Among the leaders of these were Ross, Collinson and MacClure, Belcher, Kennedy, McClintock, Rae, and Kane. The search continued for more than thirty years before the fate of the Franklin expedition was finally determined, and this was done by a young U. S. lieutenant named Schwatka, who, following the indications of McClintock and the reports of natives, found the graves of the last remnant of the force and other mementoes in the desert expanse between Great Fish river and Hudson Bay. The geographic results of the search for Franklin were very rich. The great complicated and ice-covered Arctic Archipelago was explored, adding from 4,000 to 5,000 sq. miles to the area capable of being mapped with fair accuracy.

Hayes, who had accompanied Kane, was convinced that an open sea exists about the geographic pole. He returned in 1860, and reached the latitude of 81° 35′ N. by way of Smith Sound, but did not find the open sea. Hall repeated the expedition in 1871, and reached lat. 82° 16′ N. Hall died the following winter, and the remnants of the expedition were rescued from a field of ice on which they had been floating 186 days and on which they had traveled 1,700 miles. In 1875 Nares took the same course, and in 1876 a party of his men under Markham traversed the frozen surface of the polar sea to the N. of Grinnell Land and reached the latitude of 83° 20′ N. For the winter 1882–83, by international co-operation, stations were established at many points near or within the Arctic and Antarctic Circles, chiefly to carry on meteorological and magnetic observations. The most northerly of these was that established at Lady Franklin Bay, on the eastern coast of Grinnell Land, in lat. 81° 44′ N., under the charge of Greely. The party was established in Aug., 1881. It retreated S. to Camp Clay in Aug., 1883, and was rescued in June, 1884, having only seven survivors out of thirty-two men. The northernmost point reached was on the north coast of Greenland, in lat. 83° 24′, and was gained by a small party under Lieut. Lockwood. This is the northernmost point reached by civilized man up to Dec., 1894. The idea of residence in polar latitudes has since been carried out by Lieut. Peary, who has spent two winters with his family, and without serious hardship, on the west coast of Greenland above lat. 75°.

The New Siberian islands were discovered in 1770 by a Russian merchant named Liakhof. The abundance of fossil ivory on Kotelnyi (one of these islands) attracted commercial attention to the southern members of this group, and they were often visited. Bennett island was discovered by De Long in his perilous escape from the Jeannette in

1881, as well as two small islands farther W. but belonging to the same group.

There have been but few expeditions by way of Bering Straits, and they have been unsuccessful. A modification of the plans heretofore employed is that of NANSEN (*q. v.*), who believed that a general ocean current sweeps over the polar region from the vicinity of the New Siberian islands to the eastern and western coasts of Greenland. To this hypothetical current, and in a ship made for the purpose of being fastened in the ice and drifting with it, he intrusted himself in the summer of 1893. In Aug., 1896, he returned without mishap, and reported that he had reached 86° 14′ N. lat. before turning southward. See *Furthest North* (London and New York, 1897).

History of Antarctic Exploration.—The lands of the Antarctic region were unknown and unsuspected until 1773–75, when they were discovered by Cook. Previous searches for a *terra australis* seem to have related only to Australasia and isolated islands far N. of the Antarctic Circle. On a second cruise Cook circumnavigated the globe in the vicinity of the Antarctic Circle, and showed that the southern continent was isolated and almost entirely within that circle. In 1819 an English whaler, William Smith, was driven S. of the Falkland islands to South Shetland, and in 1819–21 the Russian navigator Bellingshausen passed westward from South Shetland within the Antarctic Circle and discovered two small islands which he named Alexander I. and Peter I. In 1823 the whaler Weddell penetrated to the parallel 74° 15′ S. in the longitude of Cape St. Roque, and reported little serious obstacle to navigation. In the early part of the nineteenth century the Messrs. Enderby, of London, interested in whaling, instructed their captains to explore as far southward and as thoroughly as possible. Their Capt. Briscoe in 1831 discovered Enderby Land, about one-third of a circle eastward from South Shetland and forming the second angle of the triangular southern continent. In 1832 he discovered and landed on Adelaide island, which lies S. W. of South Shetland and near Graham Land. He was apparently the first man to set foot on the southern continent. In 1833 Capt. Kemp discovered the eastern extremity of Enderby Land. In 1838 their Capt. Balleny discovered the third angle of this continent in what is now known as Wilkes Land. In 1839–43 the Antarctic region was visited by a U. S. expedition under Wilkes, a French one under d'Urville, and a British one under Ross. Many discoveries were made by each, but the most successful was the last named. Ross penetrated to 78° S. in the latitude of New Zealand and discovered the mountainous district of Victoria Land, terminating to the southward in the active volcano Mt. Erebus, 12,000 feet high. Since this date only occasional sealers or whalers have penetrated to the southern continent, the most notable of these cruises being that of three Dundee whalers (Donald, Bruce, and Murdoch) in 1893–94. No noteworthy additions to the knowledge of Antarctic lands have been made since the expeditions of 1839–43.

Results.—Each terrestrial pole is covered by a cap of continuous ice, which remains unbroken on the land-areas and apparently over the smaller inclosed water-areas of extreme high latitudes, and these caps vary in size with the season and with the year. Greenland is covered with an unbroken ice-sheet, and so probably is also the southern continent. Around the margin of these caps is an area of variable width covered with floating ice, either derived from the frozen surface of the ocean when it forms the pack, the ice-fields or the floebergs, or derived from the sheet of land-ice when it forms icebergs. This area is more or less open, and at its outer margin is very open, irregular, and variable. Floating ice extends farther toward the equator in the Atlantic Ocean than elsewhere. In the North Atlantic it may float as far S. as lat. 42° N. and in the South Atlantic to lat. 39° S.

In general the surface-currents of the ocean flow away from the ice-caps. An exception is found in the Antarctic field, where S. of New Zealand a current sets in toward the great bay in this field which was found by Ross. Another is in the Arctic field, where the Gulf Stream extended enters the Arctic Ocean to the N. of Scandinavia.

Of the climate of the Antarctic regions little is known, but a fairly accurate picture of the succession of seasons can be made for the Arctic. The entire Arctic area (extending far S. in Siberia and North America) has a mean annual temperature of 32° or lower, except the northeast coast of Norway and a coastal strip of small size on Eastern Greenland. The region of lowest mean annual temperatures appears to extend over a strip reaching from Grinnell Land across the New Siberian islands to the basin of the Yana river in Siberia. This area passes slightly to the American side of the pole, is apparently mostly covered by water, and has a mean annual temperature of 0° F. or lower. The seasons are reduced to two, summer and winter, and the diurnal changes are relatively slight. The greatest cold in winter is in the Yana basin, where the mean temperature for January descends to — 50° F. or lower. In Grinnell Land for this month it is about — 35° F. The July mean temperatures run from 36° F. in the vicinity of the pole to about 50° F. near the Arctic Circle. In the Yana basin it is about 30°. The precipitation about the pole is small, varying from 8 to 25 inches, and is somewhat more likely to fall in late summer than at other seasons. The accumulations of ice and snow are due not to heavy precipitation, but to the conservation of what does fall. It is largely in the form of snow, and evaporation is very small because of the low temperatures. Fog and high winds are common.

The north magnetic pole was found by Ross to be on Boothia Felix in 1832. It has since traveled a few degrees E. and is now probably near the southeast angle of this peninsula. The south magnetic pole is in an unexplored area S. of Australia and 17° 25′ from the geographic pole. In Arctic regions the compass-needle is subject to so great variations and uncertainties that its usefulness is much impaired. These variations are due in part to the vicinity of the magnetic pole and in part to sudden and severe, yet unexplained, magnetic storms. Other anomalies, not explained as above, are thought to be due to the existence of masses of iron ore in the rocks. Arctic researches have also given opportunity for many studies of the aurora. The center of greatest frequency is in Northeastern America.

The geology of the Arctic region is apparently as diversified as elsewhere. Certain Cretaceous and Tertiary strata in Spitzbergen, Northern Greenland, and the Arctic Archipelago show that in Cretaceous times this area had a subtropical climate with a luxuriant flora, something like that now found in Southern Japan. By Tertiary times the climate, as shown by the fossil flora, had become cooler and was like that of Western Oregon. Volcanic action is seen only about the south pole. The Erebus volcano already mentioned was active when seen, and a small isolated peak 500 feet high among the South Shetland islands emits smoke continuously. Several volcanic peaks and craters have been recognized and much volcanic scoria seen.

The flora of Arctic regions is scanty. Willows, dwarf birches, and a few other shrubs extend to Southern Greenland and a dwarf willow extends far north. The flowering herbs of high latitudes are few in number, and include several rushes and grasses, the dandelion, a poppy, the crowberry, and several saxifrages. The most common and most Arctic flowering plant is the *Saxifraga oppositifolia*. Beyond these are found only flowerless plants—mosses, algæ, and lichens. The Antarctic flora is much more scanty than the Arctic. The species are identical or very similar in all longitudes in each polar region.

Animal life is relatively more abundant, but there is the same resemblance of species. The Lady Franklin Bay party recorded N. of lat. 81° the polar bear, the Arctic fox, the blue fox, the wolf, the ermine, a lemming, the polar hare, the reindeer, and the musk-ox. The two last named have been abundant in Northern Greenland and the reindeer is abundant on Spitzbergen. The party also recorded three species of seal, two species of whale, the swordfish, and the narwhal. Thirty-two species of birds have been observed N. of 81° 30′ N., and the most of these have also been seen at Point Barrow and on Nova Zembla and Spitzbergen. The rock-ptarmigan is the only winter resident, the others being migratory. The list includes the gray eagle, gyrfalcon, snowy owl, raven, snow-bunting, two geese, three ducks, and a dozen gulls, terns, auks, divers, and similar birds. The migratory birds arrive usually in June and depart in September. There are also many fish and lower marine forms and insects.

The Antarctic region has generally been represented as swarming with animal life, especially the marine forms. The Dundee whalers before referred to in the summer of 1893–94 found five species of whale (not, however, right whales or sperm-whales), four species of seals, and twenty species of birds, among them seven petrels, two gulls, two terns, the common hooded crow, and a black-and-white duck. Enormous numbers of penguins were seen.

The Antarctic area is uninhabited by man, as also are Nova Zembla, the New Siberian islands, Franz Joseph Land, Spitzbergen, Jan Mayen, and the Aretic Arehipelago, but on the eoasts of the last named are many evidenees of a former oeeupation by the Eskimo. The Lapps oeeupy the Aretic eoasts of Europe W. of the White Sea, and the Samoyeds eastward to the Yalmal Peninsula. From the mouth of the Obi to that of the Kolyma the eoast is now uninhabited, though probably onee oeeupied. From the Kolyma mouth to Bering Straits the coast is oeeupied by the Chukchees, who also extend southward about the Anadyr Gulf. The Aretic eoast of America, both sides of Baffin Bay, and Davis Strait, and the southeast coast of Greenland are oecupied by Eskimo. The most northern of these are the Arctic Highlanders, who occupy the western shore of Greenland to the N. of Melville Bay. They are simple in life, kindly in charaeter, and not less intelleetual than their brethren farther S. They now reach in their migrations no higher N. than lat. 79°, but traces of their former oeeupation can be found farther N. and on Grinnell Land. Though they endure the rigors of their climate with equanimity and fair eomfort, they are thought to be deereasing in numbers. See GREENLAND, SIBERIA, NOVA ZEMBLA, SPITZBERGEN; COOK, JAMES; FRANKLIN, JOHN, etc. See also POLAR RESEARCH in the Appendix.

REFERENCES.—The literature of polar research is very extensive. The best modern books are the series of reports of the international polar expeditions of 1882–83. These are all government reports, and are as follows: U. S., *Point Barrow* (1885) and *Lady Franklin Bay* (1888); English, *Fort Rae* (1886); Freneh, *Cape Horn* (5 vols., 1884–88); Danish, *Godthaab* (1889); Norwegian, *Bossekop* (1888); Swedish, *Spitzbergen* (1887); German, *Kingua Fiord* (1886) and *South Georgia* (1886); Austrian, *Jan Mayen* (1886); Finnish, *Sodenkyla* (1886); Russian, *Lena* (1886) and *Nova Zembla* (1886). A list of the literature to 1890 is given in Saint-Martin and Rousselet—*Nouveau Dictionnaire de Géographie universelle*, articles *Région Antarctique* and *Région Arctique* (1892). MARK W. HARRINGTON.

Polar Seas: See ANTARCTIC OCEAN and ARCTIC OCEAN.

Pol'der [Dutch]: the technieal term in Holland for a onee submerged area of land surrounded by dikes and reclaimed by artifieial drainage, usually in the smaller polders by wheels driven by windmills, in the great polders by powerful pumping-engines moved by steam. The polders vary in area from 100 aeres and less to 12,000 or 15,000 aeres; their surfaee is usually depressed from 1 to 15 or 20 feet below the surrounding eountry, and these lowest, as those of Schieland near Rotterdam, the Haarlemermeer polder, etc., are below the sea-level. South Holland alone contains more than 1,000 polders. The most important are those which have been created by artificial drainage of what were permanently-submerged areas, such as that of the Haarlemermeer. (See HAARLEM LAKE.) In connection with the formation of the NORTH SEA CANAL (*q. v.*), all the areas once eovered by the waters of the Y and Wijkermeer are converted into polders.

Pole, REGINALD: prelate; b. at Stourton Castle, Staffordshire, England, in Mar., 1500; son of Sir Riehard Pole, Lord Montacute, and of Margaret Plantagenet, Countess of Salisbury; graduated at Oxford, 1515, and afterward studied at the University of Padua, Italy, 1520–23. Returning to England in 1525, he was favorably reeeived by his cousin, Henry VIII., by whom he was sent in 1529 to negotiate for the approval by the University of Paris of the projected divorce of Queen Catharine of Aragon, but soon came himself to an opinion adverse to that measure, and though the king sought to win his support by making him Arehbishop of York, Pole refused the offer and left the kingdom. He resided successively at Avignon, Padua, and Venice; sent to Henry his book, *Pro Ecclesiasticæ Unitatis Defensione* (1536), for writing which he was summoned to return to England, and, refusing to obey, was deprived of his ecclesiastical preferments and attainted by Parliament, but in compensation was in the same year invited to Rome by Pope Paul III. and created cardinal Dec. 3. In his hostility to the Protestant eause he tried to induee the Roman Catholic powers to undertake the invasion of England, but was unsuecessful. He was legate at Viterbo 1539–42; presided as papal legate at the opening of the Counеil of Trent, Dec. 13, 1545; was exeepted by name from the amnesty decreed by Edward VI. on his aecession to the throne 1547: was a prominent eandidate for the papaey in the eleetion of 1549; was appointed legate to England on the accession of Queen Mary, and reeeived by her with great pomp Nov. 24, 1554; successfully invited Parliament to a reeoneiliation with the papacy, and freed the realm from spiritual censures; was appointed by the pope Arehbishop of Canterbury Dec. 11, 1555; was consecrated Mar. 22, 1556; elected chancellor of the Universities of Oxford and Cambridge 1556; made a visitation of the universities Feb., 1557, and exereised a great influence upon the government of Mary. D. at Lambeth Palaee Nov. 18, 1558, the day following the death of Mary. Author of *Liber de Concilio* (1562), the first work printed at Rome by Paulus Manutius; *De Summo Pontifice Christi in Terræ Vicario* (1569), and *A Treatise of Justification* (1569), besides his principal work, previously mentioned. Revised by F. M. COLBY.

Pole-axe: See BATTLE-AXE.

Polecat: a name often, in the U. S., applied to the skunk, *Mephitis mephitica*, but properly belonging to one of the weasels—*Putorius fœtidus*—a European speeies (also ealled fiteh), about 16 inches long. The fur, whieh is brown, blackish on the tail and feet, and harsh, is used in making paintbrushes, but the name fiteh, originally given to brushes made from the fur of this animal, has been extended to others. The ferret is a semi-domesticated, more or less albinistic, variety of this speeies. F. A. L.

Polem'ics [from Gr. πολεμικός, warlike, deriv. of πόλεμος, war]: the side of the department of dogmaties especially eoncerned with eeclesiastieal controversy, particularly of an aggressive eharaeter. It reeognizes and emphasizes eonfessional differences and maintains the distinetive denominational tenets. It may be justly said that polemics is as old as the Chureh. For many eenturies it was a somewhat prominent feature of all theological writing. As was inevitable, at times there was more disposition to win a victory over an opponent than to establish the truth, and the literary battle between the Latin and Greek Churehes, between Protestants and Roman Catholies, and between different braneh es of the Protestant Chureh have been too frequently eharaeterized by unholy passion and unfair methods; but there is a growing indifferenee to theological distinetions, and the ehurches are eoming nearer together; so there is less polemies in the systems of theology. Irenies, or the harmonizing of differenees, is the end to be sought by polemies. The formation of religious and philanthropie societies by members of different denominations, the bringing of the Old Catholie, the orthodox Oriental, and the Anglican Churehes together, in conferences and sueh gatherings as the World's Parliament of Religions in Chieago in 1893—these are signs that polemies is yielding to irenies. The early Christian apologies, while defenses against, were also attaeks upon Paganism. They are translated in the Ante-Nieene Christian Library. The Latin theologians of the ninth eentury busied themselves with attaeks upon the Greek theologians. The most elaborate work upon this controversy is by Joseph Cardinal Hergenröther, *Photius, Patriarch von Constantinopel* (Regensburg, 3 vols., 1867–69). Of the eonfliet between Romanism and Protestantism the best works are by J. A. Moehler (R. C.), Eng. trans. *Symbolism* (2 vols., London, 1847), and by K. Hase, *Handbuch der protestantischen Polemik gegen die römisch-katholische Kirche* (Leipzig, 5th ed. 1890). The systematie theologies of the various Protestant denominations, e. g. C. Hodge (Presbyterian, 3 vols., New York, 1872), W. G. T. Shedd (Presbyterian, 3 vols., 1884–94), H. B. Smith (Presbyterian 1884), A. H. Strong (Baptist, 1889), H. Sehmid (Lutheran, Eng. trans., Philadelphia, 1876), S. Buel (Anglican, New York, 1890), J. Miley (Methodist, 2 vols., 1892–94), contain discussions of points in eontroversy betweeu the different denominations, sueh as predestination, regeneration, and the divine unity. The Chureh creeds are to a eertain extent polemieal. See the most eomplete collection, by P. Sehaff, *The Creeds of Christendom* (5th ed., New York, 1890). See APOLOGETICS.

SAMUEL MACAULEY JACKSON.

Polemon (in Gr. Πολέμων) THE PERIEGETE: the first to develop the preparation of "guide-books," with especial referenee to works of art, inseriptions, and the like; flourished about 150 B. C., and is supposed to have been the souree of mueh of the wisdom of PAUSANIAS (*q. v.*). See Müller, *Frag. Histor. Græcorum*, vol. iii., pp. 108–148. B. L. G.

Polemoniaceæ: See PHLOX FAMILY.

Polevoï, NIKOLAÏ ALEKSEÏEVICH: author; b. in Irkutsk, Siberia, June 22, 1796. Self-taught and originally a merchant, he gave himself up to literature, and founded the

Moscow *Telegraph* (1825), which became one of the chief Russian journals of the day. He attacked with passion and skill the writers of the pseudo-classical school, in opposition to whom he defended Pushkin, Byron, and other romantic authors. His own talent was remarkably many-sided, for he was at the same time critic, story-teller, dramatist, historian, and translator with varying success. Some of his plays (*Ugolino*, *Parasha*, *The Grandfather of the Russian Fleet*, *Death and Honor*, etc.) are still played, in spite of absurd exaggerations in them, which are also to be found in his stories (*Abaddonna*, *The Bliss of Madness*, *Emma*, etc.). His *Outlines of Russian Literature* had value for his time, but his unfinished attempt to write Russian history (6 vols., 1824–33) in the style of Guizot and Niebuhr, and in rivalry to the great work of KARAMZIN (*q. v.*), was a failure. His later years were unfortunate. His paper was suppressed by the Government (1835). As by changing his opinions he had lost his former adherents, in order to support his numerous family he was obliged to do literary hack-work as one of the editors of the *Son of the Fatherland*, in support of the party he had formerly opposed. D. Feb. 22, 1846.—His son, PETR NIKOLAÏEVICH POLEVOÏ, has written a *Life* of Shakspeare (prefatory to the edition of translations from Shakspeare of Gerbel and Nekrasov, 4 vols., 1866–67); a well-known *History of Russia in Sketches and Biographies* (4th ed. 1881), and other works. A. C. COOLIDGE.

Polianthes Tuberosa: See TUBEROSE.

Police [= Fr. < Lat. *politi'a* = Gr. πολιτεία, condition of a city or state, government, administration, from πόλις, city, state]: the means instituted by the government to maintain public order, liberty, property, and individual or personal security. In the accomplishment of this function it is sometimes the auxiliary of the administrative department, sometimes of the judicial department. In the former case the measures which it employs are chiefly preventive, and to a certain extent discretionary.

The real court of first instance is the policeman. The policeman on his daily post is the universal referee, as well as the universal guide-board; he has knowledge of more disputes and quarrels and he decides more cases than all the courts in the land. Of course, these are to the last degree trivial when looked at individually, but in the aggregate they are of vast importance. If the policeman be a man of good common sense he so decides these cases as not only to put an end to animosity between neighbors, but to prevent an infinite number of petty lawsuits which would otherwise occupy the courts. In doing this he merely carries out the object of his vocation—to keep the peace.

It is a narrow view of a policeman's functions which pictures him solely as arresting criminals. The discovery and apprehension of those who have broken the law is a most important part of his work, but in addition he has many petty duties, such as seeing that outside doors are locked, watching the street traffic and untangling blocks of vehicles, looking after the safety of women and children, enforcing corporation ordinances, and finding lost children. The organization of the police in a city enables cognate branches of that city's government to bring laws to the knowledge of the people as no other machinery can. In time of threatened epidemic, for example, the health authorities would be practically helpless without the police. As contrasted with the aggregate of these functions, in their value to the community, the sterner duties of the police, such as suppressing riot, are of comparatively little worth.

The need of discipline, of centralized power, has imparted to the police in every large city a semi-military organization. Everywhere the same general system is to be found. The people are represented by the police commission, which appoints men to serve on the force, makes the rules which are to govern them, sometimes fixes salaries, etc. It is in the commission, when there is more than one member, that all debate on police matters takes place, and it is here that debate ends. Immediately after the commission, and subject to the rules made by it, comes the police force. A marked difference is seen at once, because membership in this is always for life or good behavior, and there is always a pension for those worn out in the service. In some cases the police force is complete within itself; that is, the administration of the rules made by the commission is carried on by the officials of the force without interference. In other words, the force is autonomous.

At the head of the force is an official known by various titles in the different localities, but often called superintendent. It is his business to see the orders of the commission carried out, to see that the members of the force, each in his degree, perform the multifarious duties exacted of them. He is the executive head of the force, and while he may, if he sees fit, consult with the higher officers on matters of moment, he issues orders to the force which all must obey. He is, from his position, not only the central authority, but the very mainspring of the force. In practice it has been found that the more uncontrolled the authority of this officer, the better the force; the more it is interfered with, the more disorganized and inefficient the force becomes. In some organizations of police, all promotions rest on the recommendation of the official who is the immediate superior of the person to be promoted and on the approval of the superintendent. This system has given the best results among the members of the force. No other has so completely secured promotion for merit, simply because all other systems have introduced causes for promotion which are not connected with the direct efficiency of the force.

Immediately under the superintendent there are officials called inspectors in the U. S. Each inspector has assigned to him five or more precincts over which he has executive control. As the superintendent carries out the orders of the commission, so the inspectors carry out the orders of the superintendent, and see that they are obeyed.

With reference to the population, a city is divided into sections called precincts, or in some countries, districts, and at the head of each is a captain of police. He rules the men attached to his precinct or station house—a building fitted up for the police and containing cells for prisoners—sees that the laws are obeyed, and the rules of the force carried out.

Below the captains in rank come the sergeants, or in some cities lieutenants and then sergeants. One of these is on duty in the precinct-house day and night. In many respects his duties are those of the captain. He is, however, more in contact with the people. He has many decisions to make, and must have a fair knowledge of the simpler rules of criminal law.

The "roundsmen," as they are called in the U. S., are the officers to whom is intrusted the inspection of the patrolmen. It is their duty to see that the latter are walking their posts, that they do not break any of the rules made for them, and that they are at all times carefully watching for the welfare of the people.

There is a separate branch of the force which contributes in no small degree to the suppression and punishment of criminals. This is the detective bureau. It consists of a number of men who have been selected for their shrewdness, courage, and common sense, and for their acquaintance with the faces and careers of criminals. It is the special duty of the detectives to investigate crime, but a far more important part of their work is the prevention of crime by a ceaseless watch kept on the dangerous elements of society. Under their scrutiny come the anarchist and the pickpocket, the burglar and the confidence operator, and though the greater part of their work is never known to the public, they are a powerful agency in the maintenance of order in the community.

In many countries there is a branch of the police which is practically unknown in the U. S. These are the political detectives, the men who watch those who are or who are supposed to be inimical to the existing government. During the civil war, and for a short time afterward, the members of the secret service of the U. S. Government did work of this kind, but since then the only avowed enemies of the Government in the U. S., the anarchists, are looked after by the local police.

The police force of the city of New York is governed by a commission, having four members, appointed for a period by the mayor. The force consists (1894) of a superintendent, 4 inspectors, 38 captains, 163 sergeants, 40 detective sergeants, 174 roundsmen, and 3,380 patrolmen—in all, 3,800 men, besides 15 surgeons, 79 doormen or janitors of station-houses, and 21 matrons who attend female prisoners. The city is divided into 38 precincts and 3 inspection districts. The posts patrolled in the day are twice as long as those during the night, so that during the latter twice as many men are on duty. In addition, a reserve of men is kept in each precinct-house ready to be sent to any point at which they are required. In the upper part of the city, where the posts are very long, many of the men are mounted. In time of danger, or when there is any great popular festival, the whole force is on duty night and day. There is a special

detail, known as the harbor police, which watches the shipping from launches and boats.

In Chicago the police force consists of a superintendent, an assistant superintendent, 3 inspectors, a chief of detectives, a superintendent of the bureau of identification, 15 captains, 59 lieutenants, 267 sergeants, and 2,493 patrolmen —in all 2,841 men.

In London the commission consists of a chief commissioner and two assistants, who are appointed for life by the Queen on the recommendation of the Home Secretary. The metropolitan police force consists of (1891) 5 chief constables, 31 superintendents, 787 inspectors—equivalent to captains in New York—1,637 sergeants, and 12,583 constables—in all, 15,043 men. There are 180 police districts (precincts) in London. This is exclusive of the city police, which consists of 905 men.

The metropolitan district of Dublin has its own police, created under parliamentary act of 1836. The force consisted on Dec. 31, 1892, of 1 chief commissioner, 8 superintendents, 24 inspectors, 176 sergeants, and 940 constables.

The Scotch police were organized under parliamentary acts of 1857 and 1862, auxiliary to and amendatory of acts passed during the early part of the nineteenth century. The force is subdivided into county districts, the authority governing each county force being vested in a commission consisting of seven county chancellors, and the sheriff of the county being an *ex officio* member of the commission. In Scotland, which has an area of 29,785 sq. miles and a population of 4,025,647, the total number of police in all the different counties is 4,700, or 1 for every 852 of the population.

In Paris the organization of the police is distinctly military. Under the Minister of the Interior, who is in the cabinet, there is the prefect of police and his subordinate, the director of public safety. The prefect occupies almost a cabinet position, in that he is expected to resign if the force fail in any great emergency. For example, the prefect, M. Lozé, resigned after the students' riots in 1892, and his successor, M. Lepin, after the assassination of President Carnot. There are 80 commissionnaires, 2 division inspectors, 25 clerks, 38 officers, 25 principal inspectors, 100 brigadiers (equivalent to sergeants in New York), 700 under-brigadiers (roundsmen), and 6,800 guards of the public peace —in all, 7,770 men. "Indicators," as they are called, are men outside the force who watch everybody. They are, in fact, spies, and the majority are reformed criminals.

In Berlin the police are divided into the county police, the industrial, the building, the criminal, the public safety, the stranger, and the community police. The fire department is also a part of the same general bureau. The Minister of the Interior is the head of the police force, and the system is purely military. Under him is the general with a staff of twelve brigade-generals who rank as colonels in the army, forty-nine district-officers who rank as majors or captains, and so on. The men carry swords and firearms.

In Russia the police form the executive administrators of the whole empire, and their number is not published. In St. Petersburg there are about 10,000 police—officials of the public safety—who maintain order. They are not armed in any way, but carry whistles. The number of those employed as detectives in the famous "Third Section" is unknown. It is the duty of these men to keep a constant watch on everybody, especially foreigners in the country, and to make their reports to the head of the section personally. For many years this was the Minister of the Interior, but of late it has been some man, generally selected from the army, who has been especially appointed.

The police in cities in Spain, Belgium, and Italy are organized under the military system so generally approved of on the Continent. In Turkey the police are more like watchmen who look out for fires than guardians of the peace.

Police organizations of a military character are maintained in several portions of the British empire. In Ireland the Royal Irish Constabulary, organized in 1836, have done good service, and it is this force which put into effect the various coercion acts passed by Parliament. In Canada a system of mounted police was formed on the model of the Royal Irish Constabulary, and in the Northwest territories have managed the Indians and maintained laws with thoroughness. In Australia and Africa similar organizations have been started, and the police branch of the East Indian Government is much like them. The organization is purely military in form: there is generally a lieutenant-colonel or major at the head, responsible to the Minister of the Interior or the official who answers to him. Under the commanding officer there are captains, lieutenants, sergeants, and privates. These bodies of men have done splendid service and have kept the peace over large territories at a minimum of cost. In Australia the police have ruled the gold-fields and the blacks, and in South Africa a similar force has (1894) been organized to maintain order among the miners in the gold regions and to hold in check the Matabeles and other tribes. In India the force is recruited from the natives, but the officers are British. There is life-tenure of position and a pension for old age or disability. With the mixed population of India, governed by an alien race, the supervision exercised by the police is of enormous value.

Returning to the police in cities, a comparison of the number of men with the population is of interest. The figures are as follows:

CITIES.	Population.	No. of police.	No. of men, women, and children guarded by one policeman.
New York	1,975,646 *	3,800	519
Paris	2,344,550	7,836	299
London, metropolitan and city police districts (1891)	5,633,806	15,948	353
St. Petersburg	978,309	10,000	97
Glasgow	670,000	1,303	514

* Population estimated by Registrar of Vital Statistics, New York Health Department, October 12, 1894.

It must be remembered that in the Paris police the "indicators" and the Government political detectives are not included, and that in London the extremely puzzling streets make a large number of human sign-boards imperatively necessary, and the dense traffic requires to be regulated by a large number of men. The police in European cities, not excepting those of Great Britain, are aided to a great extent in their duties, so far as those duties relate to suppressing organized lawlessness, by the regular troops, large garrisons of which are quartered in every town of any considerable size.

THOMAS BYRNES.

Police Power: See the Appendix.

Policy: a name applied to various forms of lottery. In one form the "policy shops" give out each afternoon slips containing two columns of twelve numbers each, and each evening slips containing two columns of thirteen each. The numbers in each column are drawn by lot from those between 1 and 78 inclusive. Before the drawing a person may make bets in various ways; in a "straight gig" the player selects three numbers and receives odds of 100 to 1 for the afternoon slips, or 87½ to 1 for the evening slips, that they will not all three appear in the same column of the slip. In this the real chances against the player are nearly 173 to 1 for the afternoon, and exactly 133 to 1 for the evening, even when the drawing is fairly conducted. Policy-playing is much in vogue among certain classes, in spite of laws against it.

Polignac, pō'lĕĕn'yaăk': the name of a French family which played a conspicuous and fatal part in the later history of the Bourbons.—JULES, COUNT DE POLIGNAC, and his wife, YOLANDE MARTINE GABRIELLE DE POLASTRON, were the most intimate friends of Marie Antoinette and the most prominent members of that faction of the court which intrigued against the reforms of Louis XVI. and his ministers. The count was made a duke in 1780, postmaster-general in 1782, and the family received immense dotations of land and money. As the prodigality of the queen and the political mistakes she made were generally ascribed to the influence of the Duchess of Polignac, she and her husband were the special objects of the French people's hatred and contempt. They left the country, together with the Count of Artois, July 16, 1789, as the first *émigrés*. The duchess died at Vienna in Dec., 1793. The duke went afterward to Russia, where he was well received by Catherine II.; she gave him an estate in Ukraine, where he died Sept. 21, 1817. His three sons tried first to form an intrigue for the re-establishment of the Bourbons by the First Consul, through his wife, Josephine; afterward they participated in the conspiracy of Cadoudal, and were imprisoned at Paris when the allied army approached the city. The second of them, JULES AUGUSTUS ARMAND MARIE, b. May 14, 1780, was made a Roman prince by the pope in 1820, and became president of the cabinet Aug. 8, 1829. As such he signed the famous *ordonnances* of July 25, 1830, which caused the immediate downfall of the Bourbon dynasty. He fled, but was arrest-

ed, and sentenced by the Chamber of Peers to imprisonment for life and forfeiture of his titles and rights as a citizen. Restored to liberty by the amnesty of Nov. 29, 1836, he went to England. D. at St.-Germain, Mar. 29, 1847.

Revised by F. M. COLBY.

Polish Language: See SLAVIC LANGUAGES.

Polish Literature: the literary monuments of the Polish language both before and since the final partition of Poland. This literature, like the nation itself, has passed through many vicissitudes. Seven distinct periods of its development are generally recognized.

I. *Poland under the Piasts* (down to 1386 A. D.).—The ancient (heathen) Poles were not acquainted with the art of writing, and what little of their literature has been preserved by tradition is found in folk-song and fairy-tale. Christianity introduced Bohemian, German, and Latin culture into Poland, and the native language entered on a struggle against the German and Latin cultivated by the priests in their schools. The earliest specimens of Polish literature are a translation of Psalm l. (about 1290), the hymn *Bogarodzica* (Mother of God), ascribed to St. Adalbert (d. 997), and the psalter of Queen Margareth (d. 1349). The historians of this period, Martin Gallus, Mateusz Cholewa, Wincenty Kadlubek (d. 1223), and others, wrote in Latin.

II. *Poland under the Jagellons* (1386–1548).—The invention of printing (first press in Cracow, 1465) and the foundation of the Academy of Cracow (re-established, 1397) exercised a powerful influence on the development of native Polish literature. The Bible of Saros Patak dates from 1455. Important collections of judicial decisions were made. Some poets still wrote in Latin, but Stanislaw Ciolek, Jedrzey Galka, and others, wrote in Polish. In this period were made the first attempts at dramatic composition (mysteries, with biblical subjects). Theological controversies created considerable polemical literature. The chief works of the period are the legal tracts of Jan Ostroróg and the historical writings (in Latin) of Jan Dlugosz (d. 1480), who is justly considered the father of Polish history. *Kronika Polska*, by Chwalczewski, and a few other works were written in Polish.

III. *The Golden Age* (1548–1606).—The Reformation and the generous policy of Sigismund August combined to raise the standard of native literature to a level hitherto unknown. Poland was the common refuge of western "heretics," the Bohemian Hussites, and others, whose Polish adherents championed their tenets in Polish and thus compelled the Catholic majority to employ that language, though Latin did not yet wholly disappear; but the large number of polemical tracts, postillas, religious songs, and translations of the Scriptures possessed but an ephemeral value. Talented literary men received encouragement and generous support from the king and many high-minded nobles and ecclesiastics; native poetry found a number of gifted interpreters, and this period is pre-eminent in both quality and quantity of literary works. It is also marked by the decline of the Cracow Academy and the rise of Jesuit influence in Poland (first Jesuit college established 1564).

The most prominent names of the golden age are those of Mikolaj Rej z Naglowic (d. 1569), Jan Kochanowski (d. 1584), his brother Peter, Sebastian Klonowicz, Mikolaj Sep Szarzyński (d. 1581), Kaspar Miaskowski, Piotr Skarga (d. 1575), and Stanislaw Grochowski (d. 1612). Rej was not a great poet, but his prose work *Zwierciadlo* (The Mirror), in which he presents the portrait of an ideal Polish nobleman, patriot, and Christian, is very valuable. Jan Kochanowski is the first great poet. Having no domestic models he had to invent a poetical language. He is best known by his excellent translation of the Psalms, his touching elegies *Treny* (Tears), his songs and satires, and, above all, the *Fraszky*. His drama *Odprawa poslów greckich* (The Expedition of the Grecian Envoys) is one of the earliest Slavonic dramas. Piotr Skarga, a champion of Catholicism, was the greatest preacher of his country. Szarzyński and Klonowicz followed Jan Kochanowski; Miaskowski and Grochowski cultivated religious poetry; Szymon Szymonowicz and Szymon Zimorowicz wrote five idyls. Mikolaj, Piotr and Jedrzej Kochanowski translated Greek, Latin, and Italian classics. Some of the poets still wrote in Latin. Valuable historical material is contained in the *Acta Tomiciana*.

IV. *The Panegyrists* (1606–1764).—The corruption of taste prevailing throughout Europe soon invaded Poland, and the golden age of her literature was followed by a period of decline. Panegyric verses, full of bombast, generally written for a pecuniary consideration, became the fashion. Every wedding, funeral, and baptism was celebrated by long-winded speeches and poems, and the custom of mingling Latin and other foreign words with those of the native language in macaronic verse became universal. The best poets of the time were survivors of the preceding era. At their head stands Waclaw Potocki (d. about 1696), whose fame rests on his great epic, *Wojna Chocimska* (The Campaign of Chocim). Krysztóf Opaliński (d. 1656) is the only satirist of note. A complete transition to Frenchified poetry was effected in the works of the Morsztyns: Hieronym, Jedrzej, Stanislaw, and Zbihniev. During this period historians confined their attention to memoirs. The first Polish newspaper made its appearance under Sigismund III.

V. *The Era of Stanislaw Augustus* (1764–1821).—This was an era of French classicism, a period of frivolous self-conceit. French customs, ideas, and forms dominated in literature as well as in society. At first the amount of literary work was comparatively small, notwithstanding the efforts of individual talent. Between 1764 and 1778 only 416 works were published in Poland, of which 84 were religious, 37 ethical, 32 political, 13 philosophical, 24 mathematical, 14 geographical, 56 historical, 13 oratorical, 56 poetical, 23 fiction, 27 grammatical, 13 medical, 2 architectural, and 22 agricultural. With a change of political conditions, however, came a change in literature; in the four years of the famous parliament (1788–91) the nation did more thinking and printing than it had done before in a century, and the functions of public newspapers became highly important.

Poetry followed French models for the most part, though there are some notable exceptions. Ignacy Krasicki (d. 1801) was an original genius, particularly in his satires, as was also Adam Stanislaw Naruszewicz. Krasicki's works *Myszeis* (The War of Mice) and *Monomachia* (War of Monks) are famous. Stanislaw Trembecki (d. 1812) was a master of form, but not a true poet. Kajetan Wegierski (d. 1787) was a clever rhymester, but his poetry is too sensual and voluptuous. Franciszek Karpiński (d. 1828) and Kniažnin (d. 1807) were authors of popular songs. Midway between the national and the French schools stood three notable poets of the Warsaw principality—Jan Pawel Woronicz (d. 1829), Julian Ursyn Niemcewicz (d. 1841), a patriotic satirist, theorist, historian, dramatist, and novelist, and Wojciech Boguslawski, the true founder of Polish drama, whose *Cud mniemany* won great popularity. French tragedy at this time found many translators and imitators, who were loudly applauded, though lacking talent.

In history the greatest name was that of the archæologist Adam Naruszewicz. Of his later followers Lelewel was the best. Politics gave rise to a considerable number of pamphlets, history of literature began to receive attention, and philology made rapid progress. Onufryj Kopczyński was the first great grammarian, and Samuel Bogumil Linde wrote the first standard dictionary of the Polish language.

VI. *The Era of Mickiewicz* (1821–63).—French pseudo-classicism could not dominate Poland for any considerable length of time; national poetry inspired the poets of the new generation. In Boguslawski's idyllic drama *Krakowiacy i górale* (The Cracowians and the Mountaineers) the national note is first sounded. The influence of Byron, Walter Scott, Goethe, Schiller, and Victor Hugo is manifest. Adam Mickiewicz (d. 1855), the leader of the romanticists, is the greatest poet not only of Poland, but of the entire Slavonic race. His great epic poems *Grażyna*, *Konrad Wallenrod*, and *Pan Tadeusz* marked him at once as a modern Homer. In his footsteps followed Antoni Eduard Odyniec, Julian Korsak, Alexander Chodzko, Antoni Gorecki, Józef Massalski, and others. The life of the people of Ukraina found its poets in Bogdan Zaleski (d. 1887), Severyn Goszczyński, and Michael Grabowski. The unfortunate Antoni Malczewski, too, wrote *Marya*, a story of Ukraina. The romanticists were sharply criticised by Osiński, Dmochowski, and others, but the attacks were ably repelled by Mickiewicz himself, and pseudo-classicism was finally doomed in Maurice Mochnacki's critical work *O literaturze polskiéj w wieku XIX*.

In Galicia reform was preached by the *Haliczanin*. The new movement soon invaded the field of novel-writing, Walter Scott being the principal model for Polish authors. Niemcewicz's *Jan z Teczyna* created a sensation. Then followed K. Gaszyński, F. Wężyk, F. Skarbek, the historical novelist Felix Bernatowicz, Mme. Jaraczewska, Alex. Bromikowski, and others.

The revolution of 1830 stopped the peaceable evolution of Polish letters. It brought stagnation to domestic production. Polish talent was to be found in exile, and Polish books then began to appear at Paris, Avignon, Strassburg, Brussels, London, Berlin, Vienna, and especially Leipzig. Poland revived slowly. The review *Wizerunki* appeared first, followed at Warsaw by the *Ateneum* of Józef Ignacy Kraszewski (d. 1887), Poland's greatest novelist. In the forties St. Petersburg became an important literary center. A decided turn for the better was announced in 1851 by the appearance of the *Dziennik Warszawski*. Some of the old poets were heard again. Mickiewicz published *Pan Tadeusz*; Bogdan Zaleski, S. Goszczyński, and S. Witwicki were still active. Among the younger generation appeared three great lights of the romantic school—Zygmunt Krasiński, Wincenty Pol, and the proud and daring Juljusz Slowacki, a rival of Mickiewicz himself. The greatest poets to come to prominence at the end of this period were Kornel Ujejski (lyric) and Wladyslaw Syrokomla (d. 1862), and the greatest novelists Jan Zacharjasewicz and Eliza Orzeszkowa.

Waclaw A. Maciejowski was at first the only historian of note, and kindred branches of literature were much neglected; but an increased activity dates from 1841. Karol Szajnocha and Alex. Batowski, editors of ancient historical documents, deserve special notice. Philosophy found its first exponents in Karol Libelt and Bronislaw Trentowski. Among the linguists Antoni Malecki is foremost.

VII. *The Present* (since 1863).—The present literature is noted for its riches, though it possesses but few names of international fame. The modern Polish novel deals chiefly with social questions—the relation of the nobility to the peasantry, the position of woman, that of the Jew, etc. The best-known author is Henryk Sienkiewicz, a number of whose novels have been translated into English by Jeremiah Curtin (*With Fire and Sword*, *Without Dogma*, etc.). Other well-known novelists are Boleslaw Prus, W. Los, T. T. Jež, Eliza Orzeszkowa, Marya Konopnicka (poet as well as novelist), Jan Zacharjasiewicz (writer of character novels), Ostoja, and Lewer. Among the poets should be mentioned Marya Konopnicka, W. Wysocki, Felicyan, K. Lewandowski, and Miriam (Zenon Przesmycki). The foremost dramatist of the nineteenth century is Alexander, the Count Fredro, whose comedies are still popular, though French in style and color. Others whose works are meritorious are Antoni Malecki (*List zelazny*, *Grochowy wieniec*), Józef Szujski (*Halszka z Ostroga*), Apollo Karzeniowski, Romanowski (*Popiel i Piast*), and, above all, Edward Lubowski (*Przesądy*, *Sąd honorowy*, etc.). The prominent historians are Antoni Malecki, the veteran, A. Szczepanski, K. Waliszewski, W. Boguslawski, and W. Spasowicz. Owing to the division of Poland the kingdom has three literary centers—Warsaw, Posen, and Cracow.

Bibliography.—A number of histories of Polish literature have been written in the native tongue, among them those of Bentkowski (1814) and Wiesniewski (10 vols., Cracow, 1845–57), besides many works on special portions of it. There are also several good works in German.

J. J. Král.

Politia'nus, Angelus: See Poliziano, Angelo.

Political Economy [*political* is from Gr. *πολιτικός*, pertaining to citizens or to government or a state, deriv. of *πολίτης*, citizen, deriv. of *πόλις*, city, state; *economy* is from Gr. *οἰκονομία*, economy, management, liter., household management; *οἶκος*, house + *νέμειν*, distribute]: the science of wealth, or the body of knowledge which relates to the production, distribution, and exchange of wealth. It is only within the concluding years of the nineteenth century that this view of the scope of political economy has been generally accepted. Down to the end of the eighteenth century it was regarded as an art rather than a science. It meant the art of conducting the business of a nation, just as domestic economy meant the art of conducting the business of a household, while it was a broader term than finance, which applied to the business of the government alone. The writers of the seventeenth and eighteenth centuries made the analogy between national and domestic economy far too close. They thought that it was the object of a nation to get rich in the same sense that it was the object of an individual to get rich. As an individual may grow prosperous by producing more than he consumes, and thus selling more than he buys, so the earlier writers on political economy conceived that a nation would grow rich by selling more to other nations than it bought from them, and that this was the only way by which the nation could be thoroughly prosperous. This view was at the basis of the *mercantile system* of political economy, so called, because it treated the business of a nation like that of a single merchant. Perhaps the leading British mercantilists were Thomas Mun in the seventeenth century and Sir James Steuart in the eighteenth. Steuart's *Inquiry into the Principles of Political Economy* (1767) was the most comprehensive English treatise previous to that of Adam Smith. To the eighteenth century belongs the work of Galiani in Italy, Justi in Germany, and Sonnenfels in Austria. Practical applications of the mercantile principle were seen in the commercial policy of nearly all European states down to the French Revolution, and still survive in many of the protective tariff systems. It was exemplified in the English navigation acts, and by the financial policy of Colbert in France in the seventeenth century.

It is easy to see that the mercantilists applied to national policy the principles of a miser rather than of a farsighted merchant, and that a wise business man becomes rich, not by the money that he accumulates, but by that which he spends farsightedly as a reinvestment. This line of criticism did not escape the notice of the mercantilists themselves. It was vigorously urged by Sir Dudley North (1691), and by his contemporary Sir William Petty. In the eighteenth century these criticisms were carried still further by the French school of economists known as *physiocrats*. This name was intended to emphasize their belief that legislative policy was subordinate in its effects to the action of the *powers of nature*. Whereas the mercantilists had attached too much importance to money as a measure of wealth and laid undue stress on forms of commerce, the physiocrats considered that national wealth was represented by the raw materials available, and laid chief stress on the productiveness of agriculture. The leaders of this school were Quesnay (1694–1774) and de Gournay (1712–59). The most eminent representative of the school in practical life was the great French minister Turgot (1727–81). It was a severe misfortune to France that this farsighted statesman was thwarted in the carrying out of his proposed reforms, which might have done much to mitigate the violence of the Revolution. Contemporary with the French physiocrats we find the work of Beccaria (1738–94) in Italy, and Adam Smith (1723–90) in England.

The work of Smith, whose *Wealth of Nations* was published in 1776, forms the starting-point of modern thought on political economy. He criticised the mercantilists as unsparingly as did his French and Italian contemporaries; but he took a broader view than the physiocrats in seeing that labor, as well as natural resources, was a decisive element in wealth and national prosperity. He also developed far more clearly than the physiocrats some operations of individual freedom and enterprise in their effect upon prices, and in so doing laid the foundation for the modern conception of economics as a science rather than an art. To Smith, more than any one else, is due the clear presentation of the truth that under free competition prices will ordinarily adjust themselves to cost of production; and the analysis—imperfect, it is true—of cost of production into its various component parts. The scientific method of Smith was carried much further by Malthus (1766–1834) and Ricardo (1772–1823). Malthus devoted special attention to social economy, the principles of consumption, and the effect of increasing numbers upon national or individual well-being. Ricardo started at the opposite extreme, with the investigation of money, banking, and finance. Applying the methods of finance to the analysis of cost of production, he developed the theory of rent which is associated with his name, as the theory of population is connected with that of Malthus. The popular movement for the repeal of the corn-laws gave these writers and their successors, of whom McCulloch and Senior were the most prominent, an opportunity to make their influence felt. To this group of writers the name of the English classical school is habitually applied. The work of this school is summed up and systematized in John Stuart Mill's *Principles of Political Economy* (1848), which is the leading treatise on the science. Its views are set forth in a more popular, but less philosophic, form in Fawcett's *Manual of Political Economy*. The continental writers at the beginning of the nineteenth century followed closely in the lines of the English. Among the French were J. B. Say (1767–1832), Sismondi (1773–1842), and Bastiat (1801–50), the last named being the most brilliant, but least scientific. The classical doctrines of political economy are gen-

erally held by French economists of the present day, among whom Leroy-Beaulieu is perhaps the most prominent. In Germany during the same period the leading names are those of Rau (1792–1870) and von Thünen (1783–1850), the latter of whom perhaps anticipated modern developments more than any contemporary writer in France or England.

It was a general characteristic of the classical school to believe in the let-alone or *laissez-faire* policy. With few exceptions these writers held that, under the action of individual liberty, the maximum of efficiency, as well as of justice, would be secured, and that all interference with liberty of contract was at least *prima facie* bad. Not content with criticising the mercantile system, they opposed the factory acts as such. Not content with pointing out the error of most legislation, they indulged in the most optimistic views as to the results of non-interference—views which the facts did not always justify. They thus exposed themselves to severe criticism from the socialist school, of whom Marx (1818–83) and Lassalle (1825–64) were the recognized leaders. Marx showed that, in point of fact, free competition did not produce the results which the political economists expected, and he therefore drew the conclusion that the social system which formed the basis of their assumptions was radically bad, while Lassalle, whose reasonings were historical rather than economic, endeavored to trace the direction which social changes must take in order to give the workman what he considered a just share of the product of industry. The protectionist writers also criticised the English classical school, but on lines wholly different from those of the socialists. Instead of accepting the deductions and attacking the system on which they were based, they may be said to have accepted the system and attacked certain deductions from it. The leading writers of the protectionist school during the first half of the nineteenth century were List in Germany (1789–1846) and Carey in the U. S. (1793–1879). They agree with Adam Smith and his followers in condemning the extreme errors of the mercantile system and in regarding labor and capital as the essential forms of wealth, but they believe that the greatest efficiency of labor and wisest expenditure of capital can be obtained, not by individual self-interest, but by certain restrictions on the part of government. Much of their argument is historical, rather than deductive. That is, they trace changes in the economic policy of nations as a whole, rather than methods of individual action under given conditions. In this way the protectionist school shades almost indistinguishably into the modern German historical school, of which Knies is regarded as the founder, and which numbers among its most prominent members the names of Hildebrand, Brentano, Schäffle, Wagner, Cohn, and Schmoller.

The criticisms of the German historical school have found an echo in England, to a greater or less extent, in Cliffe Leslie and Thorold Rogers and W. J. Ashley.

On the whole, it may be said that the work of the historical school has been very ineffective in proportion to its volume. The modifications in economic doctrines since 1870 have largely come through the detailed criticisms of those writers who profess to apply the deductive or individual method. The beginnings of this criticism may be seen in the writings of Cairnes (1823–75) and Bagehot (1826–77). Of greater importance were the criticisms of Longe and Thornton on the traditional doctrine of wages. Mill himself was converted to Thornton's views, although he died too early to incorporate the results in his *Principles of Political Economy*. Similar lines of criticism were carried on by F. A. Walker in America and Marshall in England.

Side by side with this critical progress we have a constructive movement on the part of the mathematical school of economists. As early as 1838 Cournot had made some important applications of mathematics to the economic analysis, and the almost unnoticed work of Gossen in 1857 had carried the same method still further; but it was reserved for Stanley Jevons in 1871, in his *Theory of Political Economy*, to call general attention to the advantages of this method. Coming at the time he did, he was able to lay the foundation for certain positive theories of political economy which could take the place of some of the untenable principles of the classical school. Contemporary with Jevons we have the work of Walras in Switzerland, and subsequently of Pantaleoni in Italy and Edgeworth in England, while Marshall in England, Clark and Patten in America, Menger, Wieser, Sax, and Böhm-Bawerk in Austria have done much to present the results of similar methods of analysis, divested of their algebraic form. So important have been the contributions of the Austrians in this field that the name "Austrian school" is now habitually applied to this whole group of writers.

Political economy in the U. S. was somewhat slow in its development. With the exception of Henry C. Carey, there was for a long time no economist of originality and eminence. The first teachers of political economy, like Amasa Walker, A. L. Chapin, or A. L. Perry, both in their thought and in their writings followed closely in the lines of the English classical school. Much more important work was done in the years following the war by a group of practical men working in special lines of study. First in this group should be named David A. Wells, for some years U. S. revenue commissioner, whose works on taxation and trade have a world-wide reputation. His last, and in some respects most comprehensive, book is entitled *Recent Economic Changes*. Edward Atkinson has done work of equal importance with reference to questions of production, distribution, and internal commerce. Charles Francis Adams, as Massachusetts railway commissioner, laid the foundation for a scientific study of railway problems. Carroll D. Wright, as labor commissioner, first of Massachusetts and then of the U. S., has attained a world-wide reputation for his investigations on wages and other matters connected with the factory system. In connection with this group should be mentioned the names of John Jay Knox and Horace White, leading authorities on questions of banking and finance. Chief among theoretical writers should be named F. A. Walker, superintendent of the census of 1870 and 1880, professor at Yale, and afterward president of the Massachusetts Institute of Technology, who is probably the leading economist of the present day, in the English-speaking world, at any rate; W. G. Sumner, of Yale, who has published books on American financial history and on certain sociological questions; and Simon Newcomb, of Washington, a political economist as well as astronomer.

A special place in the history of economics in the U. S. must be assigned to Henry George, a writer standing midway between the classical economists and the socialists, agreeing with the former in their advocacy of freedom from interference, with the latter in their projects of nationalization of the land. His *Progress and Poverty* was first published in 1879, and has had an unprecedented popular influence. Another important writer, springing like Henry George from the ranks of the laborers, but more conservative in his conclusions and more careful in his methods of analysis, is George Gunton.

Until about 1880 most of the study of political economy in the U. S. had been under English influence. At that time a group of younger men who had studied in Germany came into prominence, and began to mould economic thought in the direction of the historical method. Among those who were prominent in this direction were Prof. R. T. Ely, of Johns Hopkins University and subsequently of the University of Wisconsin, Prof. E. J. James, of the University of Pennsylvania, and Prof. Henry C. Adams, now of the University of Michigan. Under their influence the American Economic Association, whose publications have done much to increase the interest in economic study, was founded in 1885. Among its most important members are Prof. J. B. Clark, of Amherst College, Prof. F. H. Giddings, of Bryn Mawr, and Prof. J. W. Jenks, of Cornell. In the most recent years the economic courses in all the leading colleges of the U. S. have been strengthened, and most of them maintain publications specially devoted to economics and political science. Among scientific publications largely devoted to political economy, besides those of the American Economic Association, may be mentioned *The Quarterly Journal of Economics* (Harvard), *Political Science Quarterly* (Columbia), *The Economic Journal* (Chicago), *The Yale Review*, and the *Annals of the American Academy of Political and Social Science*.

Scope of the Science.—Political economy or economics is the science which undertakes to explain prices and price-movements. Any such explanation involves two processes. We may assume a given set of laws and customs, and see how the operation of individual motives will affect the price of different goods or services; or we may go one step farther back and investigate the reasons which have caused those laws and customs to be established, and which make modifications desirable or probable. Those who chiefly occupy themselves with the former class of problems are said to employ the deductive method, those who chiefly study the latter class employ the historical method; but it is begin-

ning to be understood that any good economist must employ both methods, and that the distinction between the so-called deductive and historical schools is much less fundamental than was once supposed.

Political economy, as thus defined, is a science and not an art. It is occupied primarily with explanations rather than precepts. It bears the same relation to the arts of finance and legislation that the science of physiology bears to the arts of medicine and hygiene, or the science of mechanics to the art of building.

Price and Value.—A price is the quantity of one article or service which is exchanged for another. If a ton of coal is exchanged for 5 bush. of wheat, either may be said to be the price of the other; but usually prices are expressed in some one article—money—which is adopted as a common measure or standard.

Many economists make a distinction between price and value by restricting the term price to those cases where it is measured in money, and applying the word value to all other standards of exchange; but this does not correspond to common usage, and is almost always misleading. In common usage, a price is a *fact*, the amount of something which we must pay for something else; while value is an *estimate*, either by the community or by some individual, of what a price ought to be. Under ordinary circumstances value means the average probable price. If we say, for example, that certain railway stock is selling below its true value, we mean that, in our opinion, this stock will, on an average, sell for a higher price than it now commands. Value is also sometimes used to mean what, in the opinion of the speaker, is regarded as a just price. If we say that a combination is able to keep the price of oil above its true value, we mean above that price which would constitute a fair return for the labor and capital invested. Many of the fallacies in economic reasoning arise from treating the term value as an estimate at one point of the reasoning, and as a fact at another point. It is better to confine it entirely to the former use and to employ the word price for the latter.

How Value is Determined. Competition.—The value or proper price of an article may be determined by the community in two ways, either by custom or by competition. The former was almost universal in mediæval times.

It was believed by the mediæval writers, as it is believed by the modern socialists, that value depends on cost of production, that there is a constant effort on the part of the producers to sell their articles for more than the value or just price, and that public sentiment, or even legislative enactment, should fix a price of this kind and compel the producers to maintain it. The objections to this view are, first, that such a way of determining prices is possible only where the processes of industry are simple and uniform. In the absence of such uniformity, the public can not readily determine what is the cost of production of an article or its just price on this basis. Second, even when the price has been fixed with substantial correctness, it is difficult to insure the production of the right quantity. If more is produced than the public will take at the price in question, it goes to waste. If less is produced than the public wants at such a price, there will be scarcity and distress. Only in the case of production for orders or for a perfectly uniform market could this matter be regulated under the mediæval system, and even under such circumstances it was necessary to determine by the most tyrannical rules what trade each man should be allowed to pursue.

The modern method of determining value by competition avoids these difficulties. Suppose wheat has been selling in the New York market at $1 a bushel. The dealers find that the quantities supplied by the producers at this price are less than the quantities demanded by the consumers, that the stocks on hand are diminishing, that if this process continues there will be a scarcity. They put the price up to $1.05 a bushel. At this price there will obviously be somewhat fewer persons who wish to buy and somewhat more who are willing to sell. The quantity supplied becomes equal to the quantity demanded; if this process goes far enough, it becomes even greater. Then comes a reaction. The dealers are afraid that unsold stock will accumulate on their hands. They will put the price down to $1, or even to 95 cents, in order to adjust the quantity which the public is willing to buy, to that which the producers stand ready to sell. The essence of this method is that the producers are allowed to fix the price at the point which the public is prepared to pay. The advantages of this system over the system of customary prices are, first, that it prevents waste. If wheat remained at $1 a bushel until the whole supply was used up, people would not economize in their consumption, and would find themselves unexpectedly face to face with a season of famine. On the other hand, if the price were kept at $1 a bushel when the supply was so great that it could not all be used at that price, the accumulated stocks would deteriorate and not be used to advantage. By adjusting the prices to the quantities on hand, excessive use on the part of consumers or excessive accumulation on the part of producers is avoided. Second, the system of competition directs production automatically. If there is going to be a scarcity of wheat, any custom or law which prevents an increase of price takes away from producers the motive to meet the public need. If the price of wheat be allowed to rise to $1.05, new supplies of wheat are attracted to the market and prevent famine or scarcity. If, on the other hand, such increase be prohibited, it is merely an attempt to check the distress by repressing the symptom. In fixing prices by custom, a deficiency in production is perpetuated; but if free competition be allowed, that deficiency is permitted to correct itself. Third, and most important of all, competition makes price conform to cost of production more closely than is possible by any system of legal enactments; for if the price of any article continues for any length of time in excess of the cost of production, new capital and new laborers will be attracted in the business of supplying it. The quantity offered will increase, and the price will go down. If, on the other hand, the price of an article for any considerable time fails to cover the cost of production, capital and labor will go out of the business, the quantity supplied will be diminished, and prices will rise until they reach a fair and just level. This automatic adjustment of price to cost makes the modern system fairer, as well as more elastic, than the mediæval one.

Relation of Value to Utility and Cost of Production.—Under this system the value of an article does not depend primarily on its cost of production, but on its utility; not upon the utility of the article as a whole, be it observed, but upon the utility of additional supplies of that article. It may be laid down as a general rule that the utility of additional supplies of any article in a given market tends to decrease as the quantity of that article supplied from day to day increases. This utility of additional supplies is the primary cause of the value. Competition among different sellers insures that the price of one part of the supply will not be much greater than that of another; in other words, that the value of the article as a whole will be fixed by the utility of the last increments or additions to the supply. The increase of supply will go on so long as this value more than covers the cost of production. When it ceases to cover the cost of production there is at once a reaction; the utility of the additional supplies is less than the sacrifices involved in producing them, the price received no longer covers the expenses of production, and the quantity offered will diminish until the utility becomes substantially equal to the cost.

Functions of the Speculator.—The adjustment is not universal or immediate. In some lines of business, where considerable stocks of goods must be kept on hand, and where large amounts of fixed capital are required before additional supplies can be put on the market, such an adjustment may take months, or even years, during which competition of sellers may be very ineffective, and prices remain much higher than cost of production. Such a state of things is not practically remedied by the socialistic schemes that have hitherto been tried, for the government is quite as likely as the individual producer to take advantage of any such temporary monopoly. It is the function of the speculator in modern society to avoid such fluctuations. A man is allowed to buy cheap and to sell dear because, on the whole, such a process does the community more good than harm. If the speculator makes money for himself by simply anticipating the needs of the market instead of manipulating it, he does an inestimable service to the community at the same time. By buying when prices are low he prevents waste. By selling when prices are high he makes available those supplies which he has saved in times of plenty. Nor is speculation confined to mercantile transactions. Under the modern system, every manufacturer and almost every producer is, to a greater or less extent, a speculator. If by his skill and foresight he is able to sell goods for more than they cost him, he serves the public by directing labor in lines where its products are needed. If, on the other hand,

he fails to cover his expenses, he has injured the public as well as himself, for he has directed labor in lines where its products were much less needed. What holds true of the control of labor is still more conspicuously true of the control of capital. The man who directs capital into profitable lines is making profitable use not merely of the labor of the present, but of that of the past. He is utilizing not merely the community's present work, but its system of past accumulations.

It must not be assumed that this speculative system always selects the best employers or the best methods of business management, but it is true that it develops better employers and better methods than any other system which has hitherto been devised. It was because of its superior efficiency that it supplanted by degrees the old mediæval system which has been already described, and which was closely analogous to that proposed by the socialists. From the fifteenth century down to the nineteenth greater powers have been constantly put in the hands of those who could control capital. In the fifteenth century the right to pursue a trade and to hire laborers was in large measure hereditary. To-day any one who will take the risks of advancing the capital is allowed to assume the direction of industry. This constitutes the wages system. He is even allowed to borrow the capital of others, and, within wide limits, to make what terms he pleases for borrowing it. This constitutes the system of interest. To encourage the speculative investment of capital for remote ends, there has developed a system of land-tenure and land-transfer, which gives control of agriculture and building to the capitalist instead of the government. To facilitate the investment of capital in new methods of manufacture whose return is somewhat doubtful, a system of patents and patent-rights has come into existence. To make possible the association of the capital of different individuals in industries requiring concentrated management, governments have not merely promoted the establishment of joint-stock companies or corporations, but have allowed their power to increase almost to the danger limit. Each step in this development has been taken somewhat reluctantly, because the speculative management of industry proved more efficient than its regulation by tradition or by government.

Attacks on the Existing System.—It is claimed by the socialists that the price determined under the existing system tends to the advantage of the capitalists and the disadvantage of the laborers—that the rich are growing richer and the poor poorer as a direct consequence of this system. They hold that of the enormous increase in efficiency of labor during the nineteenth century the laborer himself has received but a slight benefit, and that the rest has therefore accrued to the speculator or capitalist, as a class. Most of the reasoning of writers of this school rests upon the assumption that capital is monopolized, while laborers are competing with one another. If there were but one capitalist in the world, the reasoning of the socialists might possibly hold true. In those industries where capital is so concentrated as to form a practical monopoly, what they say may be partly true; but, taking the world as a whole, their charges are not well founded in fact or in theory. The investigations of Col. Wright and Edward Atkinson show conclusively that the poor are not growing poorer, either in their absolute condition or in their share of the national income, and that if the difference in accumulations between the richest and the poorest is greater now than it was a hundred years ago, it is because the accumulated wealth itself is so much greater that the difference between the richest and the poorest must necessarily be larger. There is reason to believe that the laborers individually have a higher average standard of comfort under the operation of the speculative system than ever before, and that, as a class, their share in the national income is increasing rather than diminishing.

The Distribution of Wealth.—The distribution of returns between laborers and capitalists is one of the most perplexing subjects in political economy. The old or "classical" theory was that the owners of capital, as a class, set aside certain funds for the payment of wages, that the amount of this fund depended on the amount of capital available for employment, and furnished the total real wages of the community, while the average rate of wages of each individual was to be found by dividing this fund by the number of laborers. Under this view, known as the wage-fund theory, the aggregate wages could be increased only by an increase in accumulations. The rate of wages in any given amount of accumulation could be increased only by diminishing the number of laborers among whom this product was to be divided. This theory is incomplete because it fails to take account of the fact that, with a given amount of accumulation, a greater or less activity in the use of capital may cause the amount offered to the laborer to rise at the expense of the amount wasted or imperfectly utilized. It will often happen that years when the past accumulations are small are the very ones when wages are high, because the expectation of renewed business activity causes business men to utilize the existing product to the utmost. This is sometimes seen after a war. It is often seen in a time of recovery from a commercial crisis. It is almost always seen in the early development of a new country. In all these cases accumulations are small, but the spirit of enterprise is so large that wages become really, as well as nominally, high. It is evident that the speculator will advance money so long as he expects the product to be decidedly in excess of the cost of wages and materials. Each extension of his enterprise constitutes at once a demand for labor in the present and a supply of products in the future. His operations and those of other persons in the same business tend to push wages up now and to push prices down six months or a year hence. This will continue until the difference becomes very small. The limit of this difference between what the employer will pay for wages and materials (and this expenditure for materials is, for the most part, but a repayment of wages already advanced) and the expected price of the product is to be found in the interest which he must pay on his advances during the period of production. Price tends to conform to the amount of wages and interest under ordinary conditions. If the price is inadequate to pay wages and interest, the employer will find that he has made a speculative mistake and will go out of business. If the price more than covers wages and interest, the employer will feel that he has done well and will strive to extend his operations in the next period of production.

Differential Gains. Theory of Rent.—Some business, however, is not done under ordinary conditions. A part of the supply may be produced under exceptional advantages of location. If the New York market must have a certain amount of Dakota wheat, the people in Minnesota, who are supplying the same market, have an advantage due to the fact that they do not have to ship their wheat so far. The price can not fall below the cost of production for Dakota wheat, else the quantity supplied would be too small. The difference in location gives rise to a gain which is known as rent. If certain of the persons supplying the New York market have the benefit of some processes and methods of industry which are not open to all, we again have a special gain closely analogous to the rent of land, due to patents or monopolies of a process of production. Finally, if under a given set of conditions one producer is possessed of exceptional organizing power, so that he can produce part of the supply at less than the general cost of the whole, he obtains a gain known as profits in the narrower sense, due to his monopoly of brains. Price, under the existing system, is not determined by the average cost of production of the commodity as a whole, but tends to approach the cost of production of that part of the supply which is produced without exceptional advantages of any kind. Rent and profits form part of the returns of industry, but are not elements in the cost of production in the same sense that wages and interest are elements. They are known to the economist by the name of differential gains, and the laws to which they are subject are much clearer than those which regulate wages and interest.

Theory of Population and Wages.—Wages form, without any question, the largest element in cost of production. Under the competitive system they are determined by an adjustment between the supply of and demand for labor. The supply of labor under certain conditions tends to increase so rapidly that some persons have supposed that wages for unskilled labor must perpetually remain at the starvation-point, and that no progress for the mass of laborers was possible except by rigid limitation of their numbers. This view has been associated with the name of Malthus, who first developed certain important facts relating to population. He showed the existence of a tendency of population to increase faster than the means of subsistence, and pointed out that if this tendency went on unchecked there must soon come a time when the increased numbers of the laborers would prevent any gain from improved processes; a time, in short, when wages would be so low that starvation must

ensue, and continue until the number of laborers was again brought within the limit of the food-supply. He saw no escape from this difficulty except by a policy of conscious restriction of population on the part of the laborers themselves. In its main features the theory of Malthus has withstood the attacks of the critics. It is not true, as urged by Henry George, that increased population will take care of itself. It is, however, a mistake to assume that there is any such general pressure of population upon subsistence as Malthus supposes. The institutions of private property and of the family have localized this pressure of population upon subsistence, and have confined the destructive effects of overpopulation within narrow limits. If a confirmation of these views were needed, it would be found in the experience of England and other countries with regard to poor relief. Wherever it has been assumed that groups or classes of men would be supported by the community, there has been a tendency to multiply their numbers. Wherever, on the contrary, relief has been strictly limited and a spirit of independence cultivated, the number of paupers has diminished in a most unexpected manner. What Malthus says about population as a whole would probably be true in the case of a society organized on the more extreme forms of socialism, but it does not hold true of society today. On the contrary, the institution of the family has established certain standards of comfort and certain habits of providence which prevent the multiplication of numbers up to the limit of the food-supply, and which causes the increase of wages to be largely spent, not in supporting greater numbers under the old conditions, but in supporting the old numbers under better conditions. Of this generalization, the statistics of America and Western Europe furnish sufficient proof. The rate of wages for any given grade of industry is primarily determined by the standard of comfort set by the mass of laborers themselves. The extent to which labor can be employed in any given direction depends upon the amount of product which the public will consume at rates sufficient to insure to the laborers wages which will conform to this standard. The employer, under the existing system, makes a speculative judgment of what this amount will be. The demand for labor is not determined by accumulations, as was falsely stated by the "classical" theory already referred to, but by the expected value of the product as estimated by those who control the capital of the community.

Theory of Interest.—If no time elapsed between the expenditure of labor and the return of the product, or if there were no such thing as interest, the probability is that the price would adjust itself accurately to the labor cost; but as it is, interest enters into the prices of nearly all products. The rate of interest is determined by a bargain or series of bargains between the borrowers and the lenders. Whoever has accumulated disposable property or capital, of which money is but the symbol, has the right to the control of industry, and the speculative employer is paying a greater or less rate of interest to secure the chance of using that right himself. (Even if he is working with his own capital the case is not essentially altered, for he could sell the right to the use of that capital to some one else, and he will therefore not employ it himself unless he can obtain a profit corresponding to that which he would receive by disposing of these rights to others.) The conditions which enter into this bargain are an estimate of risk on the part of the lender and an expectation of profit on the part of the borrower. The expected profit on a loan creates a demand for such loans, just as utility creates a demand for commodities. The estimated risk tends to limit the supply of such loans, just as cost of production and many other considerations tend to limit the supply of commodities; but, just as in the purchase of ordinary commodities some persons are able to buy them for less than their utility to them as individuals, and some are able to sell those commodities for less than the cost to them as individuals, so, in the case of interest, some can borrow at rates which leave them a large margin of expected profit, and some can lend at rates decidedly above those which they would take in case of necessity. The rate for any given class of loans adjusts itself to the point which will bring into the market an amount of such capital equal to the amount business men demand at the rate in question. Risk enters into interest in precisely the same way that cost of production enters into value.

Depreciation of Capital.—It is, to say the least, an open question whether in the U. S. and Great Britain to-day the losses of investors on their principal do not more than counterbalance the receipts in the form of interest or dividends. That the borrowers of capital as a class make money by the aggregate of transactions there can be little doubt, but that the lenders of money more than indemnify themselves for their losses is by no means certain. The socialist assumption of an enormous sum earned by capital in the form of interest is unquestionably false, and so long as this is so any scheme based upon the assumption of such a surplus must be regarded as utopian. The causes which fix the rate or the amount of interest must be carefully distinguished from those which establish the system of interest. The system of interest has grown up because, on the whole, it brought the use of capital into efficient hands. Society maintains this system as a means of securing efficiency. Whether the judgment of individual investors with regard to the rate they are receiving be true or false is a secondary question, and one with which society has not hitherto concerned itself.

Effect of Improvements in Production.—A controversy has arisen as to what class in society receives the "residual share" of the product of industry. To whom, it is asked, does the benefit of improvements in production ultimately go? The socialist, as a rule, holds that it goes to the capitalist. Henry George thinks that it goes to the landowner. Gen. Walker, with the majority of economists, believes that it goes to the laborer. The last view appears to be nearest the truth. To be sure, in an individual transaction under the existing system it is the speculator who receives the gain. If he has introduced an improved process which is covered by a patent, he is, for the time being, enabled to sell his goods at the old prices, while his cost of production has been much reduced and his profits correspondingly increased. When, however, the use of the new process becomes general and all the less economical producers have gradually dropped out of the business, a fall in prices or an increase in wages, or both, must ultimately follow. There *may* be a considerable gain to the landowner in the form of rent, as urged by George; but it does not seem likely that this is nearly so important an element as George assumes. The action of different business men narrows down the margin between wages at one extreme and prices at the other. True, there always remains a certain amount of margin represented by the rate of interest, and it might be supposed that with the increased accumulations of capital the amount paid in interest would be covered; but the investigations of Edward Atkinson go to show that the increase in capital under the old system of industry, where each man worked by himself or in small factories, though less in each individual case, was even greater in the aggregate than exists at the present day, and that the ultimate benefit of the improvement shows itself in a larger demand for labor and a lower price of product. By the former the laborer benefits directly. By the latter he benefits with the rest of the community, as a consumer. Though it doubtless is true that the gain to consumers from new processes has been more conspicuous than the increase in wages, it is also true that the result of new processes and new methods has been to promote an increased popular use of commodities which were formerly confined to a few. It is the staples, rather than the luxuries, that have cheapened. So far as this is true, the gain from the new processes goes to the laborers rather than to the landowners or capitalists. This will appear in another way if the conditions under the present system of manufacture be compared with those under the system of hand labor. Under the system of hand labor there was a small quantity of each kind of manufactured article sold at high prices, and the laborer made his money not by the quantity of his output, but by the high price for each unit of work. He resisted labor-saving machinery because it seemed likely to throw him out of employment; but the cheapening of the product created an increased demand which more than counterbalanced the increase in supply. When railways were first introduced they were opposed by large classes of the community because it was thought that the increased efficiency of transportation would throw teamsters and innkeepers out of employment; but the increase of travel and shipment proved to be many times more than the increase of efficiency, so that to-day the reduction of cost from a dollar a ton-mile to a cent a ton-mile has increased the amount of transportation more than a hundredfold, and has increased the demand for labor instead of diminishing it.

Government Interference with Industry.—These general principles form the basis of what is known as the system of

laissez faire, or the scientific justification of the let-alone policy. The majority of economists have held that it was best for the community that the interference of government with industry should be reduced to a minimum, and that in this way a higher degree of industrial efficiency and a more equitable distribution of wealth could be secured than in any other; but there has been some disposition to modify these views, especially with regard to equity of distribution. The principle that government should not interfere with industry is no longer treated as an axiom, but as a general result of experience. That most cases of government interference with industry have done harm instead of good is pretty clearly proved by history; but it is far from true that all such interference has been bad, or that proposed measures of restriction should be condemned unheard.

Usury laws furnish an example of the kind of government interference which seems right, but really is wrong. Those who advocate the restriction of the rate of interest say that the capitalists are few in number, intelligent, and well organized, while the borrowers are many, needy, and short-sighted. In these circumstances it has been urged that the government should step in and fix a maximum rate as a necessary means of preventing extortion. Yet the amount of good which has been done by such interference has been very much less than the amount of harm. In the great majority of cases the high rate of interest is not an indication of extortion so much as of exceptional opportunities for the investment of capital. If we refuse to permit the high rate one of two things happens. Either the law will be evaded, which is always bad, or the supply of capital will be restricted, the development of the country checked, and the rich opportunities which made the high rate of interest possible will remain unused. The high rate of interest is a symptom of scarcity of capital. The attempt to lower the rate by law makes that scarcity continue, and deprives the community of the natural means of remedying it.

The Labor Contract.—A somewhat similar case is furnished by the relations between labor and capital. Here again the relations between workmen and employers are somewhat like those between borrowers and lenders, and it has been proposed that the government should remedy the disadvantage under which laborers act by direct interference with the wages contract. A few extremists think that government ought to fix the rate of wages, a great many more believe in regulation of the hours of labor, while a still larger number hold that the work of women and children should be subjected to special oversight and special regulations. It is hardly necessary to say that attempts to fix the rate of wages have proved a failure wherever tried. Attempts to regulate the hours of labor have been successful in a limited degree, yet even here it may be questioned whether much good has been done in connection with the labor of adult men. The work of women and children furnishes much better ground for regulation. This is one of the cases where the self-interest of the individuals does not promote the best interests of the community. As men are constituted each is likely to strive for the maximum enjoyment in the present, even though the labor power and the intelligence of the community in the future be jeopardized by keeping married women and children in factories. The experience of England and of many parts of the U. S. with restrictive acts concerning such labor has been distinctly good. See FACTORIES AND FACTORY SYSTEM.

Monopolies, Railway Regulation.—Special regulation is also proposed in those cases where an individual or group of individuals has a monopoly in a particular line of business, whether that monopoly be due to special legislation, or, as is now more commonly the case, to the necessities of business organization. With the progress of invention large establishments have become more economical than small ones. It is no longer possible for the independent workman to compete with the large monopoly. It is scarcely possible for the small establishment to compete with the great one. In railway business first, and afterward in all other lines of industry requiring much capital, monopolies have grown up in the hands of enormous joint-stock companies. It is held, with a great deal of plausibility, that such industries form a necessary subject for special regulation by the government, if not for direct government ownership, and that in the absence of such special regulation the public has no protection whatever. Most of the arrangements of modern society are based upon the assumption that individuals will act as individuals, and where such individual action does not in fact take place many of the traditions of modern industrial law cease to apply. Yet even in those cases the dangers of interference are greater and those of non-interference less than superficial observers suppose. See MONOPOLIES.

Throughout this article the purchasing power of money has been assumed to be constant, and little has been said about variations in the operation of the credit system. On the way in which supply and demand regulates the value of money comment will be found under CURRENCY. The operations of the credit system and their effect on speculation are treated under the head of COMMERCIAL CRISES, while certain details respecting the relation of labor and capital are treated more at length under WAGES. See also RENT.

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Political Parties: free social organizations founded and kept together for the purpose of accomplishing certain political results.

POLITICAL PARTIES IN GENERAL.—*Essential Principles.*—Political parties can not exist and flourish where government is not of a nature to be influenced greatly by public opinion; but where public opinion is recognized and encouraged they grow up spontaneously out of certain psychological characteristics of human nature. In regard to all important political questions there will not only be differing opinions, but such opinions, when free to act, will almost invariably range themselves ultimately into two opposing parties. When not influenced by authority or considerations of personal gain or loss, such party alliances are determined by certain fundamental conceptions or principles. Those persons in whom the importance of stability and order predominates range themselves on the one side, while on the opposite side are to be found those who give emphasis to the importance of action and progress. Frederick Rohmer, in his *Doctrine of Parties*, compares these two principles with the peculiarities of the different periods of human life. The boy and the youth, he says, represent the impulse in behalf of action and progress. This impulse corresponds with the radical element in political life. At the other extreme the old man represents the most conservative element. He is inclined to oppose every departure from the ways of the past; he distrusts all innovations; he forms at once an obstacle to progress and a security against precipitancy. Between these two elements represented by age and youth there are elements represented by the developing stages of manhood. Conservatism may be found in the boy and radicalism may be found in the old man, but whatever the views of the individuals at the two extremes, there is an intermediate period during which less extreme views are commonly held. While, therefore, youth and old age are the personifications of radicalism and absolutism, manhood is the personification on the one hand of liberalism, and of conservatism on the other. Hence wherever political parties are organized these four elements, corresponding to the terms absolutist, conservative, liberal, and radical, will be found in a greater or less state of activity. The doctrines in relation to which political parties take their characteristic positions are determined by the dominant political issues of the day; but whatever the question at issue, the matter of personal temperament will generally exercise a controlling influence in determining party affiliations. This, however, must not be understood as applying to all classes of persons. On the contrary, there are two classes to whom these considerations do not apply: First, those who unselfishly devote their lives to the work of reforming what they consider abuses, and, secondly, those whose political actions are selfishly determined by considerations of personal advantage. These two classes either refuse to acknowledge allegiance to any party or are bound by such feeble party ties that they can readily pass from

one party to another. It is in consequence of such feebleness of tenure that these two classes constitute the uncertain element in every popular election. Notwithstanding the tendencies of political parties to group themselves into a dual system under the general character of conservatives and liberals, it frequently happens that minor interests of various kinds express themselves, as shown below, by means of separate organizations.

Party Declarations and Methods of Action.—The doctrines of political parties are nowhere very clearly or authoritatively expressed. This statement would seem to be at variance with the custom in the U. S. of adopting "party platforms"; but a very slight familiarity with the political history of that country must reveal the fact that such declarations have no very authoritative significance. The importance of such a manifesto of course depends upon the deliberateness and the discretion with which it is framed. The Tamworth manifesto of Sir Robert Peel in 1837 outlined the policy by which the Conservative party in Great Britain was guided for many years, and the Nottingham address by W. E. Gladstone in 1890 performed a similar service for the Liberals; but in the U. S. the platforms are either the joint product of conflicting opinions, or the utterances of single individuals acting in an irresponsible capacity. They are ordinarily designed quite as much to show the weaknesses of the opposing party as to set forth the principles of the party making the declaration. Moreover, new exigencies may arise, and if the declarations are too definite there may be no room for that flexibility necessary to party efficiency. If a party declares itself unequivocally in favor of an immediate policy of a certain kind, it may be found a little later that only a partial fulfillment of its promises are for the present within the range of possibility. Hence it is that the various party platforms are generally somewhat vague in their utterances, and that parties consider themselves bound to such utterances by very slender ties.

The management of political parties differs greatly in different countries. In Great Britain each party has its official leader, who, acting under such advice as he may seek, controls and directs all party action. By parliamentary law all candidates are required under oath to make a public statement in detail of expenditures of every kind, such expenditures being strictly defined and limited by statute. Contested elections are tried, not by Parliament, but by the courts, and in case the law in regard to expenditures is shown to have been violated the seat of the defendant goes to his opponent. Nominations are made by personal announcement, not by the choice of a CAUCUS (*q. v.*). As the legitimate expenses of a parliamentary election for printing and for speakers are necessarily very considerable, the number of candidates presenting themselves is limited by the probabilities of success or failure. In the U. S., on the other hand, there is practically very much less individual liberty on the part of candidates, and very much more party supervision. The candidate does not nominate himself, but is nominated by a caucus or a convention. Each political party has its national committee, its committee in each State, and its local committees. These committees determine the general plan of canvass or "campaign," providing, for the most part, by voluntary subscriptions for the necessary expenses. Toward these expenses the candidates are expected to make large contributions; and in many instances holders of minor offices have been made to feel that the permanency of their tenure depended upon the liberality of their contributions. The freedom with which money is expended depends upon the supposed importance of the election. In case of a hotly contested election, especially when a U. S. Senator is to be chosen by the Legislature or when there is a presidential election, the efforts of the various political committees are extended down to a personal canvass of the voters in every voting precinct. It not infrequently happens that even in the largest States the issue is determined by a very small majority. In the presidential election of 1884 the entire electoral vote of the State of New York was determined by a majority of only a few hundred, and the electoral vote of the State determined the presidential election, on which depended the tenure of more than 100,000 subordinate officials. Either human nature must be reformed or so momentous an issue must be the parent of widespread corruption. With human nature as it is, the more thorough the organization of political parties, the more intense will be the political feeling, and the more dangerous will be the political menace.

POLITICAL PARTIES IN PARTICULAR STATES.—*In Great Britain.*—The four principal parties represented in the British Parliament are the Conservatives, Liberals, Home-rulers, and Liberal-Unionists. Of these, the first two can be traced back to the early times of the monarchy, in that the earliest records reveal the existence of contests between a party of progress and a party that clung with tenacity to the established order. A clearer dividing-line appears in the reign of Elizabeth, but party designations corresponding in any respect to the present party terms were not employed till the time of the great civil war, in which Cavaliers and Roundheads may be regarded as the prototypes of the two modern groups. The latter, however, correspond more nearly to the later distinction between Petitioners and Abhorrers—terms employed in the reign of Charles II. to designate respectively those who favored the petition for the summoning of a Parliament hostile to the succession of the Duke of York, and those who, in their hatred of the Exclusion Bill, declared their "abhorrence" of the attempt to induce the king to call Parliament. These terms soon gave way to the more familiar Whigs and Tories, as the enemies and friends of the royal prerogative were respectively called; and these names continued to designate the party of progress and the party that held to established rights till, in the nineteenth century, they were replaced by the terms Liberals and Conservatives. It is not to be supposed that the party issues which divide modern Liberals and Conservatives can be found in the older distinctions between Whigs and Tories or their respective predecessors, but the same attitude toward measures of change and reform is discernible throughout all the vicissitudes of party history. The Home Rule party came into existence as a distinct political organization through the efforts of Butt and Parnell. (See HOME RULE.) By an alliance with the Liberals under Gladstone's leadership, in 1886, it made Home Rule the chief issue between the Liberals and Conservatives, and in the House of Commons of 1892 secured a majority favorable to that measure. This action of the Liberals caused the defection of an important group of members who, under the name of LIBERAL-UNIONISTS (*q. v.*), have strenuously opposed Home Rule for Ireland. A less important party than any of these is the Labor party, which is socialistic in some features. See GREAT BRITAIN (*History*) and PARLIAMENT.

In France.—While progressive and conservative elements are discernible throughout French political history, it was not till the era of the Revolution that definite party issues and party names made their appearance. Radical and moderate opposition to the old *régime* were the respective characteristics of the JACOBINS and the GIRONDISTS (*qq. v.*) during this period, while the Feuillants tried to maintain the Bourbon monarchy, but with constitutional limitations. Since that time political parties in France have passed through many changes both of name and principle. After the restoration of the Bourbons on the final overthrow of Napoleon I., there were, in addition to the Constitutional Monarchists who supported Louis XVIII., the Ultra-Royalists, or adherents of the Count of Artois, afterward Charles X., the Bonapartists, the DOCTRINAIRES (*q. v.*), and the Republicans. When the Bourbon monarchy was finally overthrown, Louis Philippe, the representative of constitutional monarchy, encountered an opposition from Bonapartists, Republicans, and Legitimists. The first of these triumphed with the elevation of Napoleon III. to the imperial throne in 1852, and the second, the Republicans, with the establishment of the republic in 1871. The death of the Comte de Chambord in 1886 made the Count of Paris of the Orleans branch the heir to the Legitimist claims, and his death in 1894 has brought the young Duke of Orleans forward as the representative of the Royalist party. This group, however, has lost much of its importance as an element of opposition to the French republic, and the Bonapartists and Radicals have shown themselves more dangerous enemies to the Government. The reactionary elements of the opposition, including both Bonapartists and Monarchists, sit together in the Chamber, and are known as the Right. The Republicans may be divided into the Opportunists, who believe in adapting their political action to circumstances rather than forcing it into conformity with certain pre-established principles, the Moderates, and the Radicals. The last of these constitute the Extreme Left, while the more moderate groups make up the Center. See FRANCE, HISTORY OF.

In the German Empire.—The leading parliamentary groups in the Reichstag after the formation of the empire were the National Liberals, who, though not in sympathy

with Bismarck's general policy, supported his efforts for unification and reform; the remnant of the Progressists (*Fortschrittspartei*), who opposed all compromise with Bismarck; the Old Conservatives, hostile even to the measure of reform that Bismarck was willing to concede; and the Free Conservatives (*Reichspartei*), who were his thoroughgoing supporters. To these were added the Ultramontane party, or Center, composed of Roman Catholics who opposed the Government's policy during the KULTURKAMPF (*q. v.*), the Social Democrats, with a socialistic programme, the Jewish members held together by racial interests; and the protesting delegates from Alsace-Lorraine. Since 1871 the representation of the Social Democrats in the Reichstag has increased from two in that year to forty-three after the election of 1893; but none of the numerous parties has increased sufficiently to secure a majority in the Reichstag. After the election of 1893 the principal parties represented in that body were, in the order of numerical strength, the Center, called also the Ultramontane or Clerical party, German Conservatives, National Liberals, Social Democrats, Radicals (*Freisinnige*), Free Conservatives, and Anti-Semites.

In Italy.—The distinction between conservatism and liberalism can not be clearly discerned in the division of Italian parties, since both the majority and the greater portion of the minority profess liberal principles. They are divided, however, on minor issues, the supporters of the ministry being known as the Ministerial Left, and the others as the Opposition Left, or the Pentarchists. The Irredentists are those who demand the annexation of "unredeemed" Italy—i. e. of the provinces inhabited by an Italian-speaking population but subject to a foreign government.

In other European countries the names and principles of the leading political parties may be briefly summarized as follows: In Austria racial and religious differences constitute the chief political issues. Thus the party of the Young Czechs desire national emancipation, to which the Germans, the most numerous element, are opposed. The chief parties in the lower house of the Reichsrath may be described as the German Liberals, the Poles, and the German Conservatives and Clericals. In Belgium the two leading parties are the Catholics, or Clericals, and the Liberals. In the Danish Rigsdag the Right, or Conservatives, hold that the lower house, or Folkething, has not the supremacy in matters of taxation and finance and in the choice of the ministers, while the Left contend that these rights are vested in that body. In the Spanish Cortes there are, in addition to the usual division into Liberals and Conservatives, the extreme Republicans and the moderate Republicans, or Possibilists. A few Carlists were returned in the elections of 1893.

In the United States.—The principal political parties in the U. S. are discussed in the articles DEMOCRATIC PARTY, REPUBLICAN PARTY, PEOPLE'S PARTY, and PROHIBITION PARTY (*qq. v.*). For an account of older political groups, see FEDERALIST, ANTI-FEDERALISTS, FREE-SOIL PARTY, and KNOW-NOTHINGS; and for the general facts of party history and the discussion of party programmes, see UNITED STATES (*History*), SLAVERY, FREE TRADE, PROTECTION, NATIONALISM, etc. On the subject of the methods of political parties in the U. S., see the articles CIVIL SERVICE AND CIVIL SERVICE REFORM and PRIMARY ELECTIONS. On the general subject of political parties, consult Wachsmuth, *Geschichte der politischen Parteiungen* (3 vols., 1856): Cooke, *History of Party in England* (3 vols., 1836); Rohmer, *Doctrine of Parties* (1844); Sidgwick, *Elements of Politics* (1891, chap. xxix.); Woolsey, *Political Science* (1878, pt. iii., chap. xiv.); Bryce, *American Commonwealth* (vol. i.).

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Political Science: the science which treats of the nature of the state, and of the principles underlying society organized for the purpose of governing itself. In accomplishing its objects political society employs force. This is what especially distinguishes it from industrial society, whose moving power is simply the desires of its individual members, and from religious society, whose motive power is likewise individualistic, acting through the consciences of its members. Of course, religious bodies have often employed force to carry out their plans, but in that case they have become political, interfering in the government of the state.

NATURE.—*The origin of the state* has been explained usually in accordance with one of three theories: First, the theological. By this God is declared to have directly instructed man how to organize government, and to have upheld government by divine intervention. Second, the contract theory. This presumes that men first lived in a state of nature, each independent of others, and with unlimited rights to all things. To keep peace and to secure the benefits of co-operation, they entered into a contract by which each gave up many of his individual rights and agreed to submit to government. Hobbes, Locke, and Rousseau, the chief exponents of this doctrine, advocate entirely different forms of government, as will be seen in the historical portion of this article, and the theory is now abandoned by scientific writers, though it still has some vogue. Third, the natural or development theory. As Aristotle says, man is a political being, formed for society. From the family, organized unconsciously under the father, grows the tribe, thence the state, assuming gradually the form of government best adapted to its needs. Man can not develop normally outside the state.

The purpose of the state may be considered either from the standpoint of its members or from that of the state as an organized unit. From the standpoint of the individual, Aristotle has well said that the state exists to enable man not merely to live, but to live well, or better, as Pollock puts it, the purpose is "complete life in the associated state." From the other point of view, Burgess, following Holtzendorff, gives three ends: the immediate purpose of securing orderly government and liberty within the state; the next end of developing the national spirit and strength; the ultimate purpose, the perfection of humanity, to be secured finally, after æons of separate national governments, in one all-inclusive world-state.

Relation of Political Science to Politics.—Ordinarily by the word politics used alone one understands the art corresponding to political science. The practice of politics, naturally, arises in governments of a low grade long before the science, and experience eventually furnishes the material from which the general principles of the science are drawn. The politician, however, or the statesman—for a statesman is simply a practical politician of the highest class—in an advanced stage of civilization has much to learn from the teacher of the science of politics, the political philosopher. The latter, from his studies, is the better equipped of the two in the knowledge of the experience of the past and in the fundamental principles of true statecraft, though it is doubtless true that he less often knows the temper of the people and the special form into which a law must be put to be adapted to their needs. The two classes of men need to work hand in hand. Neither can do his best work without the aid of the other. It has been a common fault of political philosophers to limit their studies too much to the letter of constitutions and laws. By so doing, and by thus failing to study the actual working of the laws, they have often been led into false judgments. They have failed to catch the spirit of the law. Even great writers like Montesquieu have at times failed in this regard. The chief intellectual characteristic of the political philosopher should be an unprejudiced judgment; but he needs a wide and accurate knowledge of facts as well. The business of the statesman is action—the accomplishment of some specific purpose for the good of his people. He needs chiefly knowledge of men, their motives and passions, and firmness and skill in handling the means at his disposal to bring about the desired results.

The relation of politics to morals is as difficult a topic as the political philosopher has to consider; it is one that the practical politician meets daily, and no one who is conversant with the actual working of politics doubts that many politicians treat the subject of morals differently when considering it from the standpoint of their duties as statesmen than when looking at it from their private standpoint. Few men will plant themselves openly on the side of Machiavelli, and say that when the advantage of the state is concerned the end justifies the means, however corrupt or wicked in themselves the means may be; and yet politicians—honest men—condone many corrupt practices in public life. The following is practically the view of Bluntschli on this subject: Many of the aims of statesmen may be morally indifferent, as when they favor the extension of a railway system, but they ought never to be immoral. It must be borne in mind, however, that the statesman deals with men as they are—weak, and often wicked—and that his business is to do something for the good of his people. He is a man of action. He can not, therefore, if he is to succeed, lift himself far above the level of the best average thought of his people. He ought to have high ideals; he can not hope to attain them soon. These ideals are doubtless rising among the

people, and it is the duty of the statesman to lead the people; but he can not push forward very rapidly. One would not justify the cruel acts of earlier times against prisoners of war; but we justify war itself, one of the greatest of evils and wrongs, and justifiable only on the ground that it prevents a greater evil. In modern society one of the chief purposes of the state is to effect the moral advancement of its citizens. This suggests the question whether the man whose political sagacity and skill are likely to serve the interests of the state, but whose private life is known to be immoral, is entitled to the support of conscientious citizens. The evil of an individual may possibly further the good of the whole, and in certain circumstances the statesman seems to be justified in making use of corrupt agents and evil passions to secure good results. This doctrine, however, may readily be abused.

Closely connected with this topic is the one concerning what has been called the *right of revolution.* Society develops and changes; laws once suitable become so no longer. Often to avoid an injustice they must be broken or evaded before they are changed. To suit the law to specific cases is the duty of the courts; and in its interpretation the law itself is slowly changed to meet the needs of the times. When, however, need is felt for a great change it must come, or suffering will ensue. It is one of the chief advantages of modern governments that the laws can be changed directly by the act of the people, usually without violence. In this way peaceful revolutions arise. When, however, the executors of the law have a personal interest in upholding the law, and the law, as executed, has become very oppressive, the question arises, Shall the people endure the wrong or commit the crime of overthrowing the law? Here, as before, one has but a choice of evils, and all agree nowadays that circumstances may be so onerous as to justify a bloody revolution. The law exists for the state; it must be shaped to meet the needs of the state.

The relation of political science to economics appears most clearly in the fact that the individualistic economic motive often determines the political action of the citizens. In times of war or other national crisis the patriotic impulses are apt to dominate, but in times of peace each person and each class is inclined to keep personal welfare in the foreground and to think little of the good of the state. Hence arise class legislation, political corruption, and the rule of the wealthy or of demagogues. The clashing economic interests of different classes lead to struggles for political supremacy, and by these struggles constitutions are subverted and new ones made. Contrariwise, political action is often the dominant cause in bringing about a change in economic conditions. See REPRESENTATION.

The best form of government for the state is a topic that has engaged the thoughts of philosophers in all ages. Comparative studies have led to the belief that there is no absolutely best form. Each people must have a form adapted to its special stage of civilization, character, and needs. No one doubts that the nineteenth century shows a strong tendency toward democracy, under various forms, in all civilized nations. There is also an evident tendency for the state to increase its functions and to become more active in regulating business and private life. The limit of this activity can not yet be seen.

HISTORY.—*Ancient Times.*—Aristotle may be said to be the founder of political science, and, indeed, since his day no other writer has appeared who has surpassed him in philosophical penetration and power of analysis, or even probably in extent and thoroughness of research. Before his time in the East—in India and China—there had been writings that touched the subject, especially in connection with religious teachings, but no one had formulated it. The laws of Manu in India give in detail many duties of the different castes in society, and even those of the king and courts are considered at some length, while Confucius and Mencius in China, among many other wise sayings, especially on morals and religion, give some also on the relations and duties of governments and people. Mencius even goes so far in liberal views as to declare that a people may rid itself of a king with whom it is dissatisfied. Again, he divides citizens into two classes, the head-workers and the hand-workers, but he has not treated the subject at all fully or scientifically. In early Greece Homer and Solon give wise advice on specific points; Aristophanes, in satirizing the wickedness of demagogues and the folly of the people, shows much political wisdom. Socrates rendered important service to the science by his discussions on ethics as applied in political life. Plato, in his *Republic*, and especially in the *Laws*, treats the subject at considerable length, though not systematically. In the *Republic* he gives us an ideal state. He does not pretend to consider the state as it is, or even to consider men as they are; rather he writes a romance showing a state and men as he might wish them to be. In the *Laws* he discusses the subject of government with much more regard for actual affairs, and, in fact, in both works there are wise suggestions for statesmen and many good ideas that might bear fruit in experience. For example, though the mental and physical education of the young can not wisely be directed in all respects as Plato advises, the importance of the proper training of the young, if one would have a successful state, can not be overlooked. It would not be well, perhaps, to have philosophers the sole governing class, with the other classes under their control, as he suggests; it would be well to have rulers, by whatever means selected, wise. The family can not be abolished, as Plato wishes. He is right in thinking that, in great part, at least, justice is the true end of the state, and that the true strength of the state lies in virtue.

In Aristotle we find thorough preparation for his work, the proper method, wonderful insight, and completeness in his treatment. He had collected, arranged, and digested, it is said, 360 different constitutions; and with this mass of facts at hand he formulated his general principles. He analyzes into their elements the state and government. He traces the influence of the various factors of which the state is composed, and their relations to one another. His idea regarding the origin and nature of the state is summed up in the words, man is a political being. This contains what is true regarding the divine origin of the state; it implies all that is true regarding the theory of the social contract. Man was created to live in society, and with a nature that develops only there. Society begins without special intent of man. As he develops his acts become more and more conscious, and politics becomes an art as well as a science; civilized government is based in great part upon contract. Aristotle classified governments into monarchies, aristocracies, and democracies, a division followed since his day, though the mixed forms of the present day render it now of doubtful utility for modern use, the names often not conforming to the reality. He rightly, too, saw that the chief danger to each form of government was in the abuse of its principle, the carrying of its principle so far that it would become unbearable. The chief danger of a democracy, for instance, is that democracy will be carried to the extent of anarchy, when the people will demand a strong hand to restore tranquillity. The monarchy, too, is in danger of becoming a tyranny, as he said, that in its turn must be overthrown. In France, since the days of Mazarin, this principle of Aristotle's has been exemplified more than once. From the nature of Greek civilization Aristotle was unable to see the evil of slavery. Instead of that, he seems to consider it a necessity and even a blessing. His doctrine of natural slavery—that some men are born to command, while others, from their natures, are incapable of self-direction—has in it much truth, and is an advanced criticism on the practice of his time. In the philosophical schools established after Aristotle's time there are hints of some of the later doctrines. The Cynics protested rightfully against the too great exaltation of the state by Plato and Aristotle. The Epicurean doctrine, by leading men away from public life, had a like tendency. Epicurus, too, may be fairly considered the precursor of Hobbes in the enunciation of the doctrine of the social compact. The Stoics laid down and emphasized the principle of natural justice that played so great a *rôle* in later times. Cicero, Marcus Aurelius, Epictetus, and others, in their writings on ethical subjects, exposed the weakness of the slave system, while Cicero, Polybius, and the jurisconsults of the empire, discussed with effect the forms of the state, the nature of law, etc., though generally with little advance on the doctrines of Aristotle.

Christianity and the Renaissance.—Although Christianity may be said to have revolutionized the politics of the world, the purpose of Christianity was not political. Christ stated that his "kingdom was not of this world," and the disciples taught men to "be subject unto the higher powers." The doctrine of absolute submission to the will of God and the founding of a spiritual "kingdom" with Christ as its supreme head show nothing different in purpose from the old Jewish political theories. Practically, however, when the "kingdom" is made a spiritual kingdom solely, and when the decision as to the duty of every individual regard-

ing this kingdom is left to himself to make, and he is held individually responsible for his beliefs and his acts, we have an entirely new principle. Individual responsibility and the equality of all are democratic principles that, if carried out in the religious world, will certainly make themselves felt ultimately in the political world. The manifestation, however, of the force of this principle did not make itself felt until about the beginning of modern history, and not until recent times has it been of prime consequence in the political world. The early Christians contented themselves with keeping Church and state apart, and with looking after the moral and religious life. When at length the state became Christian, however, the question of supremacy arose; and the struggle between Church and state lasted throughout the Middle Ages. Thomas Aquinas was the most illustrious writer on one side, as was Dante on the other.

With the Renaissance came a new spirit into all fields of learning, and in Machiavelli political science found an admirably equipped exponent of the political doctrines of his day and a writer whose teachings have had a great influence. He was a man of wide experience in political matters and of keen insight into human nature and the real character of political problems. He did for political science the great service of separating in thought the field of politics from that of morals. In political practice the statesman can not afford to neglect the moral sentiment of his people nor to favor immoral practices. It is, nevertheless, very important for the student of political science to distinguish the two fields, and to be able to look at political problems from the standpoint of only the advantage of the state. This Machiavelli did more completely, probably, than any other writer. He sets out in the *Prince* the way in which a ruler, under various circumstances, should act in order to hold and to strengthen his government, and in giving these counsels he halts at nothing, however bad. If they can strengthen the ruler, as he thinks they can under certain circumstances, he advises hypocrisy, treachery, oppression, and murder. See MACHIAVELLI, NICCOLO DI BERNARDO.

Modern Times.—The Reformation emphasized the principle of individual responsibility as it had never before been emphasized, and this brought about a freer discussion of religious and, naturally, also of political principles. Protestants first, and then Catholics, questioned the rights of kings and peoples, and then first the question of sovereignty and where it rests was propounded, the question that since then has been the central one in political philosophy. There were many writers on all sides—Luther, Melanchthon, Reuchlin, Colet, More, Erasmus, Politian, Suarez, Calvin, Bacon. The most illustrious was Bodin, whose great work *Les Livres de la République* in method and extent may be compared with those of Aristotle and Montesquieu, for he, too, studies historically, and attempts to base his opinions on a wide knowledge of facts. He criticises Aristotle on many points, sometimes effectively, sometimes not. He exposes well the weakness of slavery, and his denunciation comes with more force from the fact that slavery was then rapidly on the increase, owing to the discovery of America nearly a century before. His discussion of sovereignty is able, and though in attempting to discover the best form of government he takes sides in favor of monarchy, he yet recognizes so well the weaknesses as well as the strong points of each form that he can not be considered partisan or narrow-minded. In his opinion every form of government should be subject to divine law. He is a vigorous opponent of Machiavelli, declaring that justice is the strongest support of all governments, and that the governor is bound at any rate to do justice. He has also rendered a valuable service to the science by his careful distinction between public and private law.

The English revolutions were indirectly the cause of the two greatest works on political science of the seventeenth century. When the doctrine of the divine right of kings had been pushed to an extreme in practical politics by the house of Stuart, its weakness was shown by the decapitation of Charles I. and the forced abdication of James II. Naturally the violent controversies of the day led the thinkers of both schools to formulate their doctrines and to defend the actions of their parties by an appeal to reason. Hobbes, in his *Leviathan*, defends absolutism. In a state of nature, which seems to him to be a state of natural warfare, each man has a right to defend himself. To secure peace and protection each one surrenders this right to a common ruler. This surrender is complete and irrevocable; the ruler therefore is absolute, subject only to the law of God. See HOBBES, THOMAS.

Many others wrote on the side of Hobbes, notably Filmer, and many wrote refutations of his opinions. The best work of the latter kind, though it was directed especially against Filmer, and the one that had by far the most influence, was the *Essay on Civil Government*, by John Locke. Locke starts, as does Hobbes, from the state of nature; but the state of nature in his judgment exists between men whenever there is no superior power to determine their possible disputes. This state is not necessarily a state of warfare, for there are rights which exist among men even without government—natural rights which have their corresponding obligations recognized by all even where civil law does not exist. Among these natural rights are the right of property, the right of liberty, the right to labor. Society is formed by contract, to be sure, to protect and carry out these rights, but it is not formed by the renunciation of these rights to a ruler. Rather the ruler is the instrument in the hands of the people to enforce these natural, but still retained, rights. One readily sees the conclusions that are drawn from such premises. He founds the right of property upon labor, a new doctrine then, and one tending most strongly toward upholding the control of the House of Commons over the royal purse. He, of course, attacks slavery as subversive of one of the natural rights. Most pointed of all at the time, and most closely applicable to the situation, is his doctrine of the right of revolution—if the king fails in his duty to the people, they may depose him.

Montesquieu, in his *Esprit des Lois*, furnished one of the most learned works on the subject of political science. "History explained by laws and laws by customs; the secrets of the customs sought for in the hidden instincts of human nature, in the mode of development of each society, in the influence of climate, and in the particular needs created for each nation by its geographical position; all the differences of race, genius, and legislation ranged in harmonious order; the science of government, which embraces morals, religion, commerce, and industry, and withal, order, method, and perspicuity, joined to an ever-present consciousness of the grandeur of man, of the responsibility of the powerful, of the rights of the oppressed, and a vigorous love of justice and right"—these are some of the merits claimed for the work by its admirers. In it are found some wrong interpretations of facts, but it is filled with valuable information, with profound reflections, and has been probably the most influential work in modern practical politics. Montesquieu's interpretation of the English Constitution, with his strong advocacy of the doctrine of the separation of the legislative, judicial, and executive powers, has been generally followed until within a few years, and it doubtless had direct influence in shaping the Constitution of the U. S. American thinkers are inclined to believe in the desirability of this separation of powers, as did he; but the experience of Great Britain has led many to question its wisdom, and it is doubtful if now a majority of writers on political science will be found in agreement with him. His theory as to the principles of governments, in which he makes monarchy rest upon honor and democracy upon virtue, i. e. patriotism and love of equality, is very suggestive and contains much truth. His views as to corruption in governments and as to the dangers from corruption that surround democracies can not be kept too closely in mind. His view of popular liberty is that of to-day, and to him is due the credit of having established it as a principle. His method was right. His thoughts, that one must carefully study the human passions that underlie political forms; that the forms of government were relative to climate, stage of civilization, surrounding people, etc.; the theory of the division of powers and of checks and balances in government, were important services rendered to the science.

Jean Jacques Rousseau, in his *Contrat Social*, elaborated the doctrine of the social contract that had been propounded by Hobbes and developed in another direction by Locke. Before examining the act by which a people choose a king, he thinks it wise to examine the process by which people become a people. "To find a form of association which shall defend and protect with the public force the person and property of each associate, and by means of which each, uniting with all, shall obey, however, only himself, and remain as free as before" is his problem. Each citizen in his state loses natural liberty, but gains civil liberty. The general will controls all. The contract is among the people. The relation between people and king is not a

contract, but a business method that the people can change at will. Any form of government may do, so long as people really keep control. Indeed, unless the people are good and intelligent, a republic is perhaps not suited to them. He thinks that all the people should come together periodically to vote (*a*) whether they wish to keep the present form of government, and (*b*) whether they wish to leave the government in the hands of the present rulers.

To his teachings regarding the omnipotence of the people, set before the people in attractive form and widely read, is ascribed by many a great influence in forming a theory for the French Revolution.

The economists of the close of the eighteenth century and of the first half of the nineteenth, by their doctrine of free trade, which resulted in extreme *laissez-faire* doctrines, exercised a great influence over political thought and theories, which has not yet ceased. This doctrine tended toward individualism, springing from the theory that the interests of the state coincide with those of individuals, without sufficient consideration of the frequent hostility of private interests to one another. Later in the century the rise of the socialistic school gave a new turn to political as well as to economic thought, and as a consequence the great question of political science of to-day is to fix the limits of the activity of the state. On the one hand, the individualists think that the state should exert only what may be called its police power, securing to each safety of property and liberty to work as he will, but taking no initiative in industrial enterprises. On the other hand, the socialists or nationalists wish to put all industrial control, and even all capital, into the hands of the state for management. Both seek equally the good of the greatest number, or, perhaps, more accurately stated the greatest good of all; both claim to base their theories on justice.

Among other modern writers who have contributed to the advancement a few require especial mention. Bentham and Austin, in England, did much in expounding the theory of sovereignty and law, and in effecting legislation along criminal and economic lines. De Tocqueville, in his *Democracy in America*, attempted to show by an examination of the real working of democracy in the great republic the fundamental principles of that form of government. The work is of great value from the standpoint of information as well as of philosophical criticism, though it may now be said to be superseded in great part by the work of James Bryce, *The American Commonwealth*. Bluntschli in Germany, Lieber in the U. S., and Laveleye in Belgium rendered distinguished service in expounding political principles. Herbert Spencer, in his *Political Institutions* and in his great collection of facts regarding various societies, better than any other writer of the day, perhaps, may be said to have formulated a general theory, and to have thrown light upon the origin of political institutions, though on this last point some of the writers on anthropology have done as good work. Space will not permit the enumeration of the long list of names that might be cited as those of living writers in this field, for the present day is one of active investigation, and many works of great value have been produced. The tendency seems to be toward study of special problems and separate states rather than toward general philosophical works, though two or three of the later writers, especially in connection with sociology, seem to be preparing to formulate again with ability the general principles of politics.

Authorities.—The best authorities are, of course, the works of the great writers, the best of whom have been mentioned. The best general commentary covering the whole field is Paul Janet's *Histoire de ta science potitique dans ses rapports avec la morate*. Besides may be mentioned Burgess, *Political Science and Comparative Constitutionat Law*; Pollock, *History of the Science of Potitics*; Bluntschli, *Lehre vom Modernen Staat* (the first volume has been translated into English under the title, *The Theory of the State*); Woolsey, *Potitical Science*; Lieber, *Civil Liberty and Self-government and Political Ethics*. Lalor's *Cyclopædia of Political Science* contains many excellent articles on the various branches of the subject.

Jeremiah W. Jenks.

Polity, Ecclesiastical: the form, system, and method of Church government. There are three general plans of such government, each of which has been advocated on the ground that it is the plan laid down in the New Testament for the perpetual conduct of the Church. There is, however, a growing agreement among Protestant scholars to concede that the New Testament can not be quoted for any one plan exclusively. The three plans named are in their historic order: 1. The *Presbyterian*, or government by presbyters, or elders, also styled bishops, all the clergy being on a level, these officers coming directly from the synagogue, and historically from the earliest constitution of the Hebrew people. (See Presbyter and Presbyterian Church.) 2. The *Congregational*, according to which each congregation regulates its affairs and settles its belief independent of control by other congregations, although such are called in for consultative purposes and joint action. (See Congregationalism.) 3. The *Episcopalian*, or government by bishops who constitute an order superior to the presbyters and deacons. (See Bishop.) Originally it would seem that the bishop was merely the presiding elder over the board of elders which governed the local church; then he was the permanent president, then raised above the other elders. In the Ignatian Epistles (A. D. 107–18) this distinction between presbyter and bishop is first made. The next step is the development of the diocese, or the union of several congregations under one bishop. This phenomenon comes out in Irenæus (d. about 200), Tertullian (d. 240), and especially in Cyprian (d. 258). Then came the metropolitan and patriarchal system, when the union of Church and state had been effected under Constantine (d. 337). The metropolitans were styled archbishops in the West. They were the bishops of the chief cities and presided over the bishops of the adjacent province. The patriarchs were the Bishops of Alexandria, Antioch, Rome, Jerusalem, and Constantinople, and had the oversight of two or more provinces. They ordained the metropolitans. The Greek Church has five patriarchs, but substituted the Patriarchate of Moscow for that of Rome. The Bishop of Rome protested against the action of the Fourth Œcumenical Council (Chaleedon 451, *Can.* 28, cf. Hefele ii., 527, *seq.*) in putting the Bishop of New Rome (Constantinople) on a level with him of Old Rome, and the conflict of the East and West Churches may be said to have thus begun. So came about the final development and the highest of the episcopal idea. The Bishop of Rome became the pope, and since 1870 the infallible pope, superior to patriarchs, metropolitans, and bishops, the successor of St. Peter, and the head of the Universal Church.

The Church of England is episcopal in government, and claims apostolic succession. It is governed by two archbishops—Canterbury and York—under the supremacy of the sovereign. The Church in the U. S., as the Episcopal denomination prefers to be called, and the branches of the Church of England are also episcopal. The bishops of the Swedish and Danish Lutheran Churches, of the Moravians, Methodist Episcopal, United Brethren in Christ, Evangelical Association, and other denominations are properly superintendents, and no divine right is predicated of them.

The Presbyterian plan is adopted by Reformed bodies which do not call themselves Presbyterian. It is usually linked with Calvinistic theology. The Congregational plan in like manner is adopted by those who are not styled Congregationalists, as the Baptists, Disciples of Christ, Unitarians, and Universalists.

Literature.—For the New Testament polity, see G. A. Jacob, *The Ecclesiastical Polity of the New Testament* (London and New York, 1871; 3d. ed. 1894); E. Hatch, *The Organization of the Earty Christian Churches* (1881; 2d ed. 1888) [advocates the Greek origin of the Church polity]; for Presbyterian view, see Charles Hodge, *Discussions in Church Polity* (New York, 1878); A. T. McGill, *Church Government* (Philadelphia, 1890); for the Congregational, H. M. Dexter, *Congregationatism* (Boston, 1865; 5th ed. 1879); G. T. Ladd, *The Principles of Church Polity* (New York, 1882); and for the Episcopalian, see Francis Vinton, *Manual Commentary on the General Canon Law and Constitution of the Protestant Episcopal Church in the United States* (1870). Samuel Macauley Jackson.

Poliziano (Lat. *Politianus*; Eng. *Potitian*), Angelo: humanist and poet; b. at Montepulciano (whence his own name), July 14, 1454; d. at Florence, Sept. 24, 1494. In 1469 he was sent to Florence to study, and had as his masters several of the most renowned scholars of the time; attracting the attention of Pietro de' Medici, he was made the school-companion of the latter's son Lorenzo. Here began the lifelong intimacy of the scholar with the great Florentine family. At eighteen years of age he began a Latin version of the *Iliad*, which, so far as it was finished (5 books, of

which, however, the first was by Marsuppini), showed marvelous facility. Even earlier he had tried his hand at both Greek and Latin verses—epigrams, elegies, odes—and these he wrote with great ease and brilliancy all his life. He was the first modern whose command of both classic tongues was so great that he could freely clothe his thought in either. Not less remarkable was his passion for exact scholarship. He toiled unremittingly on the text of the ancients, employing as aids inscriptions and coins, as well as manuscripts. Particularly important were his labors on the text of the famous manuscript of the *Pandects*, which Florence had taken from Pisa, as Pisa from Amalfi. He translated from Greek into Latin Epictetus, Herodian, Hippocrates, Galen, Plutarch's *Eroticus*, Plato's *Charmides*, and portions of other authors. At the age of twenty-six he was made Professor of Greek and Latin Eloquence in the studio, or university, at Florence; and his lecture-room was frequented even by his own former masters. To these audiences were read his introductions to his courses (*prælectiones*), several of them in verse, in which he discussed and praised that form of literature represented by the author about to be expounded. This success aroused the jealousies of other scholars; and when in 1489 Poliziano printed a collection of critical notes to classical authors (*Miscellanea*), he was speedily assailed by Giorgio Merula, Bartolommeo Scala, Michele Marullo, and other humanists. The strife lasted till his death. Poliziano was also one of the most important Italian poets of the fifteenth century. He was a spirit eager for beauty, delighting in nature, gifted with imaginative sympathy for the loveliness to be found even in simple things, and, though he was essentially a court poet, it was not as subservient or adulatory that he praised his friends as well as masters, the Medici. His first important work in Italian, *L'Orfeo*, which was recited in Mantua in July, 1471, is the earliest Italian secular drama extant. Later this was remodeled, probably by one Antonio Tebaldeo, into a regular tragedy in five acts. Probably in 1475, in honor of a splendid tournament held in Florence, Poliziano began his *Stanze per la giostra del magnifico Giuliano di Piero de' Medici*—left unfinished, however, perhaps because of the death of Simonetta Cattaneo, whom Giuliano loved and the poet sang. Still more gracious and lovely than these longer works are the *rispetti* and *ballate* which the poet wrote under the inspiration of the naïve popular songs of Tuscany —*strambotti*, *rispetti*, etc. Like many scholars of his time, Poliziano, though not a priest, enjoyed benefices and emoluments of the Church. He became secular prior of the Church of San Paolo in Florence, and in 1486 was made canon. Only his premature death prevented his becoming a cardinal. The *Opera Angeli Politiani* were published at Lyons (3 vols., 1536–46). G. Carducci edited, with excellent introduction, *Le Stanze, l'Orfeo e le Rime* (Florence, 1863); and I. del Lungo, the *Prose Volgari e Poesie Latine e Greche* (Florence, 1867). The best *Life* is the Latin one of F. O. Menckenius (Leipzig, 1736). See also A. Gaspary, *Geschichte der italienischen Literatur*, vol. ii., p. 213, *seq.* (Berlin, 1888); and J. A. Symonds, *The Renaissance in Italy*.

A. R. Marsh.

Polk, James Knox: eleventh President of the U. S.; b. in Mecklenburg co., N. C., Nov. 2, 1795, of Scotch-Irish stock originally named Pollock; was a grand-nephew of Col. Thomas Polk, celebrated in connection with the Mecklenburg Declaration (*q. v.*); removed to Tennessee with his father, Samuel Polk, 1806; graduated at the University of North Carolina 1818; studied law in Nashville with Felix Grundy (*q. v.*); was admitted to the bar 1820; was a member of the State Legislature 1823–25; acquired prominence as a lawyer; was elected to Congress 1824, and continuously re-elected until 1839; was an able speaker and debater; conspicuous as an opponent of the administration of Adams, of all Federal appropriations for internal improvements, of protective tariffs, and of the national bank; was an early and influential supporter of Jackson, whose conduct in the removal of the deposits he vindicated in the session of 1833–34, being then chairman of the committee of ways and means; was defeated as a Democratic candidate for Speaker 1834, but elected 1835, and re-elected 1837, presiding over the House with dignity and ability; was Governor of Tennessee 1839–40; was proposed by the Legislatures of Tennessee and of other States 1840 as a suitable candidate for Vice-President of the U. S., but received only one electoral vote. He was defeated in 1841 as a candidate for re-election as Governor; was nominated by the Democratic national convention at Baltimore (May 27, 1844) for the presidency in opposition to Henry Clay, and elected by 170 electoral votes against 105, the chief issue being the annexation of Texas, which was accomplished by the expiring administration of Tyler the day before Polk's inauguration, Mar. 4, 1845. President Polk formed an able cabinet, consisting of James Buchanan, Robert J. Walker, William L. Marcy, George Bancroft, Cave Johnson, and John Y. Mason; settled the Oregon boundary question; created the Department of the Interior; succeeded in carrying the low tariff of 1846: reorganized the financial system of the Government; and conducted the Mexican war, which resulted in the acquisition of California and New Mexico and had far-reaching consequences upon the later fortunes of the republic. The annexation of Texas caused, as had been predicted, an immediate rupture between the U. S. and Mexico. On June 4, 1845, President Herrera of Mexico issued a proclamation declaring the right of Mexico to the Texan territory, and his determination to defend it by arms if necessary. Fully aware of the hostile feelings of the Mexicans, President Polk ordered Gen. Zachary Taylor, then in command of the U. S. troops in the Southwest, to go to Texas and take up a position as near the Rio Grande as prudence would allow, that river being regarded by the U. S. as the boundary between Mexico and Texas, while the Mexican Government claimed jurisdiction to the Nueces. In September Gen. Taylor formed a camp at Corpus Christi, and there he remained during the autumn and winter; but in Jan., 1846, he was ordered to move his camp to the Rio Grande, opposite the city of Matamoras. There he was attacked by the Mexicans, but defeated them; and on May 11, 1846, Congress declared that "by the act of the republic of Mexico a state of war exists between that Government and the U. S.," authorized the President to raise 50,000 volunteers, and appropriated $10,000,000 for carrying on the war. It was prosecuted with great energy, and lasted two years. Declining to seek a renomination, Polk retired from the presidency Mar. 4, 1849, when he was succeeded by Gen. Zachary Taylor; retired to Nashville, and died there June 15, 1849. Without being possessed of extraordinary talents, he was a capable administrator of public affairs and irreproachable in private life. Revised by F. M. Colby.

Polk, Leonidas: bishop and soldier; b. at Raleigh, N. C., Apr. 10, 1806; graduated at the U. S. Military Academy, and entered the artillery July, 1827; resigned Dec. 1, 1827; in 1831 was ordained in the Protestant Episcopal Church; was missionary bishop of Arkansas and the Indian Territory S. of 36° 30′, with provisional charge of the diocese of Alabama, Mississippi, and Louisiana, and missions in the republic of Texas 1838–41; bishop of Louisiana 1841–61. In 1861 he accepted the appointment of major-general in the Confederate army—without, however, resigning his bishopric—and was placed in command of the districts along the Mississippi from the mouth of the Arkansas to Paducah, on the Ohio; Fort Donelson and Fort Henry were constructed under his direction. He subsequently commanded a division in the West; at Murfreesboro', Chattanooga, Chickamauga, and in the Georgia campaign of 1864 commanded a corps, ranking then as lieutenant-general. He was killed by a cannon-shot at Pine Mountain, Ga., June 14, 1864. See *Leonidas Polk, Bishop and General*, by W. M. Polk, LL. D. (2 vols., New York, 1893). Revised by James Mercur.

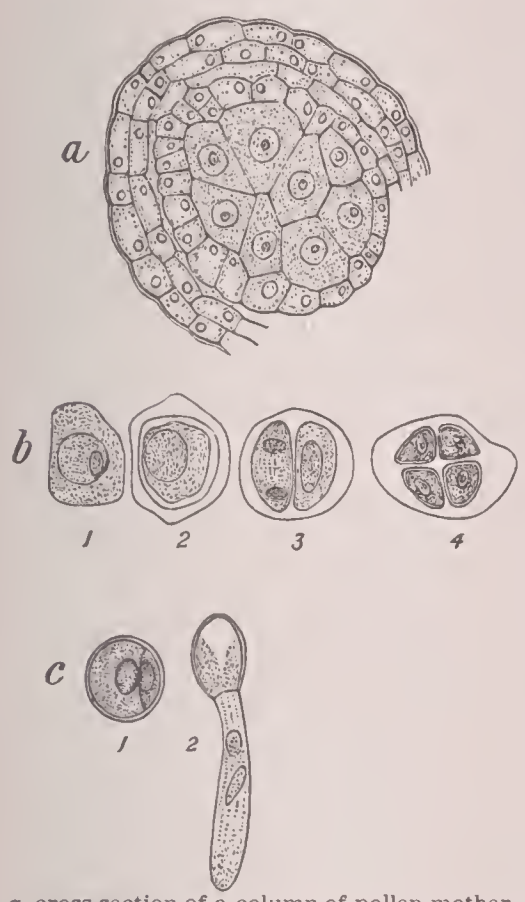
Polko, Elise: story-writer; b. at Leipzig, Jan. 31, 1823; a sister of the African traveler Edward Vogel; was trained under Garcia as an opera-singer, and appeared on the stage in Frankfort; after her marriage left the stage and devoted herself to literature, living at Minden and subsequently at Deutz, on the Rhine; made her *début* by her *Musikalische Märchen* (1852), which afterward grew into a whole series, comprising many volumes. Among her other works are *Neue Novellen; Ein Frauenleben* (1854); *Aus der Künstlerwelt; Erinnerungen an Felix Mendelssohn-Bartholdy* (1868; translated into English by Lady Wallace, 1869); a *Life* of her brother; *Plaudereien* (1872–73); *Aus dem Jahre 1870; Neues Märchenbuch* (1884); and several books for children. D. in Munich, May 29, 1899.

Pollaiuolo, pol-lăă-yoo-ō′lō, Antonio: painter, sculptor, goldsmith, and engraver; b. at Florence, Italy, in 1429. He studied under Bartoluccio, the stepfather of Lorenzo Ghiberti, who employed him in modeling the ornaments of the architrave of the central gates of the baptistery of Florence. After this he worked on his own account as a goldsmith. Vasari asserts that he was the first artist who dissected the

dead body for art instruction. He devoted himself to painting after he had attained much success as a sculptor, and was one of the earliest Florentine artists who used the oil medium. D. at Rome, Feb. 14, 1498. W. J. Stillman.

Pollaiuolo, Piero: painter; b. at Florence, Italy, 1443; brother of Antonio Pollaiuolo. Vasari says that the younger Pollaiuolo was a pupil of Andrea del Castagno, but this is doubtful. The two brothers generally worked conjointly, Antonio furnishing the design and Piero carrying it out in color in many instances. D. in 1496. *The Martyrdom of St. Sebastian* in the London National Gallery is supposed to have been the work of both brothers. It was painted for the Pucci chapel in Florence, and finished in 1475. Piero designed the Belvedere Palace built by Innocent VIII. He was a medalist also, and an engraver; his works in this branch surpassed all others of his time. W. J. Stillman.

Pollen [from Lat. *pollen*, fine flour or dust]: the dust-like cells produced in the anthers of flowers. They are developed as follows: When the anther is still young the cells in (usually four) longitudinal columns undergo internal division, each into four daughter-cells (see Figures, *a*, *b*) and these cover themselves with a coat of cellulose, at first thin, but later thick and separable into an outer and an inner wall. In the meantime the wall of the mother-cell usually deliquesces, and the pollen-cells are set free within the anther. Later the anther opens (usually by splitting longitudinally) and the pollen falls out as a yellowish, sometimes whitish powder. In some cases the pollen-cells adhere more or less to one another by a sticky substance in masses of considerable size, as is seen in milkweeds and orchids.



a, cross-section of a column of pollen mother-cells; *b*, development of pollen-cells from a mother-cell; *c*, the two nuclei in pollen-cells, one cell germinating. All highly magnified.

In the study of the comparative anatomy of plants it is seen that the pollen-cell is the homologue of the microspore of the higher fernworts, and some botanists now use this term in preference to the old one of pollen-cell. Before germination the pollen-cell has two nuclei—namely, the "vegetative" and the "generative" nuclei, the former the sole representative of the prothallium (*c*). In gymnosperms there are usually two or more fully formed vegetative cells. See, further, the articles Botany, Flower, and Physiology, Vegetable.

Charles E. Bessey.

Pol'lio, Gaius Asinius: orator and author; b. at Rome in 76 B. C.; began his career as an orator; sided in the war between Cæsar and Pompey with the former, whom he accompanied from the Rubicon to Rome, and again on the march to Pharsalia; commanded in Spain against Sextus Pompeius; was consul in 40 B. C., during the first triumvirate; made a successful campaign in Illyria in 39; retired from public life, and devoted himself to literary pursuits; was a friend of Vergil, Horace, and Catullus; founded the first public library in Rome, and wrote a history of the civil war in seventeen books, which is lost. He was also a poet and literary critic. D. 5 A. D. Three letters from him to Cicero have been preserved, and a few fragments of his orations. As an orator he enjoyed a very great reputation; his contemporaries ranked him next to Cicero and on the same line as Cæsar and Brutus. He was very young when he attracted great attention by his accusation of C. Cato, who as tribune, in 56 B. C., had committed numerous illegal acts in favor of Pompey and Crassus. Afterward he defended the rhetors Moschus and Apollodorus, who were accused of poisoning their relatives for the sake of the inheritance, and he continued to plead to the last. His speeches were always very carefully prepared. He was especially anxious to eliminate anything vague or superfluous, avoiding the redundancy of Cicero, whom he sharply criticised; but his austere taste sometimes made him dry, a quality which became still more visible among his pupils and imitators. He was fond of archaic and poetic expressions, and Landgraf and Wölfflin attribute to him the *Bellum Africum*, but this is still a disputed question. He introduced the custom, afterward so common, of reciting his writings to an audience of friends. See J. H. Schmalz, *Ueber den Sprachgebrauch des Asinius Pollio* (Munich, 1890); also Wölfflin, *Archiv für Lat. Lexikographie* (vi., 84–106); Landgraf, *Untersuchungen zu Cæsar und seinen Fortsetzern* (Erlangen, 1888); and Wölfflin and Miadoński, *Polionis de Bello Africo Commentarius* (Leipzig, 1889). Revised by M. Warren.

Pollock: See Coalfish.

Pollock, Sir Charles Edward: lawyer and author of legal works; b. Oct. 21, 1823; son of Sir Frederick Pollock; studied law under Justice Willes and was called to the bar in 1847; made queen's counsel in 1866; appointed baron of the exchequer in 1873, and knighted in the same year. Besides other writings he published a *Compendium on the Law of Merchant Shipping* (jointly with Frederick P. Maude; 4th ed. London, 1884) and a *Treatise on the Power of the Courts of Common Law to Compel the Production of Documents for Inspection*. D. in London, Nov. 21, 1897. F. S. A.

Pollock, Sir Frederick: lawyer; b. in London, England, Sept. 23, 1783: graduated at Cambridge 1806; studied law at the Middle Temple, and was called to the bar Nov., 1807; had great success in his profession; became king's counsel 1827; sat in Parliament for Huntingdon 1831–44; was knighted Dec., 1834; was attorney-general during the first and second administrations of Sir Robert Peel; chief baron of the court of exchequer and privy councilor from Apr., 1844, to 1866, when he retired with a baronetcy. D. at Hatton, near London, Aug. 23, 1870.

Revised by F. Sturges Allen.

Pollock, Sir Frederick: jurist; b. Dec. 10, 1845; grandson of Sir Frederick Pollock. He was educated at Cambridge University, and was called to the bar at Lincoln's Inn in 1871; has been several times examiner in law at Cambridge University and in other universities; Professor of Jurisprudence at University College, London, 1882–83; Professor of Law in the Inns of Court 1884–91; Corpus Professor of Jurisprudence at Oxford University since 1883; lecturer in the University of Calcutta 1893–94. He has been editor of *The Law Quarterly Review* since 1885, and of the revised reports since 1891. He has written much for periodicals upon jurisprudence and legal ethics, and is a leader in the modern school of historical and analytical law writers. His most important works are *Principles of Contract* (6th ed. 1894); *The Law of Torts* (4th ed. 1894); *A Digest of the Law of Partnership* (5th ed. 1890); *The Land Laws* (2d ed. 1887); *Spinoza, his Life and Philosophy* (1880); *The Law of Fraud, Misrepresentation, and Mistake in British India* (1894); *Leading Cases done into English, and Other Diversions* (1892); *Essays on Jurisprudence and Ethics* (1882). F. Sturges Allen.

Pollock, Walter Herries: journalist; b. in London in 1850; brother of Sir Frederick Pollock, jurist. He graduated at Cambridge, in 1871, and was called to the bar in 1874. In 1884 he became editor of *The Saturday Review*. Author of *Lectures on French Poets* (1879); *Songs and Rhymes* (1882); *The Picture's Secret* (1883); *Verses of Two Tongues* (1884): and (with Lady Pollock, his mother) *Amateur Theatricals* (1880). H. A. Beers.

Pol'lok, Robert: poet; b. at Muirhouse, Renfrewshire, Scotland, in 1799; graduated at the University of Glasgow; studied theology, and was licensed as a preacher of the United Secession Church 1827. D. at Southampton, Hants, Sept. 17, 1827. Author of *Tales of the Covenanters* (1823) and of *The Course of Time* (1827), a poem in blank verse which gave great promise of future excellence. It became extremely popular in Great Britain and in the U. S., where for many years it was used in schools as a parsing-book.

Poll-tax: See Finance.

Pollux: See Castor and Pollux.

Pol'lux (in Gr. Πολυδεύκης), Julius: scholar; b. at Naucratis, Egypt, about 130 A. D.; lived in Athens as teacher of rhetoric and philosophy. His *Onomasticon*, edited by Dindorf (Leipzig, 1824) and Bekker (Berlin, 1846), is a kind of dictionary in which the principal words relating to certain subjects are collected into groups, defined, and illustrated by quotations. The work is of manifold interest to the student of the Greek language, literature, and art.

Po'lo: a modern adaptation of the Persian game of *chaugán*, the origin of which is unknown. It was introduced into Great Britain in 1869, from India, by officers of the Tenth Hussars; into the U. S. in 1876 by James Gordon Bennett; and in 1883 a flourishing club was started in Mexico city. It has earnest supporters in Africa and Australia, while in Great Britain it has long been a recognized sport. The game is an old one in Tibet, and the Japanese have a very similar form of recreation in *daiku*.

Briefly, polo is simply playing the game of "hockey" or "shinny," on horseback. The game consists in knocking a ball, with a stick having a crook or "mallet" at its end, from one goal to another, these goals being some 8 yards wide and about 250 yards apart at opposite sides of a level rectangular field. The players, four upon each side, are mounted on ponies. By the rules of the New York club the height of the ponies is limited to 14 hands, and the "mallets" to be used must be 4 ft. 4 in. in length. The ponies used are "hogmaned," and have their tails cut short. The game is extremely rough, and accidents upon the field are numerous. Because of the expense attached to securing and keeping "mounts" the game is confined to the wealthier classes.

Roller-polo came in with roller-skating rinks, with rules adapting it to skaters and indoor playing.

Water-polo seems to have no logical connection with polo proper, it being a game played by swimmers. Sides are chosen, and the attempt made while swimming to force a football through the opponents' goal. This game has generally been confined to the baths in the larger gymnasiums.

E. Hitchcock, Jr.

Polo: city; Ogle co., Ill.; on the Burl. Route and the Ill. Cent. railways; 12 miles N. of Dixon, 23 miles S. of Freeport (for location, see map of Illinois, ref. 2–E). It is in an agricultural region; contains a high school, the Buffalo Public Library (founded in 1871), a national bank with capital of $65,000, a private bank, a semi-weekly and a weekly newspaper, and manufactories of agricultural implements and buggies; and ships large quantities of cattle and hogs. Pop. (1880) 1,819; (1890) 1,728; (1900) 1,869.

Polo, Gaspar Gil: romancer; b. at Valencia, Spain, probably about 1540; little is known of his life. Most likely he is the same Gaspar Gil Polo who held the second professorship of Greek in the University of Valencia from 1566 to 1574. He seems also to have had legal training, for he appears in Valencian documents of 1571 to 1573 with the title of "Notario." He died probably before 1591. His fame is due to the fact that he published at Valencia, in 1564, a continuation of the *Diana Enamorada* of Montemayor (*q. v.*). This passed through many editions in Spain, and was translated into several other languages—e. g. English, by Bartholomew Yong (with Montemayor's *Diana*, 1598); Latin, by Caspar Barth (under the title *Eroto-didascalus sive Nemoralium libri V.*, Hanover, 1625). Cervantes esteemed Polo's work more highly than Montemayor's (cf. *Don Quijote*, i., 6). The best edition of Gil Polo's *Diana* is that with *Life* by Francisco Cerda y Rico (Madrid, 1778). A good modern edition of the text is printed with that of Montemayor's *Diana*, in the *Biblioteca clásica española* (Barcelona, 1886). A. R. Marsh.

Polo de Medina, Salvador Jacinto: poet; b. in Murcia, Spain, about 1607; d. about 1660. After studying and amusing himself with poetry in his native place he went, about 1630, to Madrid to continue his studies. He became a priest, and in 1638 was secretary to the Bishop of Lugo. In his earlier work he showed himself gifted with considerable satiric power. His chief model was Cervantes, but he was influenced also by Góngora and Saavedra. In 1630 he published at Madrid his *Academias del Jardín*, his *Buen humor de las musas*, and his fables *Apolo y Dafne* and *Pan y Siringa*. In 1636 appeared his *Hospital de incurables, viaje de este mundo al otro*—a vision, in which the poet visits the infernal world. His moral treatise *Gobierno moral á Lelio* (1657) was much admired, and frequently imitated during the remainder of the seventeenth century. The first complete edition of his works, *Obras en prosa y verso*, appeared at Saragossa in 1664. The works in verse are printed in vol. xlii. of Rivadeneyra's *Biblioteca de Autores Españoles* (Madrid, 1875). A. R. Marsh.

Polo, Marco: traveler; b. in Venice in 1254; son of Nicolo Polo, one of three brothers, who seem to have been jointly engaged in extensive mercantile ventures in the East. In the year 1260 Nicolo, who had left a family at Venice, and his brother Maffeo went on a mercantile venture to the Tartar court at Sarai on the Volga. Thence circumstances carried them to Bokhara, and a party of Mongol envoys, passing that way, invited their company to the court of the Great Khan in the far East. Kublai, the ablest descendant and successor of Chinghiz, was then reigning. Never before having seen European gentlemen, he took the Polos into great favor, and after a time sent them back, in the character of envoys, to the papal court, to ask, among other things, for a great body of priests to instruct his people. The two brothers reached Acre in Apr., 1269, and, hearing that the papal see was vacant, went home. Nicolo found that his wife was dead, but that his son Marco, the subject of this article, was then a fine lad of fifteen. After waiting two years vainly for a new pope, the brothers started again for the East, taking young Marco. They were yet on the Gulf of Scanderoon when they heard at last of a pope's election in the person of Tedaldo Visconti, a Church dignitary of Acre, who had shown great interest in their mission, and who afterward reigned creditably as Gregory X. He recalled them to Acre to receive his letters, but in lieu of the hundred teachers asked by Kublai he could give but two, and the hearts of these failed at the outset. The long journey to Cathay occupied three years and a half. It lay through Southern Armenia, Persia, the valley of the Oxus, and Badakhshan, thence over the high plateau of Pamir. From Pamir they descended upon Kashgar, and thence by Khotan and across the Gobi desert to *Tangut*, as the country at the western end of the Great Wall was then called. Here they were met as the Great Khan's guests, and conducted to his summer-seat at Shangtu on the plateau of Mongolia, nearly 200 miles N. of Peking. Kublai received the party cordially, and showed especial favor to Marco. The young man applied himself to acquire some languages current at the Mongol court (though Chinese was certainly not one of his acquisitions), and soon got employment in the khan's service. His first important commission carried him through Western China and the wild Tibetan frontier to Yunnan, called by the Mongols Karajang (*Carajan*), and thence to the borders of Burma (*Mien*). A mission to India was one of his charges, and the government of the great city of Yangchow, on the Grand Canal, with its district, was another. The khan grew old, and the Polos began to fear what might follow his death; they desired to depart, but he heard them with displeasure; and it was not till 1292 that an opportunity offered. Kublai's kinsman, Arghûn, Khan of Persia in 1286, having lost his favorite wife, Bulugân, envoys were sent to Cambaluc to request that a Mongol lady of Bulugân's own family be selected to succeed her, as she had requested on her deathbed. Kukâchin, a beautiful maiden of seventeen, was selected. The envoys desired to return by sea, and sought the company of the experienced Venetians. Kublai was reluctant, but consented, and fitted the party out nobly for the voyage, charging the Polos with friendly messages for the Kings of France, England, and Spain. Their fleet of fourteen vessels sailed from Fuh-kien in the beginning of 1292; the voyage was long and disastrous, but the Polos after two years landed in Persia. After a time the Polos proceeded to Europe, and late in 1295 reached Venice, where they were received coldly by their relatives, who had long considered them dead. Venice and Genoa were then in hot and often sanguinary rivalry. In 1298 Marco joined the Venetian fleet under Andrea Dandolo as gentleman-commander (*sopra comito*) of a galley, and in an action off Curzola was taken prisoner with 7,000 others and carried to Genoa. At Genoa he fell in with a certain Rusticiano or Rustichello of Pisa, an inmate also of the prison there. To him is due the preservation of Polo's travels and memory, for he probably suggested the record of his experiences, and certainly he wrote them down from Polo's dictation. In the summer of 1299 peace was made and the prisoners were liberated. Marco Polo survived to Jan., 1324, the date of his will still extant, but died soon after—certainly before June, 1325. He had married, and left three daughters; two of them married before his death.

The *Book of Marco Polo* consists of two unequal sections. The first, called *Prologue*, is a personal narrative of great interest, but too great brevity. The second consists of a long series of chapters, extremely various in length and interest, descriptive of the regions of Asia visited by the Polos in their different journeys, but especially of the Emperor Kublai, his court and dominions. It is a curious fact that the original work, dictated by Marco, a Venetian, to Rustichello, a Pisan, was written in French, and very bad French too. The greatest number of MSS. are, however, in Latin, a version by Friar Pipino, executed in Polo's lifetime, having been much diffused. Italian versions are also numerous, the French less so, but far more valuable. The whole number of MSS. known is under eighty. Polo's recognition as prince of mediæval travelers is due to his romantic story and to the vast compass of his travels, anticipating so many supposed discoveries of the sixteenth century, rather than to transcendent character or capacity. He was the first traveler to trace a route across the whole longitude of Asia from the shores of Cilicia to the Yellow Sea—the first traveler to reveal China in all its wealth and vastness, the first to tell of the nations on its borders; of Tibet, of Burma, of Laos, of Siam, of Cochin-China, of Japan; the first to speak of that museum of beauty and wonder, the Indian Archipelago; of Java, the pearl of islands; of Sumatra (*Java Minor*); of Ceylon, with its Mountain of Adam; of India, not as a mythical region, but as a country seen and partially explored; of the secluded Christian kingdom of Abyssinia; of Zanzibar, Madagascar, and Socotra; and of remotely opposite quarters of the high plateaus of Pamir, with their wild sheep; of Siberia and the Arctic Ocean; of white bears, sledge-dogs, and reindeer-riding Tunguses. His book has presented many difficulties, but progress in exploration and in the translation of Oriental literature has made most of them now clear. Marsden's (London, 1818) was the first edition of value; Pauthier's (Paris, 1865) brought a vast amount of interesting Chinese learning to bear upon the subject. The most important is Yule's *Book of Ser Marco Polo* (2 vols., London, 1871; 2d ed. 1875).

Polonium: See the Appendix.

Polo y Bernabe, Luis: See the Appendix.

Poltava, pōl-taa′vă: government of European Russia; bordering S. and W. on the Dnieper. Area, 19,265 sq. miles. The surface is level, the soil fertile, and the climate mild. Agriculture and rearing of cattle are almost the only branches of industry pursued. Grain, hemp, tobacco, the sunflower, and fruits are raised; bees and silkworms are extensively reared. Pop. (1897) 2,794,756.

Poltava, or **Pultowa**: town; capital of the government of Poltava, Russia; on the Vorskla, a tributary of the Dnieper; 88 miles S. W. of Kharkoff (see map of Russia, ref. 9–D). It has manufactures of tobacco and leather and four annual fairs, at which horses, cattle, leather, wool, hides, etc., are sold to the value of about $12,000,000 annually. It is the seat of a bishopric. June 27, 1709, Peter the Great won here a decisive victory over Charles XII., in commemoration of which a large monument has been raised in the principal square. Pop. (1897) 53,060.

Polyæ′nus (Gr. Πολύαινος): sophist; flourished under Marcus Aurelius, and composed in rhetorical style and with an utter lack of critical spirit eight books of *Stratagems* (Στρατηγήματα), which are extant with the exception of gaps in the sixth and seventh. There are editions by Casaubon (1589) and by Wölfflin Melber. B. L. Gildersleeve.

Polyandry [Gr. πολύς, much, many + ἀνήρ, ἀνδρός, man]: See Marriage and Married Women.

Polyan′thus [Mod. Lat., from Gr. πολύανθος, many-flowered; πολύς, much, many + ἄνθος, flower]: any one of a large class of primroses, probably belonging to *Primula grandiflora*, and closely allied to the auriculas, cowslips, oxlips, etc. The polyanthus is a hardy perennial, and the flowers are often beautiful and profuse.

Polyatomic Alcohols: See Alcohols.

Polybasic Acids: See Acid.

Polyb′ius: Greek historian (b. 205, d. about 123 B. C.); a native of Megalopolis, in Arcadia; son of Lycortas, general of the Achæan League. His birth and his ability brought him early to the front, and he was employed in important diplomatic and military affairs. After the defeat of Perseus at Pydna, in 167, he was one of the 1,000 prominent Achæans who were deported to Italy by the Romans as hostages for the future good conduct of the Achæan League. In his seventeen years of exile he learned to appreciate the mission of Rome; and his study of the Roman state and his familiar intercourse with the leading men of Rome filled him with admiration of the new favorites of fortune (Τύχη). He was an intimate in the house of Æmilius Paulus, and accompanied Scipio the younger on his campaigns. In 150 his exile was at an end, but he returned to Rome twice and was in the suite of Scipio at the fall of Carthage (146) and at the siege of Numantia. Polybius was of great service to his countrymen in their subsequent complications with Rome, and was highly honored for his patriotic intervention. He preserved his mental and physical vigor to the age of eighty-two years, when he died in consequence of a fall from his horse. His great work was his *Histories* in forty books, five of which have come down to us entire; of the remainder we have fragments of considerable compass, part of them preserved in the excerpts of Constantinus Porphyrogenitus.

Polybius is the expounder and exemplar of the "pragmatic" method in history. The facts (πράγματα) once ascertained must be made to yield their causes, the causes ascertained must be made to yield lessons for the future. Pragmatic and practical are the same thing from different points of view. For the ascertainment of the facts he was rarely equipped by practical knowledge of the art of war and the life of politics. Not only did he bring a critical spirit to bear on the traditions of the past and on the work of his predecessors in the domain of history, but he was personally cognizant of many of the events which he describes. He "thinks straight and sees clear," and his love of truth is manifest; but there is far too much "exposure" of his fellow-workers, far too much sermonizing about right methods and correct results; although no one can deny that in the study of the causes of events Polybius showed in some directions wider and deeper vision than any of his predecessors, and with him begins a new era of historiography. He studied what was in man, he studied what was in nature, in order to find the springs of action; and it was he who taught historians to take into calculation the effect of political institutions, and the influence of soil, of climate, of geographical situation. True, his practical soul was not open to the influence of religion, which was to him an engine to work on the masses withal, not a spirit to animate a nation. To him the central force of history which dominated all the causes he had so laboriously evolved was a mysterious Τύχη (Fortune), the unknown, unaccountable power that took the place of the old gods. He does not seem to have been susceptible to the charm of poetry or alive to the influences of philosophy, but, Romanized though he was, Polybius was still too much a Greek not to admit with Aristotle the potency of music. As a stylist, Polybius has the merit of clearness, but lacks grace and charm, and his mechanical scrupulousness in the avoidance of the hiatus stands in amusing contrast with his neglect of the weightier matters of stylistic law. With Polybius begins the period of the so-called common dialect in contradistinction to Attic; he lets in new words with a flood, multiplies periphrases, and inspissates his style with abstracts and articular infinitives. The student of classical Greek finds himself in a new world of language just as the student of Greek history finds himself in a new world of thought.

Editions.—Schweighäuser (Leipzig, 1789–95); 8 vols., I. Bekker (Berlin, 1844); L. Dindorf, re-edited by Büttner-Wobst (Leipzig, 1882; Hultsch, 2d ed. Leipzig, 1888. Translated into English by Shuckburgh, 2 vols., London, 1889). See also W. W. Capes, *The History of the Achæan League as contained in the Remains of Polybius* (London, 1888); J. L. Strachan-Davidson, *Selections from Polybius* (Oxford, 1888); and Rudolf von Scala, *Die Studien des Polybius* (2 vols., 1890). B. L. Gildersleeve.

Pol′ycarp [from Lat. *Polycarpus* = Gr. Πολύκαρπος, liter., bearing much fruit]: one of the Apostolic Fathers, b. about 70 A. D., apparently of Christian parentage: a disciple of St. John and Bishop of Smyrna, where he suffered martyrdom, probably, according to modern scholars, in 155 or 156. The old date was 166 or 167 A. D. Most of what is known of him comes from his pupil Irenæus, who was Bishop of Lyons 177–202 A. D. In his letter to Florinus (preserved by Eusebius, *Hist.*, v., 20) Irenæus gives a graphic account of Polycarp as remembered by him. Another extract (*Adv. Hær.*, iii., 3, 4) emphasizes Polycarp's hostility to heretics, and there is still another extract from a letter of Irenæus to Victor, Bishop of Rome (preserved by Eusebius, *Hist.*, v.,

24), in relation to the Passover dispute, describing a visit of Polycarp to Anicetus, Bishop of Rome from 154 A. D. An epistle from the Church in Smyrna to a neighboring Church in Philomelium, describing the martyrdom of Polycarp, is probably in its main contents genuine, but in its present form has two closing sections which are not. Some features of the narrative are above suspicion and in keeping with the best traditions of the age. When entreated to save his life by reviling Christ the answer of the martyr was: "Eighty and six years have I served him, and he has done me no ill. How, then, can I blaspheme my King who has saved me?" The spot now pointed out as the site of this martyrdom is marked by a tall cypress on the face of Mt. Pagus, overlooking the city of Smyrna. Polycarp's Epistle to the Philippians appears to have been written shortly after the martyrdom of Ignatius, 115 A. D. Its genuineness is now generally conceded. Its tone is hortatory; its most important characteristic, great profuseness of quotation from the apostolic writings. The best recent editions of Polycarp are by Jacobson (1838; 4th ed. 1863); by Hefele (1839; 5th ed. by Funk, 1878); by Dressel (1857; 3d ed. by Zahn, 1876); but especially by Lightfoot (*Ignatius and Polycarp*, 1885). See also Lightfoot's *Apostolic Fathers* (1893). Revised by S. M. Jackson.

Polycen'tridæ [Mod. Lat.; named from *Polycen'trus*, the typical genus; Gr. πολύς, much, many + κέντρον, goad, spine]: a family of spiny-rayed fishes peculiar to the fresh waters of tropical South America. It is composed of two genera—(1) *Polycentrus*, without a barbel, and (2) *Monocirrus*, with a barbel. Two species of the former and one of the latter are known.

Polychætæ [Mod. Lat., from Gr. πολύς, many + χαίτη, bristle]: an order of annelids (jointed worms) belonging to the class Chætopoda (*q. v.*). In these forms each segment of the body bears numerous bristles, which either project from the general surface or from fleshy outgrowths (parapodia) on the sides of the body. The head is distinct and usually provided with feeler-like appendages, some of which may be modified into gills; the parapodia are usually complicated in shape, and besides the bristles they may bear tentacular processes (cirri) and in some instances respiratory organs. The internal organs are upon the general annelid plan, but usually the circulatory organs are highly developed. Reproduction is largely by means of eggs, although some species have the power of spontaneously dividing into two individuals. The young escape from the egg as a spherical embryo (trochophore), which gradually elongates into the adult condition. With the exception of the single genus *Manyunkia* from the Schuylkill river, Pennsylvania, all are marine. Among them are many forms beautiful alike in shape and color, which go far toward contradicting the common impression that a worm is a loathsome creature. The *Polychætæ* are usually subdivided into two groups. In one, *Errantia*, the animal lives a free life, either burrowing in the mud or swimming through the water. These animals are predaceous and are provided with strong jaws for capturing their prey. In the second group, *Tubicola* or *Sedentaria*, the parapodia are less developed, the animals live in tubes of their own construction, and, since jaws are lacking, they have to depend for food upon the minute particles brought them in the currents of water produced by the appendages of the head. There are many hundreds of species of *Polychætæ*. The most valuable papers upon the group are Ehlers, *Die Borstenwürmer* (Leipzig, 1864–68); Claparède, *Annelides du Golfe du Naples* (Geneva, 1868–70); and various articles by Grube, Malmgren, etc. The American species have largely been described by Verrill (*Invertebrata of Vineyard Sound*), Webster, and Andrews. For the development, reference should be made to Hatschek (*Arbeiten Zool. Inst.*, Vienna, i., 1878), Wilson (*Johns Hopkins Studies*, ii., 1882; *Journal of Morphology*, vi., 1892), A. Agassiz, and Fewkes. For structure, Claparède (1862), Meyer (*Mittheil. d. Zool. Station*, Naples, vii., 1887), Andrews, and others.

J. S. Kingsley.

Polychrome: synonymous with Æsculin (*q. v.*).

Polychromy: the application of varied and generally bright colors to buildings, statuary, and other objects; also the study or theory of this art. Most ancient peoples decorated their buildings inside and out with painting in vivid colors. When this was not done it was because the materials of the building or of its facing were naturally varied in color: Thus the frieze of the Erechtheion at Athens was in black marble, with white-marble figures in relief upon it, and the interiors of Roman temples, basilicas, and palaces were lined with variegated natural marbles. Oriental nations, both those of the far East and the Mohammedan peoples of the Levant, show great skill in polychromy. The differences between these nations in their use of color in this way are considerable: Thus the Japanese excel in the combination of browns and grays, gold of different tints, bronze, and other alloys, and generally in all the effects of subdued and delicate color, while the Chinese surpass them and all other peoples of modern times in handling dark and light blue, pure green, vivid yellow, orange, and white. The surprisingly refined combinations which they make of these strong and pure colors help us to understand how a Greek temple may have looked with patterns and even broad surfaces of pure red and deep blue, with white and gold. The modern peoples of European extraction show little power in making designs in color, and are generally content to copy those of antiquity or of the East. Russell Sturgis.

Polycle'tus (in Gr. Πολύκλειτος): statuary of the fifth century B. C.; b. at Sicyon, Achæa; was made a citizen of Argos; received instruction, together with Phidias and Myron, from Ageladas, and made the celebrated chryselephantine statue of Hera in the Heræum of Argos, and the still more celebrated statue of the *Spear-bearer*, which was afterward studied by other artists as containing the *canon* with respect to the proportions of the human body. He was also famous as an architect, and built the theater of Epidaurus. See Murray, *History of Greek Sculpture* (London, 1880), i., p. 257 ff.; Mitchell, *History of Ancient Sculpture* (New York, 1888), i., p. 384 ff.; Overbeck, *Geschichte der Griechischen Plastik* (Leipzig, 1893), i., p. 507 ff.; Collignon, *Histoire de la Sculpture Grecque* (Paris, 1892), i., p. 485 ff.; see also the article *Polykleitos* in Baumeister's *Denkmäler*.

Revised by J. R. S. Sterrett.

Polyc'rates (in Gr. Πολυκράτης): tyrant of Samos; one of the most daring and most successful of the many sea-kings who in ancient times swarmed over the Ægean Sea. When seeking the alliance of Egypt, he was warned by Amasis that he should sacrifice whatever he valued most highly in order to ward off the envy of the gods. He consequently threw his ring, a jewel of immense value, into the sea, but the next day the ring was found in the stomach of a fish that was served up on his table. Thereupon Amasis abandoned the alliance on the ground that his destruction was decreed by the gods. His life, which was one long series of brilliant victories, ended, nevertheless, in a pitiful manner. One Orœtes, satrap of Sardis, lured him into Magnesia, and seized and crucified him for some unknown reason about 522 B. C. Revised by J. R. S. Sterrett.

Polydæmonism: See Animism.

Polyg'amy [from Gr. πολυγαμία, deriv. of πολύγαμος, polygamous, having many marriages: πολύς, many + γάμος, marriage]: the state of a man having two or more wives at the same time. The state of a woman having two or more husbands at the same time is generally called *polyandry*. In ancient times polygamy was practiced by all the Eastern nations, and was sanctioned, or at least tolerated, by their religions. In the Homeric age it seems to have existed to some extent among the Greeks, but during the later development of Greek civilization it entirely disappeared. To the Romans and the Gotho-Germanic races it was unknown. With the Jews it was common among the patriarchs and tolerated by the law of Moses, but toward the beginning of our era the custom appears to have died out. The Koran sanctions it, but among the Arabs it does not prevail as a general rule. Among Christians, although the New Testament contains no positive injunction against it, it was never tolerated except among the Mormons. (See Mormons.) In modern times polygamy is common only among the savage African and Malayo-Polynesian races, and among the degraded nations of Asia. See Bigamy.

Polyglot [from the Gr. πολύς, many, and γλῶττα, tongue]: a book with versions of its texts in several languages, but generally used only of such editions of the Bible. Of Origen's *Biblia Hexapla* (see Origen), only a few fragments are extant. The first great polyglot printed was the *Complutensian* (printed under the care and at the cost of Cardinal Ximenes at Alcalá de Henares, Spain, named in Latin *Complutum*, 1502–17, 6 vols. fol., but not published till 1520); it was followed by the Antwerp (edited by Benedict Arias Montanus, 8 vols. fol., 1569–72), the Parisian (ed-

ited by Gabriel Sionita, 1628–45, 10 vols. fol.), but all these are far surpassed by the London (edited by Walton, 6 vols. fol., 1654–57).

Polygno'tus: painter; b. in the beginning of the fifth century B. C. in the island of Thasos; was an intimate friend of Cimon, and lived mostly in Athens, where he decorated the temple of Theseus, the Anaceum or temple of Castor and Pollux, and the Pœcile or painted portico; afterward, also, the inner halls of the Propylæa. He painted also some important pictures at Delphi. His pictures were celebrated in antiquity, and the art of painting appears to have been raised from early formality and elevated to a high standard by his genius. Revised by R. STURGIS.

Polygon [from Gr. *πολύγωνος*, polygonal, many-cornered; *πολύς*, many + *γωνία*, corner, angle]: a plane figure bounded on all sides by straight lines. The bounding lines are called *sides* of the polygon, and the points at which they meet are called *vertices* of the polygon; the entire bounding line is called the *perimeter*. Polygons are divided into classes according to the number of their sides or angles. Polygons of three sides are called *triangles*; those of four sides are called *quadrilaterals*; those of five sides, *pentagons*; those of six sides, *hexagons*; and so on. If the sides of a polygon are equal, the polygon is said to be *equilateral*; if its angles are equal, it is called *equiangular*. A *regular* polygon is both equilateral and equiangular. A closed broken line, all of whose sides are not in a single plane, is often called a *twisted polygon*. Revised by R. A. ROBERTS.

Polyg'onal Numbers: See NUMBERS.

Polygor'dius [Mod. Lat., from Gr. *πολύς*, many + *Γόρδιος*, Gordius, in allusion to the Gordian knot]: a genus of annelid worms. It is usually, with a few others, assigned to a special group, *Archiannelida*. Species are found in the seas of Europe and America.

Polygraph: See RECORDING APPARATUS, PSYCHOLOGICAL, in the Appendix.

Polyhedral Angle: a solid angle formed by three or more planes passing through a common point. If there are but three planes the angle is called *trihedral*. The intersections of the bounding planes are called *edges* of the polyhedral angle, and their common point is called the *vertex* of an angle. If a sphere be described about the vertex as a center with a radius equal to 1, the part of its surface included within the bounding planes is taken as the measure of the angle. Revised by S. NEWCOMB.

Polyhedron [Mod. Lat., from Gr. *πολύεδρος*, having many bases or sides; *πολύς*, many + *ἕδρα*, seat, side]: a solid bounded on all sides by polygons. The polygons are called *faces*, and the lines in which they meet are called *edges* of the polyhedron. The points in which two or more edges meet are called *vertices* of the polyhedron. The simplest polyhedron is bounded by four triangles, and is the pyramid known as a tetrahedron.

Polyhym'nia [= Lat. = Gr. *Πολυμνία*, liter., abounding in songs; *πολύς*, many + *ὕμνος*, song]: one of the Muses, the inventor of the lyre and the genius of lyric poetry; generally represented by ancient artists in a pensive attitude.

Polymer'ism: See ISOMORPHISM.

Polymorphism [from Gr. *πολύμορφος*, multiform; *πολύς*, many + *μορφή*, form]: in biology, that condition in which different kinds of individuals appear in the same species. In the animal kingdom it has its greatest exemplification in the group of SIPHONOPHORÆ (*q. v.*), where the whole colony is made up of members, all reducible to a common type, which are specialized for the functions of floating, swimming, reproduction, eating, and touch. Among the free forms it is not so common, but still is not rare. Thus among insects we find butterflies in which not only the males and females are different in their markings, but among the females different patterns may easily be recognized; in fact, so different may they be that did we not know their life-history we should not regard them as belonging to the same species. Where but two forms are known, the phenomenon is spoken of as DIMORPHISM (*q. v.*). J. S. K.

Polynem'idæ [Mod. Lat., named from *Polyne'mus*, the typical genus; Gr. *πολύς*, many + *νῆμα*, thread]: a family of spiny-rayed fishes peculiar for the free filiform rays below the pectoral fins. The family is represented by about twenty-five species, distributed in almost all tropical regions, and one (*Polydactylus octonemus*) occasionally wanders northward as far as New York.

Polyne'sia [Gr. *πολύς*, many + *νῆσος*, island]: a geographical designation somewhat loosely applied. It is now generally used for that part of Oceanica which lies S. of the equator and E. of the 170th meridian of E. lon.—a division based on ethnographic grounds.

Polyni'ces (in Gr. *Πολυνείκης*): in Grecian mythology, the first-born son of ŒDIPUS (*q. v.*), by his own mother Jocasta. He was banished from Thebes by his younger brother, Eteocles, and fled to Argos, where he married Argeia, a daughter of Adrastus, the King of Argos. Adrastus undertook to reinstate Polynices, but the seer Amphiaraus knew that the expedition (see SEVEN AGAINST THEBES) was doomed to failure, and he urged Adrastus not to undertake it. Polynices gave the necklace of Harmonia to Eriphyle, and she persuaded her husband to sanction the expedition, which meant death to himself. All the chieftains except Adrastus were slain at Thebes, Polynices falling at the hands of Eteocles, whom he slew. J. R. S. STERRETT.

Polyp [Mod. Lat. *po'lypus*; Gr. *πολύς*, many + *πούς*, foot]: one of the individuals of any of the fixed CŒLENTERATA (*q. v.*), and in earlier times of the *Polyzoa* and Tunicates. At one time there was recognized a "class" of polyps or *Anthozoa*, but the term is obsolete. See SCYPHOZOA.

Polyphe'mus (in Gr. *Πολύφημος*): in Grecian mythology, the famous Cyclops, a son of Poseidon; a gigantic monster with one eye in the center of the forehead; lived in the island of Thrinacia, where he captured Odysseus on his return from Troy. Odysseus escaped by making Polyphemus drunk and burning out his eye. See GALATEA.

Polyphony [Gr. *πολυφωνία*, variety of tones; *πολύς*, many + *φωνή*, tone]: in music, composition in several parts, vocal or instrumental, each part having an independent melodic flow of its own, but all uniting to express one musical thought or idea. This is in contrast to *homophony*, so called, which may be popularly explained as a simple succession of chords supporting a given melody, but without independent progression among the various accompanying parts or voices themselves. A well-written fugue exhibits, through the independent movement of its parts, a good example of practical polyphony. There is no essential distinction between polyphonic and contrapuntal writing.
DUDLEY BUCK.

Polyplacoph'ora [Mod. Lat.; Gr. *πολύς*, many + *πλάξ*, *πλακός*, tablet, plate + *φέρειν*, bear]: an order of molluscs containing the chitons, and better called *Placophora*. See CHITON and MOLLUSCA.

Pol'ypod, or **Pol'ypody** [*polypod* is from Gr. *πολύς*, many + *πούς*, *ποδός*, foot; *polypody* is from Gr. *πολύς* + *ποδίον*, dimin. of *πούς*, foot]: popular names given to many ferns, but properly belonging to those of the genus *Polypodium*, of which the U. S. has eleven species, growing on rocks, tree-trunks, etc. See FERNWORTS. C. E. B.

Polyp'terus [Mod. Lat., from Gr. *πολύς*, many + *πτερόν*, feather, wing]: a genus of ganoid fishes of considerable interest to the naturalist from its affinities to the lower sharks, the siluroid fishes, and the urodele batrachians, as well as from the fact that it and another African genus (*Calamoichthys*) are the only living representatives of a group of fishes which were predominant in Palæozoic times. *Polypterus bichir*, the only species, occurs in the rivers of West Africa and in the upper Nile. It reaches a length of 4 feet, the body is covered with lozenge-shaped scales, and the dorsal fin is represented by from eight to eighteen spines, each bearing an articulated finlet. For details of structure, see Leydig, *Zeitschrift für wiss. Zoologie*, v. (1854); van Wihje, *Niederland. Archiv für Zool.*, v. (1882); Pollard, *Zoolog. Jahrbücher*, v. (1892); and Traquair, *Jour. of Anat. and Physiol.*, v. (1871). J. S. KINGSLEY.

Polytechnic Schools: See SCHOOLS.

Polytheism: See ANIMISM and GOD.

Polyu'ria [Gr. *πολύς*, much + *οὖρον*, urine]: excessive urination. The term is applied to occasional increase in the flow of urine, due to transient causes, but also to a permanent condition or disease characterized by excessive excretion of urine, consisting chiefly of water, but not dangerous and seldom met with. See DIABETES. W. P.

Polyzo'a [Gr. *πολύς*, many + *ζῷον*, animal]: a group of animals formerly associated with the hydroids, later among the molluscs, and recently placed among the worms, together with the brachiopods and sipunculids, in a class, *Prosopygii*. The name *Polyzoa* alludes to the fact that these forms are

colonial, many individuals being associated together, while the term *Bryozoa* used mostly by the Germans has reference to the mossy appearance due to the small size of the numerous individuals. The separate animals are situated in chambers or "cells" in a horny or calcareous exoskeleton, and each can retract entirely into the hard case. When extended, each polyp presents a circle of tentacles (sometimes folded into a horseshoe shape) borne on a disk or lophophore, in the center of which is the mouth, the alimentary canal (consisting of œsophagus, stomach, and intestine), folded on itself, the vent being either inside the circle of tentacles, or, more usually, just outside the lophophore. The nervous system consists of a ganglion between mouth and vent. Nephridia (but a single pair) are occasionally present, and open near the mouth. The stomach is usually tied to the body-wall by a cord, or funiculus, in which may be situated either the testes or both testes and ovaries. In some the sexes are separate, in others united in the same individual. The *Polyzoa* reproduce both by eggs and by budding. The eggs in their development pass through a metamorphosis, with free-swimming embryos entirely different from the adult. When the adult condition is reached, the sessile individual forms the beginning of a colony which increases in size by the outgrowth of new persons from the older members of the colony. In the *Entoprocta* the buds become detached, forming free individuals,

The *Polyzoa* are divided into *Entoprocta* and *Ectoprocta*, accordingly as the vent is within or outside the circle of tentacles. The *Entoprocta* are few in number, and are all marine. The numerous *Ectoprocta* are subdivided into the *Gymnolæmata*, in which the tentacles are in a true circle, and the *Phylactolæmata*, in which the circle of tentacles is folded in horseshoe shape. These latter are exclusively fresh-water forms, and frequently occur in large gelatinous masses in lakes and streams. To carry the species through the winter cold, they form peculiar reproductive buds or statoblasts, inclosed in hard shells, which, with the return of warm weather, re-form the colony. Except one or two genera, all of the *Gymnolæmata* are marine. The genera *Rhabdopleura* and *Cephalodiscus*, formerly regarded as polyzoans (*Pterobranchia*), are thought to be related to Balanoglossus (*q. v.*). Polyzoans occur in all geological ages since the Silurian. See Hincks's *British Marine Polyzoa* (1880); Hyatt, *Proceed. Essex Institute*, v.; and papers by Barrois, Schmidt, Smitt, etc. J. S. Kingsley.

Pombal', Sebastian Joseph de Carvalho e Mello, Marquis of: statesman; b. near Coimbra, Portugal, May 13, 1699; studied law at the University of Coimbra: spent some years in the army; afterward entered the civil service and obtained the favor of the court; was sent in 1739 as minister to London, and in 1745 to Vienna, where he married the wealthy Countess of Daun, and succeeded as mediator in averting the threatened rupture between the court of Austria and Pope Benedict XIV.; became Minister of Foreign Affairs of Portugal 1750; acquired a great influence over his sovereign, King Joseph; displayed great vigor and judgment as a political reformer, curtailing the powers of the Inquisition and improving the finances of the kingdom; exercised a kind of beneficent dictatorship during the days of panic following the great earthquake of Nov., 1755; superintended the rebuilding of the city with greater magnificence; became first minister 1756, and caused the banishment from Portugal of all the members of the Society of Jesus by royal decree of Sept. 3, 1759, they having been suspected of connection with the attempted assassination of the king in the previous year; created Count of Oeiras in 1759, he was made Marquis of Pombal in 1770, and retained nearly supreme power until Joseph's death in 1777. On the accession of Pedro III. he was superseded in favor at court, and retired to his estates. D. at Pombal, May 5, 1782. He is known in Portugal as the "great marquis." See Smith, *Memoirs of Pombal* (London, 1843); Oppermann, *Pombal und die Jesuiten* (Hanover, 1845); and Canota, *Marquis Pombal* (London, 1871). Revised by F. M. Colby.

Pomegranate, pŭm-grăn'it [from O. Fr. *pome grenate* < Late Lat. *po'mum* (earlier *ma'lum*) *grana'tum*, lit., apple with many seeds; *po'mum*, fruit, apple + *grana'tus*, seeded; deriv. of *gra'num*, grain, seed]: a shrub, *Punica granatum*, of the Old World (of the family *Granataceæ*), now naturalized in most warm countries. It grows finely in those parts of the U. S. bordering the Gulf of Mexico. Its fruit, also called pomegranate, is of fine appearance. Some of the varieties are sub-acid and others sweet; most of them abound in small seeds, but some are seedless. The fruit is very grateful in hot climates. The plant is sometimes used for hedges. The flowers are very fine, and sometimes are double. The bark is used in tanning. The rind of pomegranates is a good astringent for medicinal use. Its active principle (pelletierine) and the bark of the root are good anthelmintics against the tapeworm. H. A. H.

Pomelo, or Pumelo: See Shaddock.

Pomerania (Germ. *Pommern*): province of Prussia; bordering N. on the Baltic, and bounded W. by Mecklenburg and S. and E. by the provinces of Brandenburg and West Prussia. Area, 11,628 sq. miles. The ground is low and the surface level. Along the Oder and the Baltic the soil is marshy, and produces good pasture; in other places it is sandy and little productive. Rye, wheat, potatoes, and hemp are cultivated; cattle and poultry are reared; the fisheries are important; smoked geese and pickled eels form two considerable items of exportation. There is an extensive commerce in the coast towns, where also ship-building and manufactures of sugar, chemicals, machines, paper, tobacco, etc., are carried on. The former inhabitants of Pomerania were of Wendish origin, and formed an independent Wendish dukedom during the Middle Ages. The present Pomeranians belong principally to the old Saxon stock. From the fourteenth century the portions E. and W. of the Oder, called Hither and Farther Pomerania, were separate duchies until 1625, when they were united under Boleslaus XIV. On his death, in 1637, the ruling dynasty became extinct, and the country was divided between Prussia and Sweden, which during the Thirty Years' war had made large conquests in Germany. After the death of Charles XII., Sweden was compelled in 1720 to cede a part of Pomerania to Prussia, but it was not until the downfall of Napoleon that the entire province became part of Prussia. Pop. (1895) 1,574,147. R. A. R.

Pomeranian Dog: a name frequently given to the Spitz Dog (*q. v.*).

Pomeranus: See Bugenhagen.

Pomeroy: city; capital of Meigs co., O.; on the Ohio river, and the Columbus, Hock. Val. and Toledo Railway; 18 miles N. by E. of Gallipolis, about midway between Cincinnati and Pittsburg, Pa. (for location, see map of Ohio, ref. 7–G). It is situated on a narrow strip of land between the river and a range of precipitous hills, and has daily steamboat connection with the principal river towns; is in a region underlaid with bituminous and cannel coal and deposits of salt, and is engaged principally in coal-mining. Salt in large quantities is obtained by simply boring into the earth. There are rolling- and nail-mills, steam-engine and machine shops, flour-, saw-, planing-, and woolen-mills, a national bank with capital of $50,000, a private bank, and 2 daily, a semi-weekly, and 2 weekly newspapers. Pop. (1880) 5,560; (1890) 4,726; (1900) 4,639.

Pomeroy, John Norton, LL. D.: lawyer; b. at Rochester, N. Y., Apr. 12, 1828; graduated at Hamilton College 1847; studied law, and was admitted to the bar 1851; Professor of Law and dean of the law faculty in the University of New York 1864–69; returned to Rochester to practice his profession; removed in 1878 to San Francisco to take the chair of municipal law in the law department in the University of California. He was a man of wide and accurate learning, and wrote numerous articles for magazines upon topics connected with constitutional and international law, general jurisprudence, and the science of politics; edited editions of Sedgwick's *Statutory and Constitutional Law* (1874) and *Archbold's Criminal Pleading and Evidence* (1877), and, besides other minor works, wrote *An Introduction to Municipal Law* (2d ed. 1883); *An Introduction to the Constitutional Law of the United States* (9th ed. 1886); *Treatises on Jurisprudence as Administered in the United States* (3 vols., 1881–83); *Remedies and Remedial Rights, according to the Reformed American Procedure* (2d ed. 1883); *Civil Code in California* (1885); *Treatises on the Law of Riparian Rights* (posthumous, 1887). D. in San Francisco, Cal., Feb. 15, 1885. F. Sturges Allen.

Pomeroy, Seth: soldier; b. at Northampton, Mass., May 20, 1706; was major in the Massachusetts forces at the capture of Louisburg 1745; lieutenant-colonel of the regiment commanded by Col. Ephraim Williams, at whose death, in the battle of Lake George, Sept. 8, 1755, he took command and gained a complete victory over Baron Dieskau. By occupation a mechanic, he was skilled in the manufacture of

arms. He was a delegate to the Massachusetts provincial Congress 1774–75, by which he was elected a general officer Oct., 1774, and a brigadier-general Feb., 1775; fought at Bunker Hill as a private soldier, and was soon afterward appointed senior brigadier by the Continental Congress, but declined the honor in consequence of disputes which arose about military rank, and retired to his farm. In the autumn of 1776 he raised a considerable military force for the relief of the army under Washington, and marched to the Hudson river. D. at Peekskill, N. Y., in Feb., 1777.

Pomfret: See PONTEFRACT.

Pomology [Lat. *po'mum*, fruit + Gr. λόγος, discourse, reason]: the science of fruit-culture. Pomology may be divided into four heads, especially as concerns its application to the U. S.: *Viticulture*, or grape-growing; *orcharding* (which is again divided into the cultivation of pomaceous fruits, or the pear and apple-like tribes; drupaceous or stone fruits; citrous fruits, as oranges and lemons; nut-fruits, nuciculture; and palmaceous fruits); *small-fruit culture*; and *cranberry-culture*. Pomological interests are greater in the U. S. than in any other country.

Statistics of the viticultural interests in the U. S. are given under GRAPE. (See also NURSERY, and the articles on the various fruits; also HORTICULTURE.) The total investment in commercial fruit-growing in 1890 was estimated to exceed $1,000,000,000. The area devoted to peaches was 507,736 acres; valuation of produce, $76,160,400. Upward of $90,000,000 were invested in peach-growing. Of almonds, California had 1,450,224 trees, nearly half of which had arrived at bearing age. Of cocoanuts, Florida had 123,227 bearing trees and 1,199,549 young trees. There were 666,007 lemon-trees, of which 386,636 were in Florida, the remainder in California. California had 607,377 olive-trees. Pine-apples were represented in Florida by 21,605,000 plants. The number of orange-trees was as follows:

	Bearing.	Not bearing.	
Florida	2,725,272	7,408,543	
California	1,553,801	2,223,710	
	4,279,073	9,632,253	13,911,326
Other States, about			600,000
Total number of trees			14,511,326

The literature of American pomology, aside from viticulture, is not extensive. The first distinct pomological work was William Coxe's *View of the Cultivation of Fruit Trees* (Philadelphia, 1817). This was followed by works by James Thacher, *The American Orchardist* (1822, 2d ed. 1825); William Prince, *Pomological Manual* (2d ed. 1832); William Kenrick, *The New American Orchardist* (1833); Robert Manning, *Book of Fruits* (1838: 2d ed. by John M. Ives, 1844); E. Sayers, *The American Fruit Garden Companion* (1839); A. J. Downing, *The Fruits and Fruit Trees of America* (1845, with subsequent editions); John J. Thomas, *The Fruit Culturist* (1846, with subsequent editions); Thomas Bridgeman, *The Fruit Cultivator's Manual* (1845); George Jaques, *A Practical Treatise on the Management of Fruit Trees* (1849); Chauncey Goodrich, *The Northern Fruit Culturist* (1849). A few others of less note, as well as American editions of English works, appeared before 1850. Since that date the chief writers of books have been Hooper, Warder, Barry, Thomas, Downing, Fuller, Strong, Baker, Roe, and Wickson. L. H. BAILEY.

Pomo'na: the Roman goddess of gardens and fruit, of whose wooing by Vertumnus, the god of the revolving year, Ovid has made a pretty story (*Metamorphoses*, xiv., 623 ff.). Her worship was presided over by a special priest, the flamen Pomonalis, and in the country between Ardea and Ostia there was a grove, called the Pomonal, sacred to her.

Pomona: the largest of the Orkney islands.

Pomona: city; Los Angeles co., Cal.; on the S. Pac. Railroad; 33 miles E. of Los Angeles, the county-seat (for location, see map of California, ref. 12–F). It is in an agricultural, mining, and fruit-growing region, contains several manufactories, and has 3 banks with combined capital of $200,000, and 3 weekly newspapers. Pop. (1890) 3,634; (1900) 5,526.

Pompadour, pōn'pȧ'door', JEANNE ANTOINETTE POISSON, Marquise de: b. in Paris, France, Dec. 29, 1721; was supposed to be the natural daughter of Le Normant de Tournehem, a farmer-general of the revenues, who provided for her education; was noted for her dignity, beauty, intelligence, and wit; was married in 1741 to Le Normant d'Étoiles, a nephew of her guardian; became the mistress of Louis XV. in 1745; was presented at court as Marchioness of Pompadour, and splendidly established in the royal residences at Paris, Versailles, and Fontainebleau; received several magnificent estates and an annual income of 1,500,000 francs, and exercised a decided influence on the Government of France for nearly twenty years, in all its branches—its finances, foreign alliances, military operations, etc.—bringing loss and disgrace over the kingdom. On the other hand, she deserves praise for her patronage of literary men and artists. Her efforts to retain her influence over the king were unceasing, and she accomplished her ends largely by encouraging him in his excesses. D. at Versailles, Apr. 15, 1764, detested by the whole French people. See the study by Campardon (1867); E. and J. de Goncourt, *Les Maîtresses de Louis XV.* (vol. ii., 1860); Beaujoint, *Secret Memoirs of La Marquise de Pompadour* (1885); and the volumes of her *Correspondance*, edited by Malassis (1878) and by Bonhomme (1880).

Pompano [adapted from Spanish *pámpano*, a kind of fish (*Stromateus fiatola*) found in European waters]: a name applied to several food-fishes, particularly to *Trachynotus carolinus*, a species found in the Gulf of Mexico and highly valued. It is rather deep in form, bluish above, silvery on the sides, and attains a length of about 18 inches. In California the name is given to a smaller fish of somewhat similar shape (*Stromateus simillimus*). F. A. L.

Pompeii, pom-pā'yĕĕ: an ancient city of Campania, on the bay of Naples, at the foot of Mt. Vesuvius. The date of its founding is unknown. Its oldest architectural remains reveal the Doric style of the sixth century B. C. The Oscans seem to have occupied the city down to the end of the fifth century B. C., when it was wrested from them by the Samnites. At this early period, through contact with the Greek colonies of Southern Italy, the city had arrived at a degree of culture far surpassing the contemporary civilization of Rome. The Samnite wars (342–290 B. C.) brought Pompeii, along with the rest of Campania, into partial subjection to Rome, through an alliance in which Rome's position was supreme; but in all domestic affairs of government it still enjoyed autonomy. Not until the Social war (90–88 B. C.) was this semi-independence replaced by regular subjection to Rome as a Roman colony. Pompeii was a well-to-do commercial city, with a harbor on the Sarno, somewhat nearer to the sea than at present. For a century before its destruction it was also a favorite site for the villas of wealthy Romans, attracted hither by the beauty of its location and the healthfulness of its climate. Its population at the time of its destruction is conjecturally placed (by Mau) at 30,000. Up to the year 63 A. D. Vesuvius had never, since the settlement of the region, given any indication of its volcanic character, but at that time Pompeii and the surrounding country were violently shaken by earthquakes, which wrought much destruction, evidences of which are still distinguishable among the later ruins. While the inhabitants were still occupied in rebuilding the city, the sudden eruption of Aug. 24, 79 A. D., overwhelmed them. (For details of this event, see the famous descriptions in the correspondence of the younger Pliny, vi., 16 and 20). This eruption was attended by earthquake, which did much damage that could not have been caused by the shower of small stones and ashes beneath which the city was buried. The depth of the covering of volcanic matter is 14 or 15 feet, the lower layer consisting of small pumice-stones, the upper layer of ashes, each of about equal thickness. It is not likely that the volcanic matter set fire to the city, but the carbonized condition of all woodwork found is due rather to chemical change under the influence of moisture. After the eruption the upper portions of the larger buildings still projected above the surface, and were not only thus themselves more quickly destroyed, but they served also to guide excavations which were doubtless made soon afterward for valuables of all sorts, including the marble which must have adorned public buildings. Most of the inhabitants escaped unharmed, but, from the skeletons discovered, Mau estimates that not less than 2,000 perished. During the Middle Ages the existence of Pompeii was forgotten and its site was unknown. Excavations were begun in 1748, and continued irregularly for more than a century. The present systematic work of unearthing the city was begun in 1861 by Giuseppe Fiorelli. About half of the city has been disclosed, and the course of the wall has been determined.

The outline of the boundaries of Pompeii is of oval form, fitting in general the hill of lava formation on which it is built. The town was laid out regularly, with the principal

streets running N. and S. and E. and W., although some deviation from parallel lines was occasioned in places by irregularities of the surface. The streets vary in width, averaging, however, about 20 feet, and are paved with irregular blocks of lava. Narrow sidewalks are found on both sides of the street, beneath which the conduits of a very complete sewer system are carried. The public buildings were clustered about two centers, the Forum and the Stabian gate. The Forum, situated near the western edge of the city, was a rectangular space, completely surrounded by temples and other structures—such as the basilica, the tribunals, the macellum (or market-hall)—serving various public ends. The area of the Forum itself was adorned on the north side by the temple of Jupiter, and surrounded on the remaining three sides by long porticoes. None of the buildings about the Forum are perfectly preserved, but the foundations and the columns still standing have generally made it possible to ascertain their design. The second group of buildings about the Stabian gate extended along one side of the so-called triangular Forum, a three-sided space almost surrounded by an admirable Doric portico. Within this space is situated the most ancient edifice of Pompeii, commonly (but erroneously) called the temple of Hercules, a structure in the Doric style of the sixth century B. C., which had already fallen into ruins at the time of the city's destruction. The open space of the Forum triangulare served doubtless as the entrance to the large theater, an adjacent structure on the east side. This theater had a seating capacity of about 5,000. The stage is raised above the orchestra, and accessible from the latter by a flight of stairs. Adjoining the larger theater and nearer the Stabian gate is the smaller theater, used, it would seem, for less formal occasions. Further toward the center of the city from the Stabian gate are found the Stabian baths, the most completely preserved example of that institution so characteristic of Roman civilization. Two other establishments of similar character are found in different parts of the city. No buildings, however, possess a greater interest than the private houses, of which those here found are the only well-preserved examples now existing. The Pompeian private residence is identical with the Roman house as described by Vitruvius, and consists of a central room or atrium with smaller apartments clustered about it. Most commonly, however, this simple arrangement is amplified by the addition of an open court or garden behind the atrium surrounded by columns, and hence called the peristylium. The houses afforded no outlook upon the street, and indeed very frequently the apartments on either side of the entrance had no communication with the house itself, but were rented as shops.

The works of art in marble and bronze which have been discovered at Pompeii are for the most part preserved in the museum at Naples. They are of very great interest, although for the most part inferior to the works of similar character discovered at HERCULANEUM (*q. v.*). Among the most attractive and unique decorations discovered at Pompeii are the paintings which adorned the walls of public buildings and of the more sumptuous private residences. There is discernible in them considerable diversity of style, showing a development from the imitation of purely architectural effects to the treatment of landscape, mythological figures, and scenes from daily life and from history. The last and most characteristic period is represented by designs which combine, in curious and often grotesque fashion, fantastic architectural motives with figures and ornamental treatment of foliage. Another interesting form of decoration is the mosaic work which adorns the floors of many of the houses. Usually it consists of merely ornamental designs in black and white, but there are a few examples of more elaborate work, such as the famous representation of the battle of Alexander in the Casa del Fauno. No manuscripts or important literary monuments, aside from inscriptions, have been found at Pompeii. Of the latter there are many very interesting specimens, ranging in subject-matter from announcements of the merits of candidates for public office or proclamations of gladiatorial games to personal effusions of the most diversified character.

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Pompe'ius Trogus: See TROGUS.

Pompey (Lat. *Gnæus Pompeius*, called MAGNUS, the Great): a Roman general; b. in 106 B. C. of a plebeian family which had only recently emerged from obscurity. From childhood Pompey enjoyed a military training, fighting with his father in the Social War (90–88 B. C.), and taking sides with Sulla and the aristocratic party in the contest with Marius. In 81 B. C., contrary to all precedent and rule, he was granted a triumph, and was greeted by Sulla with the cognomen MAGNUS, which he continued to bear through life, and even passed on to his son. After Sulla's death he was recognized as the leader of the aristocratic party. His successes in the war against Sertorius in Spain, and in the suppression of the rebellion of the slaves, were not indicative of great military talent, but they stood out by contrast to the failures of the leaders who had preceded him with sufficient brilliancy to make him a successful candidate for the consulship before he had passed through the usual preliminary grades of office. However, it was only by accepting the programme of the democratic party that he could secure the coveted prize, thus alienating himself from the senatorial party with which he had hitherto been identified. Although as consul (70 B. C.) he carried out the popular measures in abolition of the constitution of Sulla, he did not make himself a leader of the democratic party. For several years after his consulship he took no active part in public affairs, but his military skill was too great and too much needed to be long unused. A popular measure proposed that he be intrusted with extraordinary and absolute powers for the purpose of clearing the Mediterranean of the pirates who infested it, and who had so harassed the carrying trade that the price of grain was intolerably high. The bill was passed against the united opposition of the aristocracy, which saw in the proposition nothing less than the abolition of the constitution and the inauguration of an absolute one-man rule. The pirates were speedily driven from the sea, and in less than a year the supreme command of the operations against Mithridates was intrusted to him (66 B. C.). In this mission he was also successful, and had attained a political and military influence which seemed to the aristocracy a menace to the constitution, and which would have been so in the case of a bolder and more discerning man; but on his return in 61 B. C. Pompey found himself in a position of complete isolation. He had disbanded his army, losing thereby his power of intimidation, and, feared by the democrats and disliked by the aristocracy, he ventured on no escape from his embarrassment in individual action, and was therefore forced into the coalition with Cæsar and Crassus (the first triumvirate), for the sake of having his wishes in regard to the reward of his army and himself carried out. Although Pompey enjoyed with Cæsar a position almost supreme in Roman politics, it became more and more apparent that Cæsar was the heir to the opportunity which Pompey had let slip. In the distribution of political prizes among the members of the coalition Pompey secured largesses of land with which to reward his army, and a formal approval of his settlement of affairs in the East. Again, after the renewal of the triumvirate in 56, Pompey and Crassus were made consuls for the following year, and the provinces of Spain were intrusted to Pompey for a period of five years. He, however, governed them only through his representatives. The course of events from the year 53 on, by which Pompey once more became the leader of the senatorial party against Cæsar, the advance of Cæsar on Rome (early part of 49 B. C.), and the retreat of Pompey through Italy into Epirus, belong equally to the history of CÆSAR (*q. v.*). The final contest took place at Pharsalus in Thessaly, and Pompey was completely routed. He fled to Egypt, and there, as he was disembarking, he was treacherously murdered. G. L. HENDRICKSON.

Pompey's Pillar (so called): a stone pillar erected, according to an inscription on its base, by one Publius, prefect of Egypt, in honor of Diocletian, about 296 A. D. It stands on an eminence just S. of Alexandria. The shaft, 73 feet long, is of beautiful highly polished red granite. The total height of the column is 98 ft. 9 in.

Pompelmoose: See SHADDOCK.

Pompo'nius, Lucius: a Latin poet from Bologna (Bononia), who flourished about 90 B. C.; famous as a writer of *Fabulæ Atellanæ*. Some seventy titles and nearly 200 verses have been preserved in the citations of grammarians. See Ribbeck, *Comicorum Romanorum Fragmenta*. M. W.

Pomponius Mela: See Mela.

Ponape Island: See the Appendix.

Ponca Indians: See Siouan Indians.

Ponce, pōn'thā: the second city in size and one of the most important ports of Puerto Rico; on a plain a mile back from a bay of the southern coast (see map of West Indies, ref. 6–J). A tramway connects it with its port on the bay, which forms a somewhat imperfectly sheltered harbor. Near the town are the celebrated mineral springs of Quintana, much frequented by invalids. Ponce has a thriving trade, principally in coffee. Population of the district (1887) 42,388; of the city proper probably 25,000.

Pon'ce de Leon', Juan: conqueror and discoverer; b. in Aragon, Spain, about 1460. He was of noble family, served in the conquest of Granada, and in 1493 went with Columbus to Española; later he was governor, under Ovando, of the eastern part of that island, whence he passed over to Puerto Rico in 1508 and began its conquest; in 1510 he was appointed its governor. From the Indians he heard of an "island" called Bimini, to the N. W., and it was reported that this contained a miraculous spring which would restore the aged to youth; probably the supposed island was Florida. Ponce de Leon received in 1512 a grant to discover and settle Bimini; he sailed from Puerto Rico in Mar., 1513, discovered some of the Bahamas, coasted along the Atlantic side of the mainland to lat. 30° 8′ N., and on Easter Sunday, Apr. 8, landed and took possession, calling the country Florida, from Pascua Florida, the Spanish name for Palm Sunday. He also explored the Gulf coast to lat. 27° 30′ N., and returned to Puerto Rico in September. His grants were renewed, but owing to Indian wars in Puerto Rico he could not again sail for Florida until 1521. He then attempted to plant a colony, but was driven off by the Indians and was himself so badly wounded that he died shortly after reaching the coast of Cuba. Herbert H. Smith.

Ponce de Leon, Luis: See Leon, de.

Ponchielli, pon-kĕe-el'lĕe, Amilcare: opera-composer; b. at Paderno Fasolaro, Cremona, Italy, Aug. 31, 1834; educated at the Milan Conservatory; produced his first opera, *I Promessi Sposi*, in Cremona, in 1856. He wrote *La Savojarda* (1861); *Roderico* (1864); *La Stella det Monte* (1867); *Le Due Gemelle* (ballet, 1873); *Ctarina* (ballet, 1873); *I Lituani* (1874); *Gioconda* (1876); *Il Figlio Prodigo* (1880); *Marion Delorme* (1885); together with several other operas, some cantatas, and smaller works. D. Jan. 16, 1886.

Pond, Frederick Eugene: See the Appendix.

Pond, John, F. R. S.: astronomer; b. in London in 1767; educated at Trinity College, Cambridge; studied astronomy under Wales, the companion of Capt. Cook; succeeded Dr. N. Maskelyne as astronomer-royal 1811; devoted himself to cataloguing and determining the exact places of the fixed stars; translated Laplace's *System of the Wortd* (2 vols., 1809); and published numerous papers in the *Transactions* of the learned societies. D. in Blackheath, Sept. 7, 1836.

Pondicherry, pōn-di-sher'ri: a French possession in India; on the Coromandel coast, 83 miles S. W. of Madras, in lat. 11° 55′ N. (see map of South India, ref. 6–F). It comprises an area of 107 sq. miles, with 172,941 inhabitants. It consists of a low, flat plain, with a sandy, not very productive soil, and is only partly watered by the river Gingee. The town of Pondicherry, which is the capital of all the French possessions in India, is regularly laid out and well built, with fine promenades and plantations. Its manufactures of fine cotton cloth and cotton thread are important; it has no harbor, vessels are compelled to anchor in an open roadstead, and landing is difficult on account of the surf. Pop. (1889) 41,253. Revised by M. W. Harrington.

Pondoland: a district of Cape Colony, Africa; inhabited by the Ama-Pondo, a branch of the Kaffir family. Pop., estimated, 200,000. It is the most eastern coast-region of Cape Colony, and is chiefly watered by the St. John's or Umzimvubu river. It was the last of independent Kaffraria to fall (1878) into the hands of the British, by whom a military post is maintained on the St. John's river, where the resident commissioner appointed by the Cape is stationed. See Kaffraria. C. C. Adams.

Pond-scums: small fresh-water algæ of the order *Conjugatæ* and the family *Zygnemaceæ*. See Vegetable Kingdom.

Pondweed Family: the *Naiadaceæ*; aquatic monocotyledonous herbs, with alternate or opposite submerged or floating leaves; flowers perfect or diclinous; perianth usually wanting, sometimes of six or more segments; pistils one to six, simple, superior, with two to many ovules. The species, which are found in all regions, number about 120. They occur in most ponds and ditches, especially in still, shallow waters. They are to be regarded as modified from the *Alisma* type by a suppression of the perianth and a reduction in the stamens and pistils. The species (sixty-four) indigenous to the U. S. are described and figured by Dr. Thomas Morong in his *Revision of the North American Naiadaceæ* (1893). Charles E. Bessey.

Poniatow'ski: the name of a celebrated princely family of Poland directly descended from the Italian family of the Torelli, which settled in Poland in the middle of the seventeenth century, and closely allied to the Leszczynskis and Czartoryskis. The most prominent members of the family were (1) Stanislas Augustus, the last King of Poland, b. in Lithuania, Jan. 17, 1732; ascended the throne in 1764 by the influence of Catherine II. of Russia; resigned in 1795, and died at St. Petersburg, Feb. 12, 1798. He was weak, irresolute, and utterly incapable of grappling with the party fury of his subjects and the treachery of his allies. The principal events of his unhappy reign are told in the history of Poland (*q. v.*).—(2) Joseph Antony, b. at Warsaw, May 7, 1762, a nephew of the king; received a military education; served in the Austrian army in the Turkish war; entered the Polish army in 1789 as a major-general; commanded against the Russians in 1792, but retired from service when the king joined the confederation of Targovitza; fought again in 1794 against Russia under Kosciusko; repaired to Vienna in 1795, but returned to Warsaw in 1798, and lived on his estates, at that time under Prussian dominion. In 1807 he commanded the Polish army which aided Napoleon against Russia, and when the duchy of Warsaw was established by the Peace of Tilsit he was appointed minister of war. In 1812 he commanded the Polish contingent of the grand army during the Russian campaign, and distinguished himself by his valor and tactical talent. Shortly before the battle of Leipzig he was made a marshal of France, and after the battle he was charged with covering the retreat of the army, but was drowned (Oct. 19, 1813) in crossing the river Elster.—(3) Joseph, b. at Rome in Feb., 1816; became known as a composer of several operas and masses. *Don Desiderio* was performed at Paris in 1868 with considerable success. D. in London, July 3, 1873.
Revised by F. M. Colby.

Ponka Indians: See Siouan Indians.

Ponsard, pōn'saar', Francis: dramatist; b. at Vienne, Isère, France, June 1, 1814; studied law in Paris, and began to practice at Vienne, but removed to Paris and gave up law for literature. He was first an admirer of Hugo, and in 1837 translated Byron's *Manfred*. He did not follow the romantic progress of Hugo, and profited by the new favor won for classical plays by the brilliant interpretations of Rachel and the recoil from the extremes of Hugo to bring out *Lucrèce*, an attempt to reconcile the old classical tragedy with a modest romanticism. His success was immense, and he was hailed as the founder of the school of "good sense." After the further tragedies, *Agnès de Méranie* (1846), *Charlotte Corday* (1850), and *Ulysse* (1852), he renewed his success with the comedies *L'Honneur et l'Argent* (1853), *La Bourse* (1856), *Le Lion Amoureux* (1866), and *Gatilée* (1867). D. in Paris, July 13, 1867. His *Œuvres complètes* (3 vols.) were published in 1876. A. G. C.

Ponson du Terrail, pōn'sōn'dü-tā'raal', Pierre Alexis de Ponson, Vicomte de: novelist; b. at Montmaur, Isère, France, July 8, 1829; intended for the navy, his weakness in mathematics unfitted him for it, and he turned to writing. He began in 1850 with *feuilletons* in *La Mode* and *L'Opinion pubtique*. *Les Coulisses du Monde* (1853) founded his celebrity and gained him a special public. He supplied the cheaper papers with a vast number of novels of sensational adventure and incident, which were very popular. D. at Bordeaux, Jan. 20, 1871. A. G. Canfield.

Pons Varolii: See Brain.

Ponta Delgada, pōn'tăa-del-gaa'dăă: town of the Azores islands, situated on the southern coast of St. Michael. Its

harbor is shallow and the roadstead outside the harbor unsafe, yet it has a large trade, especially in oranges to Great Britain, grain to Portugal, and earthenware to Brazil. Pop. about 17,500.

Pontchartrain, pon-char-trān′, **Lake** [named after Jérome Phélypeaux, Comte de Pontchartrain, Minister of Marine under Louis XIV.]: a lake of Louisiana, about 40 miles in its longest dimension E. and W. and 25 miles N. and S., the southern shore of which is but about 5 miles distant from and nearly parallel to the Mississippi river in its local easterly course in this region. It is separated on the W. by a peninsula of cypress-swamp from Lake Maurepas (named after Count Maurépas, son and successor of Pontchartrain), a much smaller lake, with which it is connected by the Pass Manchac. New Orleans communicates with the lake by a branch of the Louisville and Nashville Railroad, and by two canals navigable by schooners and smaller craft, one of which (see BORGNE) enters the head of the bayou St. John, by which the navigation is continued to the lake; the other is wholly artificial. These canals have their heads in "basins" in the rear of the city; they do not communicate with the Mississippi. The lake communicates with Lake Borgne and Mississippi Sound by the passes of the Rigolets and Chef Menteur, through which there is a tidal flow of the sea-water. Fort Pike and Fort Macomb defend these passes. An important commerce in lumber, firewood, bricks, etc., is carried on through the lake and the Rigolets. The northern shore of the lakes, a continuation westerly of the "pine-woods" region, is elevated and healthful. There are many places of resort on the shores of the lake.

Pont du Gard, pōn′dü-gaar′: the remains of one of the most magnificent Roman structures in France, consisting of three tiers of arches, on which the aqueduct which brought the water of the Aure to Nîmes crossed the Gard 10 miles N. E. of that city. See AQUEDUCTS.

Pontecorvo, pōn′tā-kōr′vō: town; in the province of Caserta, Italy; on the Garigliano, about 28 miles S. of Sora and 37 miles N. W. of Capua (see map of Italy, ref. 6–E). The old walls and towers, once very strong, are now in a ruinous condition. A bridge of Pelasgian construction connected the city with its suburbs. This bridge was broken down to check the march of Hannibal, and afterward restored. In 1860 it was blown up by the Bourbon troops, but was rebuilt soon after. In and near the town there are some fine churches, containing frescoes, and among the archives of the cathedral are Lombard, Gothic, and mediæval Latin MSS. The ruins of the ancient *Fregellæ* are distinctly traceable, and among them are found mosaics of great beauty. Bonaparte created Bernadotte Prince of Pontecorvo in 1806. Macaroni and works in plaster constitute the chief industries. Pop. 5,172.

Ponte, da: See BASSANO.

Pontefract, pom′fret, or **Pomfret**: town of Yorkshire, England; on the Aire; 13 miles S. E. of Leeds (see map of England, ref. 7–I). It has two churches, a grammar-school (founded in 1549), a town-hall, a market-hall; trades chiefly in grain, cattle, malt, and garden-produce. Pop. (1891) 9,702; of the parliamentary borough (which returns one member), 16,407.

Pontevedra, -vā′drăă: town; in the province of Pontevedra, Spain; at the head of the Bay of Pontevedra; on the Lerez, which is crossed by a noble bridge (*pons vetus*) built in Roman times (see map of Spain, ref. 13–A). The city is substantially built, and the surroundings are among the most fertile regions of Spain. There are sardine-fisheries and manufactures of hats and cloth. Pop. (1887) 19,996. The province of Pontevedra lies on the Atlantic Ocean, between the Minho and Ulla rivers. Area, 1,739 sq. miles. Pop. (1887) 443,385.

Pontiac: Indian chief; b. near the river Ottawa about 1720; son of an Ojibway woman; through the alliance of the Ojibways and Pottawattamies with the Ottawas became chief of the three tribes; became an ally of the French in Northern Michigan, and in 1746 defended Detroit against Indian attacks. He was present, it is believed, at Braddock's defeat in 1755. After the British in 1760 had displaced the French in the Northwest, Pontiac organized a conspiracy among the Indian tribes between the Ottawa and the lower Mississippi with the purpose of murdering the British garrisons at all points. In May, 1763, eight garrisons (ranging from Western Pennsylvania to Mackinaw) were destroyed or dispersed on the same day, and the whole frontier was ravaged. The attack on Detroit, led by Pontiac himself, was anticipated by the British, but the chieftain besieged the town May 12–Oct. 12, 1763, maintaining his force by food received from the Canadian settlers, who received in return promissory notes written on birch-bark, all of which Pontiac subsequently redeemed. Deserted by his followers, he still endeavored to arouse his people to the dangers in store for them, but in 1766 he was obliged to submit to the British rule. He was murdered at Cahokia, Ill., in 1769, by an Illinois Indian. See Parkman's *Conspiracy of Pontiac* (1867).

Pontiac: city; capital of Livingston co., Ill.; on the Vermilion river, and the Chi. and Alton, the Ill. Cent., and the Wabash railways; 33 miles N. N. E. of Bloomington, 93 miles S. S. W. of Chicago (for location, see map of Illinois, ref. 4–F). It is in an agricultural, coal-mining, and stock-raising region, and contains several mills, iron-foundry, shoe-factories, straw-paper factory, the Illinois State Reformatory, 2 national banks with combined capital of $100,000, and 3 weekly newspapers. Pop. (1880) 2,242; (1890) 2,784; (1900) 4,266.

Pontiac: city; capital of Oakland co., Mich. (for location, see map of Michigan, ref. 7–K); on the Clinton river, and the Detroit, Gr. Haven and Mil. and the Pontiac, Oxford and N. railways; 26 miles N. W. of Detroit. Within the county and a few miles from the city are over 400 lakes, with a total area of about 30,000 sq. miles, teeming with choice fish, and having on their shores the Michigan Military Academy and many club-houses, hotels, and summer residences. The city has a large trade in wool and agricultural productions, and contains the Eastern Michigan Asylum for the Insane, gas and electric lights, a national bank (capital $100,000), 2 State banks (combined capital $150,000), and 5 weekly newspapers. Pop. (1880) 4,509; (1890) 6,200; (1900) 9,769. EDITOR OF "GAZETTE."

Pontianak′: town of Borneo; on the west coast of the island, at the confluence of the Landak and the Kapuas, which from here to its mouth is called the Pontianak, and lined on both sides with impenetrable forests (see map of East Indies, ref. 7–D). Pontianak is the capital of the Dutch dominions of Western Borneo, the residence of the governor, and is defended by Fort du Bus. Its trade in diamonds, gold-dust, sugar, rice, cotton, and coffee is important. Pop., estimated, 15,000, most of whom are Chinese, and very few Europeans. Revised by M. W. HARRINGTON.

Pon′tifex [= Lat. *pons, pon′tis*, bridge (perhaps originally a path, road) + *fa′cere*, make]: a priest of the college of the pontifices, the foundation of which tradition carried back to Numa. Before the banishment of the kings the king himself was at the head of this college, but after that time it was presided over by a member of the college called the pontifex maximus, or chief priest, whose official residence was the old royal palace, the regia. The pontifices did not, like the flamens, have charge of the worship of particular divinities, but they exercised a general supervision over the public religion, interpreted and declared the pontifical law, managed the complex machinery of the Roman calendar, and acted as official advisers to the senate and magistrates in all religious matters requiring their attention. The college originally consisted of five members, including the pontifex maximus, but by the end of the republic it had been increased to fifteen, while under the empire new members were added to it without reference to a fixed number. At first vacancies were filled by the choice of the college itself (*coöptio*), later the pontifex maximus, and finally all of the pontifices were elected by the people. In imperial times the emperor was always the pontifex maximus. G. L. H.

Pontifical States: See PAPAL STATES.

Pontine Marshes [*Pontine* is from Lat. *Ponti′nus, Pompti′nus* for **Pometi′nus*, Pometian, deriv. of *Pome′tia*, ancient name of the place near which these marshes are situated]: a tract of marshy ground in the province of Rome in Italy. The marshes extend from the vicinity of Cisterna S. W. to the sea at Terracina, a distance of about 28 miles, with a mean width of little more than 5 miles. The level near Cisterna is about 30 feet above the sea, while at Terracina it dips below the sea-level. Both the marshes and the boggy and tangled forest on the low sands which bound them on the S. W. are very unhealthful during the warm season, and the miasma they exhale is borne by the south winds even to Rome. The ancient Romans made many par-

tially successful attempts to drain and reclaim this territory, built the Appian Way through the center of it, and constructed a navigable canal not far from the line of the road, quite down to Terracina. Pliny states that this district was once thickly inhabited and contained twenty or thirty large towns, besides numerous villages and hamlets. Several drainage schemes were promoted by the popes, especially by Pius VI., in the last quarter of the eighteenth century. See Prony, *Description hydrographique et statistique des Marais Pontins* (1813); Giordani, *Gita alle Paludi Pontine* (1872). Revised by M. W. Harrington.

Pontois, pōn'twăă', Jean Félix Honoré: lawyer and writer; b. at Thouars, France, July 26, 1837. After he came of age he took up legal work (1859) as a digester, and was made a judge of the tribunal of Annecy; was transferred to the tribunal of Algiers 1874; made judge of the appellate court of Algiers 1879; and successively judge of the court of Bourges, president of the tribunal of Tunis 1883, and president of the division of the court of appeals at Nîmes 1886; resigned in 1889, and entered into active and successful political work in opposition to the Boulangerists, with whose administration of affairs in Tunis he had been dissatisfied while there. He is a member of the Legion of Honor. He has published *Les Petits-fils de Tartuffe* (1864); *Réforme du Code d'Instruction criminelle et du Code pénal* (1871); *La Conspiration du Général Berton* (1877); and other political and judicial studies, as well as some theatrical plays, as *Les Hannetons*, *Dix Minutes d'Arrêt*, *La Robe de Chambre de Diderot*, etc. F. Sturges Allen.

Pontoon: See Bridges, Military.

Pontop'pidan, Erik Ludvigsen: historian and theologian; b. at Aarhuus, Jutland, Denmark, Aug. 24, 1698; studied theology at the University of Copenhagen; became professor in 1738; Bishop of Bergen, Norway, in 1747; chancellor of the University of Copenhagen in 1755. D. at Copenhagen Dec. 20, 1764. As a theologian he was a disciple of Spener; as an historical writer he was careful, generally accurate, and possessed of immense learning. His principal works, written in German, Danish, and Latin, are *Everriculum fermenti veteris* (1736); *Psalmebog* (1740); *Gesta et Vestigia Danorum extra Daniam* vols., 1740); *Menoza* (3 vols., 1742), a theological romance; *Glossariam Norvagicum* (1749); *Annales ecclesiæ Danicæ diplomatici* (1741–52); *Norges naturlige Historie* (1752; translated into English, London, 1755); *Den Danske Atlas* (7 vols., 1763–81), a topographical account of Denmark. D. K. Dodge.

Pontor'mo, Jacopo, di: painter; b. at Pontormo, near Empoli, Italy, in May, 1494; family name Carucci or Carrucci. He studied painting with his father, and afterward with Leonardo da Vinci, Albertinelli, and Piero di Cosimo successively, until in 1512 he became a follower of Andrea del Sarto, whose manner he finally adopted. His finest work is the fresco-painting of the *Visitation* in the court of the Annunziata in Florence. The fresco paintings of the *Deluge* and the *Last Judgment* for the Church of San Lorenzo in Florence have disappeared. He was the master of Bronzino, who painted under him in many of his works. Pontormo died at Florence, and was buried in the Church of the Annunziata, Jan. 2, 1557. A *Holy Family* and a portrait of Giovanni delle Corniole, in the Louvre, are good examples of his art; also the portrait of a boy in the London National Gallery. W. J. Stillman.

Pontus: an ancient territory of Asia Minor, lying S. of the Black Sea, between the Phasis and Halys. The name was first applied by Xenophon. Afterward it became an independent kingdom, and included the territory between Colchis, Armenia, Cappadocia, Galatia, and Paphlagonia. Its historic celebrity is mainly due to Mithridates VI. the Great (120–63 B. C.), who made it a great power, but who was conquered by Pompey 65 B. C. It became a Roman province 63 B. C. It is now comprised in the Ottoman vilayets of Sivas and Trebizond. E. A. Grosvenor.

Pontus Euxinus: See Black Sea.

Pontzen, Ernest: civil engineer; b. at Budapest, Hungary, Jan. 20, 1838; studied in the Polytechnic School of Vienna, and in the École de Ponts et Chaussées of France, graduating in 1860 at the head of his class; he was for four years in the service of the Austrian Railway Company; in 1864 was engaged by the Southern Railway of Austria, first as inspector of operation, and afterward placed in charge of the railways in Venice, upon completion of which he was for three years in charge of the works of the port of Trieste. In 1869–70 he was head of the main office of Kleim Brothers, where he worked out the complete plans of the Arlberg Railway and built a railway in Transylvania; in 1870–75 he was consulting engineer to the Anglo-Austrian Bank. In 1873 he visited the U. S. for study; in 1876 was member of the juries on railways and on industries of the Centennial Exposition. On his return he took up his permanent residence in Paris. He was a delegate of the French Government to the railway conference at Berne in 1886, and to that of St. Petersburg in 1892. He was sent to Russia by the French Government in 1890 to study the transportation of grain. His plans for the sewerage of Havre and of Cairo received first prizes. He is general manager of the Southern Railway of Spain and consulting engineer of the Peloponnesian railway in Greece. He has published many pamphlets, papers, etc., upon engineering subjects, has written many papers for the Society of Civil Engineers of France, and has published a treatise on *Methods of Construction*. His most important work, in which he was associated with E. Larvinne, is upon the railways of America. W. R. Hutton.

Pony [probably of Celtic origin; cf. Gaelic *ponaidh*]: a small form of the horse. The most famous European ponies are the Shetland, Iceland, Welsh, Dartmoor, Corsican, and Greek. In North America there are the Canadian, Sable Island, Gay Head, Sea Island, and mustang. These little animals are tough and spirited, but often vicious. The smallness and unusual growth of the hair, mane, and tail of many are due to exposure and scanty food for many generations.

Poodle [loan-word from Germ. *pudel*, small dog]: a dog distinguished by the extremely long and curly hair. This may vary from the wiry texture found in the Russian poodle to the woolly curls of the French breed, but should in all be thick and elastic. The color may be brown, white, or black, but not mottled, and the weight may vary from 5 to 40 lb. The head should be broad and carried high, ears long and well-clad, tail carried with an upward curve. Poodles are very intelligent and usually play an important part in exhibitions of trained dogs. F. A. Lucas.

Pool: in the U. S. and elsewhere, a game played on a table similar to that used in billiards, except that at each corner and midway of the two sides "pockets" are inserted. (See Billiards.) One cue-ball and object-balls numbered consecutively from one to fifteen are employed. In the beginning of a game the latter are usually arranged in the form of a pyramid, with the apex on what corresponds to the red-ball spot of a billiard-table. The cue-ball is placed anywhere behind the string-line, and is played at the numbered balls, the object being to drive them into the pockets; a player's turn ends with the first shot in which he fails fairly to pocket one, and the next player plays the cue-ball from where he finds it, or, if pocketed, from behind the string-line. There are many varieties of the game, each with elaborate rules. In *pyramid pool* each ball pocketed counts one, and (when only two play) the first to secure eight wins. Failing to hit any object-ball, or driving the cue-ball off the table or into a pocket, involves the forfeiture of one ball (together with any balls pocketed in the shot itself), and this is placed on the spot or as near as may be directly behind it. In *fifteen-ball pool* the forfeit is three points, and each ball secured counts its number. *Continuous pool* is played in tournaments; it is like pyramid pool, except that the game consists of any number of balls or points agreed on, and forfeitures are deducted from the player's score, instead of a ball being replaced on the table.

In Great Britain games like the above are called *pyramids*, the term pool being applied to a game played for a stake on a pool-table, each player having one ball. The object of this game is to drive the balls of opponents into the pockets; for each ball so pocketed the player receives from its owner a stipulated sum; when one's ball has thrice been so pocketed the player withdraws from the game and his share of the stake, but he may on certain conditions secure another "life" by adding a further sum to the stake. The player whose ball last remains on the table wins the game.

Poole: town; in Dorsetshire, England; on the estuary of the Frome (see map of England, ref. 14–C). It has some ship-building and manufactures of sail-cloth and cordage, and exports pipeclay and potter's clay. Pop. (1891) 15,405.

Poole, John: humorist; b. in England in 1792; author of a large number of successful dramas and farces, of which the best known were *Paul Pry* (1825), *Deaf as a Post*, *Turn-*

ing the Tables, and an adaptation of Shirley's *Wife's Stratagem*. He also wrote novels, essays, and character sketches, among which *Little Pedlington and the Pedlingtonians* (2 vols., 1839) took high rank for originality and racy humor. In his last years Poole enjoyed a pension from the civil list. D. in London, Feb. 5, 1879.

Poole, Matthew: author; b. at York in 1624; educated at Emmanuel College, Cambridge; took orders in the Church of England, and became rector of St. Michael-le-Querne, London, but was ejected for nonconformity in 1662; wrote much against Roman Catholicism; is said to have narrowly escaped being murdered at the time of the "Popish plot," and removed to Amsterdam, where he died Oct., 1679. Author, among other works, of a famous compendium of the critical views of 150 biblical commentators, entitled *Synopsis Criticorum* (5 vols. fol., London, 1669–76), and of *Annotations upon the Holy Bible* (2 vols. fol., 1683–85), left unfinished, but completed from Isaiah lviii. by eminent Nonconformists (reprinted 1842, 3 vols.).

Poole, William Frederick, LL. D.: bibliographer; b. at Salem, Mass., Dec. 24, 1821; graduated at Yale College 1849; published while there an *Index to Subjects in Reviews and Periodicals* (1848), subsequently expanded into the valuable *Index to Periodical Literature* (1853, and 3d ed. 1882). He was librarian of the Boston Mercantile Library 1852–56, of the Boston Athenæum 1856–69, of the Cincinnati Public Library 1869–73, of the Chicago Public Library 1873–87, when he became librarian of the Newberry Library, Chicago. Author of *The Battle of the Dictionaries* (1856); *Websterian Orthography* (1857); and *Cotton Mather and Salem Witchcraft* (1869). D. at Evanston, Ill., Mar. 1, 1894. H. A. Beers.

Poo'na: town of British India; capital of the district of Poona, in the Presidency of Bombay; on the Muta, near its influx in the Mula; on a dry and treeless plain, 2,000 feet above the sea (see map of South India, ref. 3–C). Although the climate is hot and dry, and water is scarce, the place is considered healthful, and has been made the station of the army of Bombay. The city is well built, and contains the palace of the former Mahratta rulers, many fine barracks, a college, and several other educational institutions. It is connected with Bombay by railway. Pop. (1891) 160,460.

Poore, Benjamin Perley: journalist; b. at Newbury, Mass., Nov. 2, 1820; learned the printing business; edited *The Southern Whig* at Atlanta, Ga., 1838–40; became an *attaché* of the U. S. legation in Belgium 1841; made a valuable collection of historical MSS. from the French archives for the State of Massachusetts 1844–48; traveled in Egypt, Palestine, and other Eastern countries as correspondent of the Boston *Atlas* 1843–48; published *The Rise and Fall of Louis Philippe* (1848); *Campaign Life of Gen. Taylor* (1848); *The Early Life of Napoleon* (1851); editor and proprietor of *The American Sentinel* (1851); editor of *Congressional Directory* in 1867; compiled *A Descriptive Catalogue of the Government Publications of the United States 1774–81* (1885); *Reminiscences of Sixty Years in the National Metropolis* (1886). D. at Washington, D. C., May 30, 1887.

Poore, George Vivian: See the Appendix.

Poor Laws: See Pauperism.

Poorten-schwartz, J. M. van der: novelist, whose pen-name is *Maarten Maartens*; b. in Holland in 1857; lived when a child in England, but was educated in Germany and at Utrecht University; became a barrister, and was destined by his parents for a political career, but devotes himself entirely to literature and the life of a country gentleman. His works which are written in English include *The Sin of Joost Avelingh* (1890); *An Old Maid's Love* (1891); *God's Fool* and *A Question of Taste* (1892); *The Greater Glory* (1894); and *My Lady Nobody* (1895).

Popayan': capital of the department of Cauca, Colombia; 3 miles from the left bank of the Cauca, near the source of that river; on the inland route from Bogotá to Quito, and 200 miles S. W. of the former (see map of South America, ref. 2–B). It is built on a beautiful plain near the foot of the Puracé volcano, 5,712 feet above sea-level. It was founded by Benalcazar in 1536, on the site of the Indian village which had been ruled by the chief Payan; for a time the district formed the province or "kingdom" of Popayan. The city was important for its commerce, for gold-mines, and for a mint established in 1749; but it suffered greatly during the revolution and in subsequent civil wars, and is now much decayed. It is a bishop's see, and has a university and college. Pop. about 8,000. Herbert H. Smith.

Pope [O. Eng. *pāpa*, from Lat. *pa'pa*, papa, father, bishop, (later) pope]: the ordinary name of the Bishop of Rome.

Origin of the Name.—The name was originally given to all bishops as signifying among other things the spiritual generation in baptism and their supreme responsibility. From the beginning of the sixth century there was a growing tendency in the West to restrict its use to the Bishop of Rome. Since Gregory VII. (1073–85) it has been formally reserved to the Bishop of Rome, as the usual title signifying his primacy of honor and jurisdiction within the Roman Catholic Church.

Beginnings of the Papacy.—The papal idea can be traced from primitive times. No other see ever claimed the supreme ecclesiastical primacy as the Roman see has from the most remote antiquity, and there are strong arguments to show that this claim was allowed. The magisterial letter of St. Clement to the Corinthians (about A. D. 96); the visit of St. Polycarp to Rome (Euseb., H. E. V., 24); the testimony of St. Irenæus (*Adv. hæreses*, iii., 3); St. Victor's display of world-wide authority and his power to exclude from the "common unity"; the claim to the "power of the keys," and the citation of Matt. xvi. 19, made by some pre-Constantinian pope, whom Harnack thinks to be Victor (see opp. S. Cypriani, ed. Hartel., vol. iii., p. 92, *seq.*); St. Stephen's judicial action in hearing appeals, and his vindication of the true tradition on baptism (*ibid.*, vol. ii.); St. Dionysius of Alexandria writing to his namesake of Rome for guidance, "so that he might not err" (St. Athanasius, *De Sententia Dionysii*); the conduct of the Emperors Decius and Aurelian; the ambition of early arch-heretics to obtain the favor of the Roman Church—all these indications, and several others previous to the peace of the Church (A. D. 312), show that Christian public opinion recognized at Rome the chief authority of the new religion. That this authority has been exercised since then in every age, both East and West, needs no proof, nor need the revolts against it, the disuse of it, the minimizing of its range, blind us to the fact of its existence or tempt us to modify its essential outlines. Of the latest definitions of the papal authority the highest and most authentic are those of the general councils of Florence (1439), Trent (1563), and the Vatican (1870). These great assemblies of Catholic bishops and doctors added nothing new to the ancient concept of the papal authority, but asserted in detail and in more definite phraseology what had been the rule in the Catholic Church from the remotest times. For a compendious collection of the earliest references to the papal authority, see Allnatt, *Cathedra Petri* (London, 1883). Among the best works on the early history of the Roman Church are Doellinger, *Hippolytus und Callistus*; Hagemann, *Die römische Kirche* (Freiburg, 1864); and Schroedl, *Geschichte der Päpste und der römischen Kirche in der Urzeit des Christenthums* (Mentz, 1888). The prefaces of Duchesne in his edition of the *Liber Pontificalis* are henceforth indispensable. See Rivington, *The Primitive Church and the See of Peter* (London, 1894).

Authority of the Pope.—The pope enjoys a primacy or supremacy of honor and jurisdiction over the whole Church, individually and collectively. He is the supreme teacher or doctor, and in this capacity is infallible when speaking as such—i. e. *ex cathedra*—or defining a doctrine of faith or morals to be held by the whole Church. He is the supreme legislator in the Church, and can interpret, modify, and dispense in all matters of ecclesiastical law. He is the supreme judge of the faithful, whether members of the hierarchy or laymen, and can hear and decide all major causes and appeals from lower tribunals. He is the supreme administrator, and as such has power to watch over the divine service, and to appoint, remove, or transfer bishops. He is the supreme supervisor, and in this quality receives regularly relations from bishops and other chief ecclesiastical authorities of the state of religion within the limits of their jurisdiction. This is supplemented by stated personal visits paid by the bishops, and known as the Visitation to the Tombs of the Apostles (SS. Peter and Paul). The universal ecclesiastical jurisdiction of the pope is immediate, ordinary, and truly episcopal, and includes the right to send agents who may represent his person and authority before the churches, or even before the temporal authorities. The authority described is vested in the pope by divine right, because he is the legitimate successor of St. Peter, and as such truly the Vicar of Christ, the chief bishop of the Catholic world, the visible and ministerial head of the whole Church, whose invisible and eternal head is Jesus Christ. The honorary distinctions of the pope in title,

dress, and functions are many. For an account of them see Laemmer, *Institutionen des Katholischen Kirchenrechts* (Freiburg, 1892). Cf. also Smith, *Elements of Ecclesiastical Law* (vol. i., New York, 1887).

The election of the pope, originally performed by the clergy of Rome and the suburban bishops, with participation of the faithful, has undergone many vicissitudes, as may be seen in Lucius Lector, *Le Conclave* (Paris, 1893). It was Nicholas II. who definitely placed it (1059) in the hands of the cardinals, and, with some modifications, this is the present method of the election. The cardinals meet on the eleventh day after the pope's decease in a series of double cells (conclave), one for each cardinal, his secretary and chamberlain, and on the twelfth day the election begins. They are not bound to elect a cardinal—only hereties and simoniacal persons are excluded—and the closing act of the election takes place in a chapel specially reserved for that purpose. Certain Catholic courts have been wont to exercise the right to exclude objectionable candidates, but there exists no juridical acknowledgment of this so-called "right of exclusion." When the pope-elect accepts the result of the conclave he changes his baptismal name (as a rule) and chooses another. If he be not a bishop, he is always consecrated by the Cardinal-bishop of Ostia. The reception of the pallium, the solemn coronation, and the "possession" of the Lateran Church take place after this, but the entire papal jurisdiction passes into his hands when he accepts the election.

Temporal Power of the Pope.—The origins of the temporal power are visible in the last deeades of the sixth century, especially under Gregory the Great. National and religious feeling contributed to its growth in the first half of the eighth century, and in the latter half of the same the papacy entered the list of European states by the formal donations of Pepin and Charlemagne. The spurious *Donatio Constantini* has been greatly overrated in the discussion of the evolution of the temporal power (*English Historical Review*, July, 1894). Under various forms and with varying boundaries the papal state existed through the Middle Ages as a spontaneous, legitimate growth, and its long, pacific possession through twelve centuries was no despicable element in the propagation of Christian faith and culture. The violent usurpation of Napoleon I. was undone by the Congress of Vienna (1815). Beginning with 1860 the Piedmontese government encroached on the states of the Church, and in 1870 they were incorporated into the kingdom of Italy. The popes have never recognized the fact, nor accepted the law of guarantees by which the Italian kingdom undertook to regulate its internal relations with the papacy.

The Papal Government.—The ordinary administration of the papal authority is carried on through the *Curia Romana* —i. e. the body of officials and agents whom the pope employs in his government, whether in the character of supreme head of the Church, as chief metropolitan of Italy, as Bishop of Rome, or as a temporal authority. The curial jurisdiction, though not distinct from the papal, is ordinary, i. e. legally fixed and attached to the office. The curia consists in general of cardinals, prelates, and *curiales*, or minor officials. The cardinals form the papal senate, and are the ordinary advisers of the pope. The solemn assembly of all the cardinals in the latter capacity is known as the *consistory*, whieh in turn may be either private or public; the latter kind usually takes place twice a year, and is only a formal ratification of acts already accomplished.

Since Sixtus V. (1585–90) the supreme jurisdiction of the pope is regularly exercised through a number of congregations, over which, as a rule, some cardinal presides in the quality of prefect, aided by assessors, consultors, secretaries, advocates, etc. Questions of law and finance, petitions of the faithful, the expedition of bulls, briefs, apostolic letters, etc., have each their special tribunal or agency, some of them very ancient, like the *Sacra Rota* and the *Cancellaria apostolica*. The cardinal-secretary of state is the official representative of the pope before foreign courts or states, and is the ordinary head of the body of legates, nuncios, ablegates, etc., through whom the pope keeps in touch with the temporal and spiritual affairs of Christendom.

Authorities and Literature.—The oldest lives of the popes are found in the *Liber Pontificalis* (ed. Duchesne, Paris, 1886–92), and in Watterich, *Vitæ Romanorum Pontificum* (Leipzig, 1862). There is a *catalogue raisonné* of their letters for the first twelve centuries in Jaffé, *Regesta Romanorum Pontificum* (2d ed.). The papal correspondence since the beginning of the thirteenth century is (1894) being published from the Vatican archives through a number of investigators, individual and collective. The *Bullarium Romanum* (ed. Coquelines, 19 vols., Rome, 1739–44, with later continuations, Turin, 1857–72) contains the text of a great many public papal documents in later centuries. Platina, Onofrio, Panvinio, Ciacconio, and Oldreinus are the post-Renaissance continuators of the "old lives of the popes." It is difficult to recommend any one work as absolutely reliable for the lives of all the popes. A multitude of monographs on individual popes, fixed epochs, and problems appear yearly. Their spirit differs according to the education and prepossessions of the writer, but there is a growing tendency toward a more calm and objective view of the papal history. A model of this new method is Pastor's *History of the Popes in the Period of the Renaissance* (Freiburg, 1886). Similar monographs of Creighton and Ranke on the popes since the Renaissance, of Gregory VII., by Voigt, and Innocent III., by Hurter, are valuable. An excellent means to obtain accurate information concerning a given pope is to consult U. Chevalier's *Répertoire des sources historiques du Moyen Âge* (Paris, 1877–88), where the sources and the relative literature up to date are given. Artaud de Montor's *History of the Popes*, and Groene's *Geschichte der Päpste* (Regensburg, 1875), are popular and useful books. The books of De Maistre, *Du Pape*, Doellinger, *Kirche und Kirchen, Papstthum und Kirchenstaat*, and Murphy, *The Chair of Peter*, are also to be read. Several foolish fables once current are exploded in Doellinger's *Papstfabeln* (Stuttgart, 1890).

List of the Popes.—The following list is taken from the chronological work of Father Gams, O. S. B., *Series Episcoporum Ecclesiæ Catholicæ* (Regensburg, 1873). The dates of accession of the popes up to the first part of the third century are approximative, but rest on sound calculations, as may be seen from the writings of Duchesne, De Rossi, Lightfoot, and others, as against the theory of Lipsius. Toward the end of the tenth century the custom arose of taking a new name on the occasion of election to the papacy. The usual mode of cessation of the papal office is by death, but it can be resigned, as was done by Celestine V. and Gregory XII. SS. Liberius, Silverius, and Martin were exiled for a time or forever, but they remained juridically popes to their death. There are some knotty problems in the long chronology, but they are not unsolvable, as may be seen from the prefaces and notes of Duchesne in his edition of the *Liber Pontificalis*. For a charming account of the tombs of the popes see Ampère's translation of Gregorovius's *Die Grabdenkmäler der Päpste*.

Name.	Date of accession.
B. Peter	41
St. Linus	67
St. Cletus (Anencletus)	about 79
St. Clement I.	" 91
St. Evaristus	" 100
St. Alexander	" 109
St. Sixtus (Xystus)	" 119
St. Telesphorus	" 128
St. Hyginus	" 138
St. Pius	" 142
St. Anicetus	" 156
St. Soter	" 168
St. Eleutherus	" 177
St. Victor I.	" 190
St. Zephyrinus	" 202
St. Calixtus I.	" 218
St. Urban I.	222
St. Pontianus	230
St. Anterus	235
St. Fabianus	236
St. Cornelius	251
St. Lucius	253
St. Stephen I.	254
St. Sixtus (Xystus) II.	257
St. Dionysius	259
St. Felix	269
St. Eutychianus	275
St. Gaius	283
St. Marcellinus	296
St. Marcellus	307
St. Eusebius	309
St. Melchiades (Miltiades)	309
St. Sylvester	314
St. Marcus	336
St. Julius	337
St. Liberius	352
St. Damasus	366
St. Siricius	384
St. Anastasius	398
St. Innocent I.	402
St. Zosimus	417
St. Boniface I.	418
St. Celestine I.	422
St. Sixtus III.	432
St. Leo I.	440
St. Hilarius	461
St. Simplicius	468
St. Felix III.	483
St. Gelasius	492
St. Anastasius II.	496
St. Symmachus	498
St. Hormisdas	514
St. John I.	523
St. Felix IV.	526
St. Boniface II.	530
St. John II.	532
St. Agapetus I.	535
St. Silverius	536
Virgilius	537
Pelagius I.	555
John III.	560
Benedict I.	574
Pelagius II.	578
St. Gregory I.	590
Sabinianus	604
Boniface III.	607
St. Boniface IV.	608
St. Deusdedit	615
Boniface V.	619
Honorius	625
Severinus	640
John IV	640
Theodorus I.	642
St. Martin	649
St. Eugenius I.	654
St. Vitalianus	657
Adeodatus	672
Donus	676
St. Agatho	678
St. Leo II.	682
St. Benedict II.	684
John V.	685
Conon	686
St. Sergius I.	687
John VI.	701
John VII.	705
Sisinnius	708
Constantine I.	708
St. Gregory II.	715
St. Gregory III.	731

Name.	Date of accession.
St. Zacharias	741
Stephen II	752
Stephen III	752
St. Paul I	757
Constantine II	767
Stephen IV	768
Hadrian I	772
St. Leo III	795
Stephen V	816
St. Paschal I	817
Eugenius II	824
Valentinus	827
Gregory IV	827
Sergius II	844
St. Leo IV	847
Benedict III	855
St. Nicholas I	858
Hadrian II	867
John VIII	872
Marinus I	882
Hadrian III	884
Stephen VI	885
Formosus	891
Boniface VI	896
Stephen VI. (VII.)	896
Romanus	897
Theodorus II	897
John IX	898
Benedict IV	900
Leo V	903
Christopher	903
Sergius III	904
Anastasius III	911
Laudo	913
John X	914
Leo VI	928
Stephen VIII	929
John XI	931
Leo VI. (VII.)	936
Stephen IX	939
Marinus II	942
Agapetus II	946
John XII	955
Leo VIII	963
Benedict V	964
John XIII	965
Benedict VI	973
Benedict VII	974
John XIV	983
Boniface VII	984
John XV	985
Gregory V	996
Sylvester II. (Gerbert)	999
John XVII. (Sicco)	1003
John XVIII	1003
Sergius IV	1009
Benedict VIII	1012
John XIX	1024
Benedict IX	1033
Gregory VI	1045
Clement II	1046
Damasus II	1048
St. Leo IX	1049
Victor II	1055
Stephen X	1057
Benedict X	1058
Nicholas II	1059
Alexander II	1061
St. Gregory VII	1073
Victor III	1086
Urban II	1088
Paschal II	1099
Gelasius II	1118
Calixtus II	1119
Honorius II	1124
Innocent II	1130
Celestine II	1143
Lucius II	1144
Eugenius III	1145
Anastasius IV	1153
Hadrian IV	1154
Alexander III	1159
Lucius III	1181
Urban III	1185
Gregory VIII	1187
Clement III	1187
Celestine III	1191
Innocent III	1198
Honorius III	1216
Gregory IX	1227
Celestine IV	1241
Innocent IV	1243
Alexander IV	1254
Urban IV	1261
Clement IV	1265
Gregory X	1271
Innocent V	1276
Hadrian V	1276
John XXI	1276
Nicholas III	1277
Martiu IV	1281
Honorius IV	1285
Nicholas IV	1288
St. Celestine V	1294
Boniface VIII	1294
Benedict XI	1303
Clement V	1305
John XXII	1316
Benedict XII	1334
Clement VI	1342
Innocent VI	1352
Urban V	1362
Gregory XI	1370
Urban VI	1378
Boniface IX	1389
Innocent VII	1404
Gregory XII	1406
Alexander V	1409
John XXIII	1410
Martin V	1417
Eugenius IV	1431
Nicholas V	1447
Calixtus III	1455
Pius II	1458
Paul II	1464
Sixtus IV	1471
Innocent VIII	1484
Alexander VI	1492
Pius III	1503
Julius II	1503
Leo X	1513
Hadrian VI	1522
Clement VII	1523
Paul III	1534
Julius III	1550
Marcellus II	1555
Paul IV	1555
Pius IV	1559
St. Pius V	1566
Gregory XIII	1572
Sixtus V	1585
Urban VII	1590
Gregory XIV	1590
Innocent IX	1591
Clement VIII	1592
Leo XI	1605
Paul V	1605
Gregory XV	1621
Urban VIII	1623
Innocent X	1644
Alexander VII	1655
Clement IX	1667
Clement X	1670
Innocent XI	1676
Alexander VIII	1689
Innocent XII	1691
Clement XI	1700
Innocent XIII	1721
Benedict XIII	1724
Clement XII	1730
Benedict XIV	1740
Clement XIII	1758
Clement XIV	1769
Pius VI	1775
Pius VII	1800
Leo XII	1823
Pius VIII	1829
Gregory XVI	1830
Pius IX	1846
Leo XIII	1878

JOHN J. KEANE.

Pope, ALEXANDER: poet; b. in London, May 21, 1688; d. at Twickenham, May 30, 1744. His father was a retired linen-draper and a Roman Catholic, and shortly after the poet's birth the family took up their residence at Binfield, in Windsor Forest. Pope was sickly and deformed, and was educated at home by the family priest and at two small schools. He was very precocious, and at the age of fifteen translated into verse the first book of the *Thebais* and wrote an epic poem, *Alcander*, which was never published. His first publication was a series of *Pastorals* (1709), musically versified, but, like all Pope's poetry of natural description, tame and artificial. These were followed by the *Essay on Criticism* (1711), a didactic poem on the rules of taste; *The Rape of the Lock* (1712, and much enlarged in 1714), a brilliant mock-heroic, occasioned by a quarrel between Lord Petre and Miss Arabella Fermor; the *Messiah* (1712), a sacred pastoral modeled upon Vergil's *Pollio*; *Windsor Forest* (1713), a descriptive piece; *The Temple of Fame* (1715), a paraphrase of Chaucer's *House of Fame*; and a collection of his poetical works in 1717, which included his only experiments in the poetry of pathos and passion, the *Elegy to the Memory of an Unfortunate Lady* and *Eloisa to Abelard*. Meanwhile he had undertaken a verse-translation of Homer. The first volume of the *Iliad* appeared in 1715, and the last in 1720; the *Odyssey*, in which he had the help of Fenton and Broome, in 1725. Pope's *Homer* was published by subscription and brought him about £9,000. After his father's death in 1717 he bought a little villa, with five acres of ground, at Twickenham on the Thames. This was his home for the remainder of his life, where he amused himself with landscape-gardening and received his friends, among whom were Swift, Gay, Arbuthnot, and Henry St. John, Lord Bolingbroke. Pope was sensitive and spiteful. He had literary or personal quarrels with Addison, Colley Cibber, Curll the bookseller, John Dennis the critic, Lady Mary Wortley Montagu—for whom he had formerly professed warm admiration—Theobald the Shakspeare editor, and many others. He paid off his grudges in his clever and malicious satires. Stung by the incessant lampoons of the small Grub Street hacks and penny-a-liners, he crucified them all in his *Dunciad*, an epic of the dunces, the first edition of which was published in 1728, and a final edition, with *The New Dunciad*, or fourth book, added in 1743. In 1732–34 was published the *Essay on Man*, a moral didactic poem in four books. This poem abounds in pithy sayings and sententious maxims which have become universally current. As a philosophical poem it is neither coherent nor consecutive. It expresses in popular shape and with great verbal cunning ideas taken from the Leibnitzian optimism which Pope had caught from the conversations of his friend Bolingbroke, but which he himself imperfectly understood. From 1731 to 1738 he wrote and published the satires and verse-epistles which, under the titles *Moral Essays* and *Imitations of Horace*, form, perhaps, his most characteristic and most enduring work. Pope was not a great poet; he seldom touches the heart or stimulates the imagination. His translation of Homer is brilliant but false. His much-admired *Eloisa to Abelard*, though splendid in expression, is rhetoric rather than poetry; but he was a great verbal artist, and excelled especially in the art of putting things. He is more frequently quoted than any English poet with the exception of Shakspeare. He brought the mock epic of artificial society, the Horatian verse-essay, and the formal satire to the highest perfection, and he gave the heroic couplet the greatest possible smoothness, variety, and point. His influence in English poetry was supreme throughout nearly the whole of the eighteenth century. H. A. BEERS.

Pope, FRANKLIN LEONARD: See the Appendix.

Pope, JOHN: soldier; b. at Louisville, Ky., Mar. 16, 1822; graduated at the U. S. Military Academy, and commissioned brevet second lieutenant of topographical engineers July 1, 1842, captain 1856. Appointed brigadier-general of volunteers May 17, 1861, he held important commands in Missouri, and in Dec., 1861, surprised a Confederate camp at Milford, which he captured with large supplies, thus forcing the Confederate general Price to Southeastern Missouri; following up his success, now in command of the Army of the Mississippi, in co-operation with Admiral Foote New Madrid was taken (Mar. 14, 1862). He was made major-general Mar. 21, 1862, and on Apr. 8 captured Island No. 10 in Mississippi river, with upward of 6,500 prisoners and about 125 cannon and 7,000 small-arms. Uniting with the combined armies under Gen. Halleck, he participated in the advance upon Corinth, and upon the evacuation of that place (May 30) pursued the Confederate army as far as Baldwin. He was made a brigadier-general in the regular army (July 14, 1862) and placed in command of the Army of Virginia, to which was added the Army of the Potomac. The unsuccessful battle of Manassas, or Second Bull Run, was fought Aug. 29–30, and the next day (Sept. 1) that of Chantilly; a few days later Pope resigned his command, and resumed command of the department of the Northwest. He charged the failure of his operations in Virginia to the misconduct of Gen. Fitz John Porter at the battle of Manassas. (See PORTER, FITZ JOHN.) Subsequently he commanded the departments of the Missouri, the Lakes, and the Mississippi. He became major-general Oct. 26, 1882; retired Mar. 16, 1886. D. at Sandusky, O., Sept. 23, 1892. He published *Campaign of Virginia of July and August, 1862* (Washington, 1865).

Pope, John Henry: statesman; b. in the Eastern Townships, Province of Quebec, Canada, in 1824; educated at the High School in Compton; was a farmer in early life. He represented Compton in the Canadian Assembly 1857–67, and in the Dominion Parliament 1867–89; was Minister of Agriculture 1871–73 and 1878–85, and Minister of Railways and Canals 1885–89. In 1880 he visited London with Sir John A. Macdonald and Sir Charles Tupper, and took active part in the negotiations which led to the Pacific Railway contract. D. Apr. 1, 1889. N. M.

Popham, Sir John: b. at Wellington, Somersetshire, England, in 1531; entered Baliol College, Oxford, then the Middle Temple, and in 1571 became sergeant-at-law; afterward was appointed solicitor-general and gave up his sergeantship; Speaker of the House of Commons 1581; attorney-general 1585, in which office he conducted the trials of those implicated in the Babbington conspiracy; lord chief justice of the king's bench June 8, 1592, which office he held for fifteen years, during which he was noted for his extreme severity to prisoners and his impartiality in trials involving party disputes. He presided at the trials of Sir Christopher Blunt, Sir Walter Raleigh, Guy Fawkes, and other noted persons. He was the author of a part of Popham's *Reports*, which are of little authority. D. June 10, 1607. He was active in colonization schemes, and was one of the patentees associated with Sir Ferdinando Gorges and George Popham. —George Popham, b. in Somersetshire, England, about 1550, was a brother of Sir John Popham, and was, with him and Sir Fernando Gorges, one of the patentees of an extensive territory in the present State of Maine in the U. S. He sailed from Plymouth May 31, 1607, with two ships and 100 men, and landed Aug. 15 at the mouth of the Kennebec or Sagadahoc river, where they built a rude fort which they named Fort George. This was the first English settlement in New England, but in the spring of 1608, after the death of Popham (Feb. 5), it was abandoned by the colonists, who returned to England.—Sir Francis Popham, probably a son of Sir John, was also a patentee of New England and was a member of Parliament in 1620. F. Sturges Allen.

Popish Plot: See Oates, Titus.

Poplar [M. Eng. *popler*, from O. Fr. *poplier* > Mod. Fr. *peuplier*, *peuple*: Ital. *pioppo*: Span. *pobo* < Lat. *pō'pulus* and Vulg. Lat. **plōpus*, poplar]: properly the name of any tree belonging to the genus *Populus* and family *Salicaceæ*, but popularly and very incorrectly extended to the Tulip-tree (*q. v.*) of the U. S. The true poplars have a light, white wood, which is very perishable if exposed to the weather or if not carefully seasoned. The common balsam-poplar, tacamahac, or balm-of-Gilead tree (*P. balsamifera*) produces a copious fragrant resin on its buds; it is a handsome tree of North America and Asia. Several of the poplars of the U. S. are called cottonwood, although this name is properly applied to the Carolina poplar (*P. monilifera*). (See Cottonwood-tree.) The cottonwoods are useful for fuel and timber, but liable to warp unless prepared with care. The white poplar, or American aspen, *P. tremuloides*, is a handsome tree, as is the *P. grandidentata*. *P. heterophylla* is a large cottonwood with large, downy leaves. The abele, or silver-leaf poplar of Europe, *P. alba*, is frequently planted in the U. S. It spreads rapidly by the roots. Its timber is excellent, as also is that of the gray and black European poplars, *P. canescens* and *nigra*. The Lombardy poplar (*P. nigra*, var. *italica*) is remarkable for the singular upward tendency of its branches. One of the most important of the more recent economic uses of the poplars is the manufacture of paper-pulp from their wood. Several poplars from Russia have been introduced into the U. S. for planting in the northern prairie States. Of these the best is *P. laurifolia*, the Certinensis poplar, which is the European representative of the American cottonwood. For an account of the cultivated poplars, see Bulletin 68, Cornell University experiment station. Revised by L. H. Bailey.

Poplar Bluff: city; capital of Butler co., Mo.; on the Big Black river, and the St. L., Iron Mt. and Southern Railway; 74 miles W. S. W. of Cairo, 166 miles S. of St. Louis (for location, see map of Missouri, ref. 8–J). It has manufactories of lumber, staves, pottery, brick, and tile, and contains a State bank with capital of $50,000, and 2 daily and 2 weekly newspapers. Pop. (1890) 2,187; (1900) 4,321.

Popocatepetl [Aztec, smoking mountain]: a quiescent volcano of Mexico: on the confines of the states of Mexico and Puebla; 43 miles S. E. of Mexico city; height about 17,800 feet, or 380 feet less than Orizaba, the highest peak in Mexico. From about 14,800 feet (in January) it is covered with snow; below this there is a broad zone of pine- and oak-forest. The ascent is difficult. There are two principal craters; the upper and more recent one is about 1,000 feet deep and has large deposits of sulphur, which are regularly mined. There is no clear record of an eruption within historical times; sulphur fumes and occasionally smoke are given out. Herbert H. Smith.

Poppy [M. Eng. *popy* < O. Eng. *popig*, from Lat. *papaver*, poppy]: any plant of the genus *Papaver* of the family *Papaveraceæ*. The flower is large and showy, the corolla being generally four-petaled and the calyx two-leaved. The stigma is in the form of rays, ranging from four to twenty in number. It springs directly from the ovary and persists upon the capsule. The latter is one-celled, though with imperfect partitions, and contains numerous seeds which escape by pores under the flaring stigma. The poppy is an annual or perennial herbaceous plant, and abounds in a milky juice. There are about a score of species, natives of Europe and Asia, most of which are found only in the warm temperate regions. By far the most important species is *P. somniferum*, from which the drug opium is obtained. (See Opium.) There are several varieties of this species, of which the most prominent are called the *white* and *black* poppy, respectively, from the color of the seeds. The flower of the former is white—that of the latter generally red or violet, though also sometimes white. This species of poppy has been known from a remote period in the countries bordering on the eastern coast of the Mediterranean, and is now extensively grown in Asiatic Turkey, Persia, Egypt, Europe, India, and China. In the Oriental countries it is cultivated for opium, but in France and Germany principally for a bland fixed oil, *poppy-oil*, found in the seeds. This oil exists in the seeds in about the proportion of 40 per cent., is entirely devoid of narcotic properties, and is used extensively for the same purposes as olive-oil, which it much resembles. In England there occurs in abundance a species of poppy called the *red poppy* or *corn-rose* (*P. rhœas*), having a fiery-red flower, the scarlet petals of which are used in pharmacy to impart a brilliant color to mixtures. In the U. S. the *P. somniferum* has been naturalized, but is cultivated principally as a garden-flower. The Iceland poppy (*P. nudicaule*), with white and yellow long-stalked flowers, is a spring-flowering species which is grown for ornament. Revised by L. H. Bailey.

Poppy Family: the *Papaveraceæ*; dicotyledonous herbs, with a white or red latex; leaves alternate; flowers perfect; perianth double, the sepals two, the petals four to eight, or more; pistil one, superior, compound, one-celled, of two to sixteen carpels, placentæ two to many, parietal; ovules usually many. About 160 species are known, mostly natives of the temperate and sub-tropical regions of the northern hemisphere. As here treated the family includes a considerable number of plants cultivated for their beautiful flowers and foliage, e. g. the California poppy (*Eschscholtzia californica*), blood-root (*Sanguinaria canadensis*), prickly poppy (*Argemone*, of several species), poppy (*Papaver*, of many species, including *P. somniferum*, the opium-poppy), bleeding-heart (*Bicuculla spectabilis*), fumitory (*Adlumia fungosa*), and many species of *Corydalis* and *Fumaria*.

Charles E. Bessey.

Population [from Lat. *popula'tio*, liter., peopling, deriv. of *popula're*, people, populate, deriv. of *po'pulus*, people, whence Eng. *people*]: the total number of inhabitants of a country, district, city, or region. The population of any part of the earth's surface is determined by one or more of several causes. The most important of these may be enumerated as, first, adaptation of soil and climate to produce food; second, natural advantages for the manufacture of articles desired; third, facilities for moving products from regions where there is excess to regions where there is scarcity; fourth, enterprise and ingenuity of men in availing themselves of existing advantages; and, fifth, knowledge and public spirit in warding off the natural and artificial checks upon increase of population. See Political Economy.

The tendency of all animal as well as vegetable life to increase in geometrical ratio is kept in check by various counteracting influences. In the case of man not only war and pestilence but also certain social conditions tend to retard the natural increase. In a complicated society where there are already marked social distinctions it is noteworthy that the increase among the poorer classes is more rapid than

among the rich. Malthus and others have accounted for this difference by an absence of prudential conditions on the part of the poor. Where there is no hope of bettering the condition there is a tendency to recklessness of indulgence, but where wealth and social distinctions have been established marriages on the part of the wealthier classes are often postponed and consequently the number of children born is diminished.

Until recently the various natural and artificial checks upon the growth of population have very nearly counterbalanced the tendencies to increase. The introduction of civilized methods of government into countries formerly barbaric has lessened war, famine, and pestilence, and thus removed some of the most powerful checks upon growth. The general advances of civilization have tended in the same direction. The more general prevalence of hygienic methods of life, greater care in furnishing supplies of untainted water, a better understanding of the causes of various diseases and the means of preventing them, and, above all, the more general adoption of sanitary drainage, have tended very greatly to diminish the death-rate and so remove some of the checks upon the increase of population. The most powerful of all influences in this direction have been the methods and facilities introduced within the nineteenth century for the more easy distribution of surplus products. Regions which formerly seemed incapable of supplying the necessities of mankind are now supplied from remote regions, and the consequence is that all over the civilized world population has increased with a rapidity hitherto entirely unknown. Within one century the population of the various countries of Europe has increased more than it had increased for several centuries before. The following table will show not only that this tendency is still going on in the Old World as well as in the New, but also will enable the reader to judge as to the comparative rate of increase in the cities and in the several countries:

TABLE SHOWING THE COMPARATIVE GROWTH OF POPULATION IN DIFFERENT COUNTRIES OF EUROPE AND AMERICA.

COUNTRIES.	1870-71.	1880-81.	1890-91.
EUROPE:			
England	21,495,131	24,613,934	27,482,104
Ireland	5,411,416	5,174,836	4,704,750
Scotland	3,360,018	3,735,573	4,025,647
Wales	1,217,135	1,360,505	1,518,914
Austria-Hungary	35,634,848	37,623,923	*41,043,835
Austria	(1869) 20,217,521	21,981,821	23,707,906
Hungary	(1869) 15,417,327	15,642,102	17,335,929
Belgium	(1876) 5,336,185	5,520,000	6,069,321
Denmark	1,794,723	1,980,259	2,185,335
France	(1872) 36,102,921	37,672,048	38,218,903
Germany	†41,060,000	45,234,000	49,428,470
Greece	1,457,894	(1879) 1,979,453	(1889) 2,187,208
Italy	26,801,154	28,459,628	‡30,347,291
Netherlands	(1869) 3,579,529	(1879) 4,012,693	4,621,744
Norway	1,701,365	No census.	2,001,000
Portugal	(1869) 3,995,152	(1878) 4,160,375	
Russia	78,281,447	No census.	(1887-89) §86,782,574
Spain		(1877) 16,625,860	(1887-89) 17,550,246
Sweden	4,168,525	4,565,668	4,784,981
Switzerland	2,669,147	2,846,102	(1888) 2,917,754
Turkey		4,275,000	(1885) 4,786,545
AMERICA:			
U. S	38,558,371	50,189,209	62,654,302
Canada‖	3,739,235	4,324,810	4,829,411
Newfoundland	¶ 161,374	181,753	197,934

* Including Croatia and Slavonia.
† *Statesman's Year-book* for 1872 gives 40,111,265 (including Alsace and Lorraine).
‡ Estimated. ‖ Excludes Newfoundland.
§ Excluding Poland and Finland. ¶ Estimated.

TABLE SHOWING THE COMPARATIVE GROWTH OF POPULATION IN THE PRINCIPAL CITIES OF EUROPE AND THE U. S.

CITIES.	1870-71.	1880-81.	1890-91.
ENGLAND:			
London	3,254,260	3,832,441	4,211,056
Liverpool	493,405	552,425	517,951
Manchester	379,374	462,303	505,343
Birmingham	343,787	400,757	429,171
Leeds	259,212	309,126	367,506
Sheffield	239,916	284,410	324,243
Bristol	132,557	206,503	220,665
Bradford	145,830	183,032	216,361
Nottingham	86,621	186,656	211,984
Hull	121,892	154,250	199,991
Salford	124,801	176,233	198,136
Portsmouth	113,569	127,953	159,255
SCOTLAND:			
Glasgow	477,156	555,289	618,471
Edinburgh	196,979	228,075	261,261
Dundee	121,925	140,463	153,066
Aberdeen	88,108	105,818	121,905
IRELAND:			
Belfast	174,412	207,671	255,896
Dublin	246,326	249,486	254,709
WALES—Cardiff	56,911	85,378	128,849
AUSTRIA-HUNGARY:			
Vienna	(1875) 1,001,999		1,364,384
Budapest	309,708	347,536	506,384
Prague	157,713	162,318	184,109
Trieste	109,324	144,437	158,344
Lemberg	87,109	110,250	128,419
Grätz	81,119	97,726	113,540
BELGIUM:			
Brussels	310,217	391,393	476,810
Antwerp	126,663	159,579	227,225
Ghent	121,469	130,671	153,740
Liège	111,853	119,942	149,789
DENMARK:			
Copenhagen	197,576	273,727	312,387
FRANCE:			
Paris	(1876) 1,988,806		2,447,957
Lyons	(1866) 323,954		401,938
Marseilles	(1866) 300,131		376,143
Bordeaux		194,241	252,415
Lille		154,749	188,272
Toulouse	(1872) 126,936		147,617
GERMANY:			
Berlin	826,341	1,122,385	1,579,244
Leipzig	127,387	148,760	353,272
Munich	169,693	229,343	348,317
Breslau	207,997	272,390	335,174
Hamburg	236,279	290,055	323,923
Cologne	129,233	144,751	281,273
Dresden	177,089	220,216	276,085
Magdeburg	84,401	97,529	202,325
Frankfort	91,040	137,600	179,850
Hanover	87,626	122,860	165,499
Königsberg	112,092	150,396	161,528
GREECE:			
Athens	48,107	63,374	107,251
ITALY.*			
NETHERLANDS:			
Amsterdam	274,931	308,948	417,539
Rotterdam	123,097	147,082	209,136
Hague (The)	93,083	111,016	160,531
NORWAY:			
Christiania	57,381	119,407	150,444
SPAIN:			
Madrid	381,470	397,690	470,283
Barcelona	249,106		272,481
Valencia	107,703	143,856	170,763
Seville	118,298	133,938	143,182
Malaga	94,732	115,882	134,006
SWEDEN:			
Stockholm	124,691	169,429	246,154
Gothenburg	58,164	74,418	104,657
UNITED STATES:			
New York	942,292	1,206,299	1,515,301
Chicago	298,977	503,185	1,099,850
Philadelphia	674,022	847,170	1,046,964
Brooklyn	396,099	566,663	806,343
St. Louis	310,864	350,518	451,770
Boston	250,526	362,839	448,477
Baltimore	267,354	332,313	434,439
San Francisco	149,473	233,959	298,997
Cincinnati	216,239	255,139	296,908
Cleveland	92,829	160,146	261,353
Buffalo	117,714	155,134	255,664
New Orleans	191,418	216,090	242,039
Pittsburg	86,076	156,389	238,617
Washington	109,199	177,624	230,392
Detroit	79,577	116,340	205,876
Milwaukee	71,440	115,587	204,468
Newark	105,059	136,508	181,830
Minneapolis	13,066	46,887	164,738
Jersey City	82,546	120,722	163,003
Louisville	100,753	123,758	161,129

* No census since 1879.

The density of the population per square mile in various countries in 1891 is indicated by the following figures: Belgium, 535·81; the Netherlands, 359·55; Great Britain, 311·88; China, 295·07; Japan, 264·59; Italy, 263·59; Germany, 234·05; France, 187·26; Switzerland, 184·69; Denmark, 162·72; Austria-Hungary, 161·88; India, 150·43; Spain, 84·23; Russia, 45·75; U. S., 20·77. The most recent estimate of the total population of the world is fourteen hundred and eighty millions. C. K. ADAMS.

Porbeagle: a shark of the genus *Lamna*, especially *L. cornubica*, a species common in the North Atlantic, which reaches a length of 10 feet. The porbeagles have rather slender teeth and feed on fishes.

Porcelain: See POTTERY AND PORCELAIN.

Porcelain, Réaumur's: a porcelain-like substance, first obtained by Réaumur by devitrifying ordinary glass. Excessively slow cooling will sometimes produce devitrification, particularly in very calcareous glasses, but it often oc-

curs in actual glass-working as an effect of careless and repeated heating and cooling. The glass becomes opaque, tougher, and less susceptible to fracture from sudden heating and cooling, having really something of a porcelain-like character. It is attributed to the formation of crystalline compounds in the mass, which, when once formed, are difficult of refusion.

Porch: a covered and partly inclosed approach to an entrance-door, as of a church or dwelling-house; also, by extension, a covered or partly inclosed room or hall not necessarily leading into or connected with an inclosed building; a covered promenade, or portico: in this sense the term is going out of use; no one would call the Stoics the philosophers of the *porch*, but the word portico or stoa would be used. In the first sense, the porch of a Greek or Roman temple, the *pronaos*, might be the first thing entered from without, or might be inclosed by the peristyle or continuous portico of columns; it was an outer vestibule. The porch of a Gothic church was sometimes such a vestibule, projecting like a small wing or pavilion from the larger structure, and was sometimes merely a deeply recessed doorway, as in the great cathedrals. In this latter case the actual working thickness of the wall of the building was often added to by an outer gable or screen, so as to make the depth of the porch greater. In modern times the *carriage-porch* is built well outside of the main structure, and has this peculiarity that the carriage is not to enter the building, but only to discharge or take up its passengers and then pass on. A carriage-porch differs from a marquise in being more solid and architectural. Russell Sturgis.

Porcupine [M. Eng. *porkepyn*, from O. Fr. *porc espin*, liter., spine-hog < Lat. *por'cus*, pig + *spi'na*, spine, thorn]: any one of various rodents characterized by the development of sharp spines among the hairs. These spines or quills are really greatly exaggerated hairs, and almost every degree of development, from soft hairs to strong, stiff spines, may be found in the same animal. These quills, which are the weapons of the porcupine, can be erected by means of peculiar muscles, and the animal, when attacked, bristles up and charges backward. The spines are finely barbed at the tip, and frequently become detached and stick in the assailant's hide or nose, and this has given rise to the fable that the porcupine shoots his quills. Porcupines belong to two distinct groups—the *Hystricidæ*, with the genera *Hystrix*, *Acanthion*, and *Atherura*, peculiar to the Old World, and the *Spalacopodidæ*, with the genera *Erethizon*, *Cercolabes*, and *Chætomys*, restricted to America. By many zoölogists these two groups are considered as divisions of one family. The best-known species, the African porcupine (*Hystrix cristata*), found in Spain, Sicily, Italy, and Northern Africa, is a stout, heavily built animal, a little over 2 feet in length, with a crest of very long, stiff hairs down the nape. The quills on the hinder part of the body are very long, and, like the hairs, marked with rings of black and white. The quills upon the short tail are truncated and open at the ends. The animal dwells in burrows or crannies among the rocks, lives on vegetables, and is sometimes sold in the markets for food. The common porcupine of North America, *Erethizon dorsatum*, is prevailingly gray or blackish, and large specimens attain a total length of nearly 3 feet. The quills are abundant and very sharp, but are comparatively short, being in winter almost concealed by the long hair. The tail is of considerable length, and the animal strikes with it very effectively. This species is found from Maine westward through the northern part of the U. S. and over a great part of British America. In the West it is replaced by another species, *Erethizon epixanthus*, distinguished by the yellowish color of the long outer hairs. These animals climb readily, live on leaves and bark, and are extremely fond of salt, sometimes eating into barrels of salt provisions stored by lumbermen. The South American porcupines of the genus *Cercolabes*, or *Synetheres*, which range from Mexico to Brazil, are distinguished by long prehensile tails. They are thickly clad with short spines. The Brazilian porcupines of the genus *Chætomys* are characterized by short, weak, wavy spines, which, except about the shoulders, are scarcely more than very strong bristles. The species of *Atherura*, known as brush-tailed porcupines, found in the Malay Peninsula, some of the large adjacent islands, and Africa, have short and rather weak flattened spines. F. A. Lucas.

Porcupine Ant-eater: the Echidna (*q. v.*).

Pordeno'ne: town; in the province of Udine, Italy; on the right bank of the Noncello; about 30 miles from the city of Udine (see map of Italy, ref. 2–E). Of its ancient walls and splendid castle only the ruins remain. In the Palazzo Comunale, the cathedral (begun 1347), and in several smaller churches may be seen oil-paintings and frescoes by Licinio, also called Il Pordenone, and others of his school. Pordenone has utilized its abundant water-power, and has cotton, silk, and earthen and iron ware manufactories. Pop. 5,100.

Pordenone: See Licinio.

Pore [viâ Fr. from Lat. *po'rus* = Gr. *πόρος*, pore, ford, means, etc., liter., way, passage]: a very narrow passage in any solid substance; particularly an efferent duct of the glands in the skin of animals. The largest and least abundant of these are the ducts of the sebaceous glands, which secrete an oily substance. They are numerous on the head and face and near the orifices of the body, but elsewhere fewer or even wanting. The ducts of the sweat-glands are most numerous on the palm of the hand, where 2,800 have been counted in 1 sq. inch. Krause estimates the number on a single person at 2,381,248.

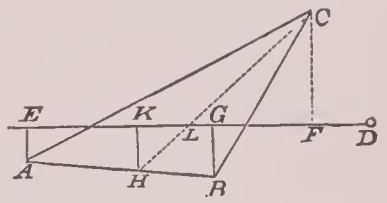
Porfi'rio Di'az, Ciudad' (formerly *Piedras Negras*): a frontier town of the state of Coahuila, Mexico; on the Rio Grande, opposite Eagle Pass, Tex.; on Mex. Internat. Railroad (see map of Mexico, ref. 3–G). It is in the "free zone," and its custom-house has to do principally with goods in transit. H. H. S.

Porfyrius: See Optatianus.

Porgy: a name applied in different localities to any one of several different fishes. In Europe it is given to *Pagrus vulgaris*; on the eastern coast of the U. S. to the scup, *Stenotomus argyrops*, and sometimes to the menhaden, *Brevoortia tyrannus*; rarely to the moonfish or angel-fish, *Chætodipterus faber*. See Fisheries. F. A. L.

Porifera: See Sponges.

Po'rism [viâ Fr. and Lat. from Gr. *πόρισμα*, thing procured, hence a deduction from a demonstration, corollary, deriv. of *πορίζειν*, carry, bring, furnish, procure]: a name given by ancient geometers to a class of propositions having for their object to show what conditions will render certain problems indeterminate. In order that the solution of a problem may be determinate, there must be as many independent conditions as there are parts to be determined. If, therefore, any supposition can be made on the data of the problem that will cause one of the given conditions to depend upon one or more of the others, the solution will become indeterminate; that is, the problem will have an infinite number of solutions. The object of the porism is, then, to discover an hypothesis that will make one of the given conditions of a determinate problem dependent upon one or more of the others. The nature of a porism will be illustrated by an example: Let A B C be a given triangle, and D any point in its plane; it is required to draw a line through D such that the sum of the perpendiculars to it from the two vertices on one side shall be equal to the perpendicular to it from the vertex on the other side. Suppose the problem solved, and let D E be a line such that the sum of A E and B G is equal to C F. Draw C H bisecting A B at H and cutting D E at L; also draw H K perpendicular to D E; then will H K = ½(A E + B G), or C F = 2H K. From the similar triangles L K H and L F C we have H K : H L : : C F : C L, or C F = 2H L. Hence the line D E must cut H C at a point one-third of the distance from H to C, and this no matter what may be the position of D. In the general case—that is, when D and L do not coincide—the problem is determinate, and admits of but one solution. Now let it be required to find the condition that will make the problem indeterminate. If we suppose D to coincide with L, the preceding proportion will be true whatever may be the direction of E K; hence the condition required is that D shall coincide with L, and the finding of this condition constitutes the essential part of the porism. The porism just considered may be enunciated as follows: To find in the plane of a triangle a point such that if any line is drawn through it, and perpendiculars let fall upon it from the vertices, the sum of the perpendiculars on one side shall be equal to the perpendicular on the other side.



Revised by R. A. Roberts.

Porosity [deriv. of *porous*, deriv. of *pore*. See PORE]: a property of matter in accordance with which its molecules are separated by intervals or pores. The porosity, for instance, of stone or wood is proved by immersing the object in water under the receiver of an air-pump; when the air is exhausted from the surface, that inclosed in the pores of the object will rise to the surface in the form of bubbles. The porosity of cast iron has been proved by forcing water through the pores of a plate 4 inches thick, and the porosity of liquids is exhibited by mixing alcohol and water, when the volume of the mixture is found to be less than the sum of the volumes of the components.

Porphy'rio, POMPONIUS: a Latin grammarian of the fourth century, perhaps from Africa, whose commentary on the works of Horace is still extant. Edition by W. Meyer (Leipzig, 1874).

Porphyrogenitus: See CONSTANTINE VII.

Porphyry [Gr. *πορφυρίτης*, from *πορφύρα*, purple]: See ROCKS and BUILDING-STONE.

Porphyry, or (Lat.) **Porphyrius**: Neoplatonist philosopher; b. at Batanea, Syria, 233 A. D.; received the instruction of Origen at Cæsarea; studied afterward at Athens under Longinus, and finally in Rome under Plotinus, of whom he became a passionate disciple; traveled in Sicily and other countries, but returned subsequently to Rome, where he died about 305. Of his numerous works, the greater part is not extant. The most important of his lost productions was his work against Christianity, which was publicly burned by order of Theodosius II. in 448. Among the works which have come down to us are biographies of Plotinus and Pythagoras; a commentary on Aristotle's *Categoriæ*, generally printed as an introduction to the *Organon*; a treatise *de Abstinentia*, etc. There is no collected edition of his works.

Porpoise [M. Eng. *porpeys*, from O. Fr. *porpeis*, liter., hogfish < Lat. *por'cus*, hog + *pis'cis*, fish]: any one of various small cetaceans, rarely over 8 or 9 feet in length, belonging to the family *Delphinidæ*, properly distinguished from the dolphins (see DOLPHIN), which are also called porpoises, by not having the anterior part of the head prolonged into a distinct beak. They have sharp conical teeth in both jaws, adapted for seizing slippery living prey. They go in

The porpoise.

shoals, sometimes containing many hundreds, and are found in nearly all seas, but more especially in temperate latitudes, and usually not very far from land. The common species, *Phocæna communis*, known also as puffing-pig and puffer, attains a length of 6 feet, has peculiar compressed teeth, and is glossy black above, lighter beneath. It sometimes ascends rivers for considerable distances. The skunk-porpoise, *Lagenorhynchus acutus*, of the North Atlantic, is larger, with broad stripes of white and yellow on the sides. In favorable localities various species are taken for their blubber, which yields oil, and for their skins, which make good leather. F. A. LUCAS.

Porrigo: See FAVUS.

Porro, EDUARDO, M. D.: gynæcologist; b. near Padua, Italy, Sept. 17, 1842; studied medicine in Pavia, graduating M. D. in 1865; from 1865–68 was assistant at the Milan Ospedale Maggiore; in 1868 he was appointed assistant and subsequently Professor of Obstetrics at the University of Milan. He accepted the same chair in the University of Pavia in 1875, and remained there until 1883, when he returned to Milan. In 1876 he published a method of amputating the uterus that served to give him worldwide prominence. He is the author of a number of monographs on gynæcological topics. S. T. ARMSTRONG.

Por'sena (less correctly *Porsen'na*): king of the Etrurian city of Clusium, under whose leadership the Etruscans compelled Rome to capitulate, and, as Pliny the elder reports, to surrender all weapons and agree to employ iron henceforth only for agricultural implements. How long this subjection continued and how the Romans regained their independence we do not know. The disgrace of the event, knowledge of which we owe to incidental remarks of Tacitus and Pliny, was concealed under the romantic stories, narrated by Livy, of Horatius at the bridge, of Scævola's sacrifice of his hand in the flame to show Porsena the character of Roman patriotism, and of the consequent voluntary withdrawal of the Etruscan forces. G. L. HENDRICKSON.

Porson, RICHARD: Greek scholar; b. at East Ruston, Norfolk, England, Dec. 25, 1759; was educated at Eton and at Trinity College, Cambridge, where he won the Craven scholarship, the chancellor's medal, and a fellowship 1782; began the publication of a series of critical labors upon the texts of classical authors; published in 1790 his famous *Letters* on the spuriousness of the text of the three witnesses; resigned his fellowship 1791 from conscientious scruples about subscribing to the Thirty-nine Articles; became Regius Professor of Greek at Cambridge, and librarian of the London Institution 1806. Next to Bentley, Porson is the greatest text-critic whom England has produced. Published critical editions of Euripides's *Hecuba* (with a famous introduction on Greek versification), *Orestes*, *Phœnissæ*, and *Medea*; Æsehylus (2 vols.); and many contributions to the text of Greek authors. D. in London, Sept. 25, 1808. See *Tracts and Miscellaneous Criticism of Richard Porson* (edited by Kidd, 1815), and J. S. Watson's *Life of Richard Porson* (1861). Revised by A. GUDEMAN.

Por'ta, CARLO: b. at Milan, 1776; was an intimate friend of Alessandro Manzoni and of Tommaso Grossi. His poems in the Milanese dialect, which have passed through many editions, the most celebrated is the one entitled *Disgrazi de Giovanin Bongee*. Porta was an amiable satirist, most true to nature, and full of power and vigor. D. 1821.

Porta, BACCIO della: same as BARTOLOMMEO (*q. v.*).

Porta, GIACOMO, della: architect; b. at Milan, Italy, in the beginning of the sixteenth century. He began modeling stucco bas-reliefs under Gobbo, but he studied architecture under Vignola, whom he succeeded as architect of St. Peter's. He finished the Palace of the Senator on the Capitol of Rome, which Vignola had continued after the drawings of Michelangelo. He constructed the Gregorian chapel for Gregory XIII., which cost the pope 80,000 scude, the Greek church in Via Babuino, the Church of the Madonna dei Monti, and a portion of that of the Florentines in Via Giulia in Rome. At the Certosa of Pavia he designed the tomb of the Conte di Virtù, and worked on the façade of the church. In 1531 he was invited to Genoa, where he built in the cathedral the chapel of St. John the Baptist, which was decorated with sculpture by his nephew William. Lastly, together with Fontana, he constructed the cupola of St. Peter's, changing, with Sixtus V.'s permission, Michelangelo's design by making the curve of the dome more elliptical than in the original model. He built also the façade of San Pietro in Vincoli, besides many fountains in Piazza Navona, Piazza Colonna, and Piazza del Popolo. D. in 1604. W. J. STILLMAN.

Porta, GIAMBATTISTA, della: philosopher; b. in Naples about 1543; traveled much in Italy, Spain, and France; founded in his native city the first society for the study of physical science in Italy, called Academia Secretorum Naturæ, which held its meetings in his own house, and to which no one was admitted unless he had made some discovery in natural philosophy; was accused of magic, and, though acquitted by the pope, was compelled to dissolve his academy; wrote many volumes on natural magic, geometry, optics, the human physiognomy, etc.; and invented the camera obscura. D. in Naples, Feb. 4, 1615.

Portadown: town; in the county of Armagh, Ireland; on the Bann; 25 miles by rail S. W. of Belfast (see map of Ireland, ref. 5–I). It has large distilleries and manufactures of linen and linen yarn, and an active trade in agricultural produce. It communicates by canal with the sea at Newry. Pop. (1891) 8,430.

Portage: city (founded in 1838, formerly called Winnebago Portage); capital of Columbia co., Wis. (for location, see map of Wisconsin, ref. 6–D); on the Wisconsin river, the ship-canal connecting the Wisconsin and Fox rivers, and the Chi., Mil. and St. P. and the Wis. Cent. railways; 30 miles N. of Madison, 85 miles N. W. of Milwaukee. It is in an agricultural and lumbering region, has important commercial and manufacturing interests, and contains a State bank with capital of $75,000, and a daily newspaper and four weekly ones. Pop. (1880) 4,346; (1890) 5,143; (1900) 5,459. EDITOR OF "STATE REGISTER."

Portage la Prairie: town; in the province of Manitoba, Canada; on the Assiniboine river; 56 miles by rail W. of Winnipeg; on the Canadian Pacific, Manitoba and Northwestern, and Northern Pacific railways. It is the market-town of a rich farming country, has flour-mills, grain-elevators, a biscuit-factory, paper-mill, etc., and a semi-weekly and two weekly newspapers. Pop. (1891) 3,363.

Portalis, pōr'tăă'lees', JEAN ÉTIENNE MARIE: jurist; b. at Bausset, in Provence, France, Apr. 1, 1745; attended the university at Aix, and became an advocate in 1765 and later the leader of the bar at Aix. He was for some years active in politics in opposition to the party of Mirabeau, and opposed the measures of the Constituent Assembly, but in 1790 abandoned politics, retiring to Lyons. In 1793, after the proclamation of the republic, he returned to Paris and resumed his law practice, and after the death of Robespierre became the leader of the moderate party opposed to the Directory; was later proscribed and escaped to Switzerland, whence he returned after Bonaparte became the First Consul. He early showed a thorough insight into the spirit of the French law and a marked ability in the matter of developing and systematizing it. By Napoleon he was made a member of the commission for drawing up the Civil Code, of which he was the principal author, the treatment of many of the most important subjects, especially those of marriage and heirship, being intrusted to him, and to those labors he chiefly owes his fame. In 1801 he was put in charge of the department of public works, and in this capacity had the chief share in the drawing up of the Concordat; in 1803 was a member of the Institute; in 1804 Minister of Public Worship, in which capacity he was the leader in reorganizing the French Church; in 1805 was made a Knight Grand Cross of the Legion of Honor. D. in Paris, Aug. 25, 1807. See René Lavollée's *Portalis, sa vie et ses œuvres* (Paris, 1869). F. STURGES ALLEN.

Port Arthur: town; in the province of Ontario, Canada; on Thunder Bay, an arm of Lake Superior; on the Canadian Pacific Railway; 993 miles from Montreal and 431 miles from Winnipeg. Steamships ply between it and Owen Sound on Georgian Bay. The town has docks, a grain-elevator, some manufactures, and a trade in lumber. It has a daily and two weekly newspapers. Pop. (1891) 2,698.

Port Arthur (called by the Chinese *Lü-shun-k'ow*): a landlocked harbor on the Strait of Pechili, near Kin-chow-t'ing and the southwest extremity of the province of Liao-tung or Shing-king, Manchuria (see map of China, ref. 3–K). The harbor is almost surrounded by hills from 300 to 1,500 feet in height, with cultivated valleys between. In 1881 it was merely a good wind-bound harbor for junks trading along the coast. It was then decided to make it the chief naval station of China, and the neeessary docks, dry-docks, refitting-basins, foundries, workshops, and dockyards, were completed (1891) by French contractors. The harbor entrance, which is from 200 to 300 yards wide, was deepened so as to admit the heaviest war-vessels, and well-constructed forts armed with modern guns were constructed to defend the port both from land and sea attacks. The village, consisting (1881) of about sixty mud huts, became a well-built town (1893) of about 1,000 houses and shops, with 6,000 inhabitants, exclusive of the garrison of 7,000 soldiers. It had 4 native banks, 2 temples, and 2 large theaters. The port is free from ice throughout the winter. Port Arthur was captured (Nov. 22, 1894) by the Japanese under Marshal Oyama, and held until Jan., 1896. C. C. ADAMS.

Port-au-Prince: capital and most important city and port of the republic of Haiti; on a deep bay of the western coast (see map of West Indies, ref. 5–G). The harbor is good and safe. The city, built on sloping ground, is regularly laid out, with wide streets; but it is very dirty, there are few pretentious edifices, and numerous ruins attest the ravages of the civil wars. Nearly all the houses are of wood, as building with stone was abandoned after the disastrous earthquakes of 1751 and 1770; the place has suffered even more from fires, some of them the work of political leaders. The surrounding scenery is very beautiful, but the mountains shut off the winds and make Port-au-Prince one of the hottest places in the island. Except during epidemics of yellow fever it is not, however, very unhealthful. The commeree is important, the principal exports being coffee, logwood, hides, and cacao. The city was founded in 1749. Pop. from 30,000 to 60,000. HERBERT H. SMITH.

Port Chester: village (incorporated in 1868); Westchester co., N. Y. (for location, see map of New York, ref. 8–J); on Long Island Sound, and the N. Y., N. H. and Hart. Railroad; 26 miles N. E. of New York city, 30 miles W. S. W. of Bridgeport, Conn. It contains a national bank with capital of $100,000, a savings-bank with deposits of over $925,000, 2 primary schools, public high-school, an institute, a public library, 3 carriage-factories, 2 iron-foundries, 2 screw- and bolt-factories, woolen-mill, shirt-faetories, carriage-coupling works, and a monthly and 2 weekly periodicals. Pop. (1880) 3,254; (1890) 5,274; (1900) 7,440. EDITOR OF "JOURNAL."

Port Clinton: village; capital of Ottawa co., O.; on Lake Erie at the mouth of the Portage river, and on the Lake Shore and Mich. S. Railway; 14 miles W. N. W. of Sandusky, 35 miles E. N. E. of Toledo (for location, see map of Ohio, ref. 1–E). It has considerable lake commeree, is engaged principally in fishing and in grape and peach culture, and contains a high-school, a State bank with capital of $35,000, and 4 weekly newspapers. Pop. (1880) 1,600; (1890) 2,049; (1900) 2,450.

Port Deposit: town; Cecil co., Md.: on the Susquehanna river, and the Penn. and the Phila., Wilm. and Balt. railways; 41 miles E. N. E. of Baltimore (for location, see map of Maryland, ref. 1–G). It has a large lumber-trade, and contains valuable granite-quarries, foundry, grist-mill, a national bank with capital of $100,000, and a weekly newspaper. Pop. (1880) 1,950; (1890) 1,908; (1900) 1,575.

Porte cochère: a door in the outer wall of a house, large and high enough to allow a carriage and horses to pass in and out. Such a door generally leads to a stable beyond the house or opening on the court. The use of this term for a carriage-porch is improper.

Port Eliz'abeth: the principal seaport of the eastern part of Cape Colony, South Afriea; 839 miles from Cape Town, and connected with that city and with Kimberley by rail (see map of Afriea, ref. 10–F). It was founded in 1820, and is situated on Algoa Bay. Its growth has been steady and rapid. The wool-trade of all the eastern districts of the eolony is concentrated here, and fine warehouses line the bay. Pop. (1891) 23,266. Revised by C. C. ADAMS.

Porte, Ottoman Porte, or, more commonly, **Sublime Porte**: an official title of the Ottoman Government. The Ottomans liken their government to a tent, at whose porte or door justice is administered and deliberations held. At Constantinople the name *Bab-i-Humayoun*, Exalted or Sublime Porte, is also applied to the main entrance of the Seraglio. E. A. G.

Porter: See BEER.

Porter, ALEXANDER: jurist; b. near Armagh, Ireland, in 1786; removed to the U. S. 1801; engaged in mercantile pursuits in Nashville, Tenn.; studied law and was admitted to the bar in 1807; settled at St. Martinsville, La., 1810; was a member of the convention which formed a State constitution 1811; gained prominence as a jurist and as a Whig politician; beeame a judge of the Supreme Court of Louisiana 1821; was U. S. Senator 1834–37, and opposed the abolition of slavery in the District of Colnmbia and advocated the recognition of the independence of Texas; again elected in 1843, and served till incapacitated by ill-health. D. at Attakapas, La., Jan. 13, 1844. The moulding of the jurisprudence of Louisiana in its present form is largely due to the labors of Judge Porter.

Porter, ANDREW, A. M.: soldier; son of George Bryan Porter, Governor of Michigan; b. at Lancaster, Pa., July 10, 1820. Educated as a civil engineer at Lafayette College, Pennsylvania, he practieed his profession for several years, and was appointed first lieutenant U. S. Mounted Rifles May 27, 1846; captain May, 1847. He served in the Mexican war, and was breveted major for gallantry at Contreras

and Churubusco, and lieutenant-colonel at Chapultepec; colonel Sixteenth Infantry May 14, 1861, and brigadier-general of volunteers May 17, 1861. He served in the Bull Run campaign and battle, and was subsequently provost-marshal of Washington, D. C. Honorably mustered out of volunteer service Apr., 1864, he resigned from the army May, 1864. D. in Paris, Jan. 3, 1872. JAMES MERCUR.

Porter, CHARLES T.: mechanical engineer; b. at Auburn, N. Y., Jan. 18, 1826; graduated at Hamilton College, 1845; studied law and was admitted to the bar 1847; practiced in Rochester and New York city, but after a few years abandoned the law for mechanical pursuits, especially steam-engineering; patented the central counterpoise governor for steam-engines 1859, and an isochronous centrifugal governor for marine engines 1861; became associated with John F. Allen in the manufacture of the Porter-Allen engine, the constructive features of which were designed by him; was the first manufacturer to use high rotative speeds in stationary steam-engines with success. He published an essay on the use of the Richards indicator (1874), and a volume entitled *Mechanics and Faith: a Study of the Spiritual Truths in Nature* (1885). He was one of the organizers of the American Society of Mechanical Engineers, and was for several years a member of its council.

Porter, DAVID: naval officer and diplomat; b. in Boston, Mass., Feb. 1, 1780; served from boyhood on board a merchant-vessel under his father, who was a sea-captain; entered the U. S. navy as midshipman Apr., 1798; was on board the Constellation during her engagement with a French frigate 1799; became a lieutenant Oct., 1799; was wounded in an action with pirates on the coast of Santo Domingo Jan., 1800; took part in the naval war upon Tripoli 1801–06; was captured in the Philadelphia Oct., 1803, and held for eighteen months a prisoner; was given command of the frigate Essex (32 guns) in 1812; captured the Alert, the first man-of-war taken from the British; sailed to the Pacific Jan., 1813; captured several whalers and trading-vessels, but his own ship was captured in the harbor of Valparaiso Mar. 28, 1814, by two British vessels after a severe fight; published a *Journal of the Cruise of the Essex* (2 vols., Philadelphia, 1815; 2d ed. New York, 1822); was a navy commissioner 1815–23; commanded an expedition against West Indian pirates 1824; was court-martialed and suspended for six months in 1825 for disobedience to orders in a difficulty with the Spanish authorities of Puerto Rico; resigned his commission Aug. 18, 1826, and accepted the command of the Mexican navy; was sent as consul to Algiers 1829; was made *chargé d'affaires* to Turkey 1831; was afterward appointed minister resident and negotiated several treaties with the Porte. D. at Pera, near Constantinople, Mar. 3, 1843. His remains were buried in the grounds of the U. S. Naval Asylum at Philadelphia. From his letters to a friend a work was compiled, *Constantinople and its Environs* (2 vols., 1835). See the *Life* by his son David D. Porter (Albany, 1875).

Porter, DAVID DIXON: naval officer; b. at Chester, Pa., June 8, 1813. His father, the gallant Porter of Essex fame, having accepted the position of commander-in-chief of the naval forces of Mexico during her war with Spain, obtained an appointment for his son as a midshipman in the Mexican navy. Two years after David D. Porter entered the U. S. navy as a midshipman, and as a lieutenant eighteen years later was actively engaged in all the operations of the navy on the east coast of Mexico. When the civil war broke out, Porter, then a lieutenant, was dispatched in the Powhatan to the relief of Fort Pickens, Fla. He then fitted out a mortar-flotilla for the reduction of the forts guarding the approaches to New Orleans by the lower Mississippi. After the fall of New Orleans the mortar-flotilla was actively engaged at Vicksburg, and in the autumn of 1862 Porter was placed in command of all the naval forces on the western rivers above New Orleans, with the rank of rear-admiral. His ability as a commander-in-chief was then exhibited, not only in the battles which he fought, but also in the creation of a formidable fleet out of river-steamboats, which he covered with such plating as they could bear. In 1864 Porter was transferred to the Atlantic coast to command the naval forces destined to operate against the defenses of Wilmington, N. C., and on Jan. 15, 1865, the fall of Fort Fisher ended his arduous war-service. In 1866 he was made vice-admiral, and appointed superintendent of the Naval Academy; and on the death of Farragut (1870) he became the admiral of the navy. He was the author of *Allan Dare and Robert le Diable* (New York, 1885); *The Adventures of Harry Marline* (1885); *Incidents and Anecdotes of the Civil War* (1885); and was a contributor to current literature. D. at Washington, D. C., Feb. 13, 1891.

Porter, FITZ JOHN: soldier; b. at Portsmouth, N. H., 1822; graduated at U. S. Military Academy; entered the army as brevet second lieutenant July 1, 1845; served in the war with Mexico; from 1849 to 1855 was stationed at West Point either as instructor or adjutant of the Military Academy; was appointed assistant adjutant-general June, 1856; served as chief of staff in department of the West during the Kansas troubles (1856) and on the Utah expedition 1857–59. In Apr., 1861, he was assigned to the duty of maintaining railway communication through Baltimore to Washington. While at Harrisburg, and when communication with Washington was broken, Porter was shown telegrams from Hon. Francis P. Blair through Gov. Curtin to the President, asking that the Missouri troops be mustered and used for the protection of that State. He at once assumed the authority of the Secretary of War in giving the orders requested. This was approved by the authorities in Washington. Until Aug., 1861, he served in Maryland and Virginia with the army under Gen. Patterson and his successor, Gen. Banks; and was then appointed colonel of U. S. infantry and brigadier-general of volunteers and assigned to duty in Washington.

In 1862 he took part in the Virginia peninsular campaign; was made director of the siege of Yorktown, and upon the evacuation of that place was placed in command of the Fifth Army-corps, with which he fought several battles, including those of Mechanicsville and Gaines's Mill. In the transfer of the Army of the Potomac from the peninsula to Northeastern Virginia he was ordered to stop at Williamsburg and become the rear guard of the army, which would pass through his lines to Yorktown and Fortress Monroe. Reliably informed that Lee was hastening to crush Pope before he could be re-enforced by the Army of the Potomac, and knowing that the army in withdrawing was not molested, Porter instead continued the march and thereby joined Pope several days earlier than if he had complied with orders. Pope highly approved of this action. Porter fought under Pope the memorable second battle of Bull Run. (See BULL RUN, SECOND BATTLE OF). He was then placed in command of the defenses of Washington, S. of the Potomac; then was ordered to rejoin the Army of the Potomac, at that time in Maryland, and was permitted to select a division of 12,000 men. At the battle of Antietam this division was held in reserve, but after it Porter followed the enemy into Virginia and with his corps alone fought the battle of Shepherdstown, capturing many prisoners and a battery of artillery which had been lost at the first battle of Bull Run.

On Nov. 12 he was relieved from command and ordered to Washington. Here he was tried by court martial on alleged disobedience of orders under Pope, declared guilty and cashiered. A re-examination was made of the charges in 1878, resulting in his complete vindication. Against many difficulties in Congress from 1879 to 1886 a bill was finally passed restoring him (Aug. 6, 1886) to the army as a colonel of infantry from May 14, 1861, and, at his own request, he was immediately placed on the retired list. D. May 21, 1901.

Porter, HORACE: soldier; b. in Huntington, Pa., Apr. 15, 1837; graduated at U. S. Military Academy 1860; chief of artillery at the capture of Fort Pulaski; on the staff of Gen. McClellan in 1862; chief of ordnance on the staff of Gen. Rosecrans in 1863; aide-de-camp of Gen. Grant till the close of the war, and his private secretary during his first presidential term. He was breveted brigadier-general for gallant and meritorious services. He is noted as an after-dinner speaker. He was appointed ambassador to France in Mar., 1897.

Porter, JANE: novelist; b. at Durham, England, in 1776; daughter of a surgeon in the Sixth Dragoons, who died during her childhood; was educated at Edinburgh; afterward lived with her mother successively at London, at Ditton-on-Thames, and at Esher; published in 1803 her popular novel, *Thaddeus of Warsaw*; in 1810 the equally successful *Scottish Chiefs*; wrote, at the request of George IV., *Duke Christian of Luneburg, or Traditions from the Hartz* (3 vols., 1824); and, besides several other novels issued in 1831, a fictitious but highly circumstantial *Narrative of the Shipwreck of Sir Edward Seaward*, which by some reviewers was deemed a genuine narrative of facts. D. at Bristol, May 24, 1850. Revised by H. A. BEERS.

Porter, Josias Leslie, D. D., LL. D., D. Litt.: clergyman and author; b. at Burt, Ireland, Oct. 4, 1823; was educated at the Universities of Glasgow and Edinburgh, and at the Free Church College, Edinburgh; was pastor at Newcastle-on-Tyne in the Presbyterian Church of England 1846–49; missionary of the Presbyterian Church of Ireland in Damascus 1849–59; was Professor of Biblical Criticism in the Assembly's college in Belfast 1860–77; commissioner of education in Ireland 1878; president of Queen's College, Belfast, 1879, till his death there Mar. 16, 1889. He is the author of *Five Years in Damascus* (London, 2 vols., 1855; 2d ed. 1870); *Handbook for Syria and Palestine* (1858; 2 vols., 3d ed. 1875); *The Pentateuch and the Gospels* (1864); *The Giant Cities of Bashan* (1865); *The Life and Times of Henry Cooke, D. D., LL. D.*, his father-in-law (1871; 3d ed. 1877); *The Pew and Study Bible* (1876), etc.

Revised by S. M. Jackson.

Porter, Noah, D. D., LL. D.: educator and author; b. at Farmington, Conn., Dec. 14, 1811; son of Rev. Noah Porter, D. D., minister of Farmington nearly sixty years (b. 1781; d. Sept. 24, 1866); graduated at Yale College 1831; master of Hopkins grammar school, at New Haven, 1831–33; was tutor at Yale 1833–35, pursuing theological studies at the same time; became pastor of the Congregational church at New Milford, Conn., Apr., 1836; settled at Springfield, Mass., 1843; was chosen Clark Professor of Metaphysics and Moral Philosophy at Yale College 1846; spent a year (1853–54) in Europe, chiefly in Germany, where he made a close study of modern German philosophy; was elected president of Yale College on the resignation of Dr. Woolsey in 1871. President Porter resigned the presidency in Oct., 1885, to take effect at the following commencement. He retained the office of Clark Professor of Metaphysics and Moral Philosophy until his death in New Haven, Conn., Mar. 4, 1892. He was author of a prize essay on *The Educational Systems of the Puritans and the Jesuits compared* (New York, 1851); *The Human Intellect, with an Introduction upon Psychology and the Soul* (New York, 1868); *Books and Reading* (1870); *American Colleges and the American Public* (1870; 2d ed., with additions, 1878); *Elements of Intellectual Philosophy* (1871), being an abridgment of the larger work; *The Science of Nature versus the Science of Man* (1871); *Science and Sentiment* (1882); *Elements of Moral Science* (1885); *Bishop Berkeley* (1885); and *Kant's Ethics* (1886). Dr. Porter was the principal editor of the revised edition of *Webster's Dictionary* (1864, 1880, and 1890), and contributed abundantly to religious and literary reviews and periodicals. He was one of the ablest of metaphysicians, and a man of varied talents and attainments.

Revised by G. P. Fisher.

Porter, Peter Buel: soldier; b. at Salisbury, Conn., in 1773; studied law; settled in New York State; was elected to Congress in 1808, re-elected in 1810, and the year following, as chairman of the committee on foreign relations, prepared and introduced the celebrated report recommending war with Great Britain. Hostilities having begun, he resigned his seat in Congress and served throughout the war with distinction, holding important commands. In acknowledgment of his services the city of New York presented him with the freedom of the city, the State of New York voted him a sword, and he received the thanks of the Congress of the U. S., with a gold medal. He was appointed in 1816 by President Madison a commissioner under the treaty to settle the boundary-line between Canada and the U. S. An early projector of the Erie Canal, he with Morris and Clinton constituted the first board of commissioners for selecting its route. In 1828 he was appointed Secretary of War, and held the office during Adams's administration. D. at Niagara Falls, N. Y., in 1844.

Porter, Sir Robert Ker: historical painter and traveler; brother of Jane Porter, the novelist; b. at Durham, England, about 1775; went to Spain with Sir John Moore 1808; was knighted in 1811; was consul in Venezuela 1826–41; lived many years in Russia. Among his most remarkable paintings are *The Siege of Acre*; *Peter the Great planning the Port of Cronstadt and St. Petersburg*, a fresco painted on the walls of the admiralty in St. Petersburg; and *Christ blessing the Little Children*, which, together with an *Ecce Homo*, was painted in Caracas. D. in St. Petersburg, May 4, 1842. He was the author of *Travels in Russia and Sweden* (1808); *Letters from Portugal and Spain* (1809); *An Account of the Russian Campaign* (1813); and *Travels in Georgia, Persia, and Armenia* (1821–22).

Porter, Thomas Conrad, D. D., LL. D.: botanist; b. at Alexandria, Pa., Jan. 22, 1822; educated in Harrisburg Academy, Lafayette College, and Princeton Theological Seminary; minister of the Gospel 1844–49; Professor of Natural Sciences in Marshall College 1849–53; same in Franklin College 1853–66; Professor of Botany in Lafayette College, Easton, Pa., 1866; professor emeritus and dean of the Pardee Scientific Department, 1898. Among his scientific publications are *Sketch of the Flora of Pennsylvania* (1872); *Sketch of the Botany of the United States* (1873); *A Synopsis of the Flora of Colorado* (prepared conjointly with John M. Coulter, 1874); *A List of the Carices of Pennsylvania* (1887); *A List of the Grasses of Pennsylvania* (1893); and many shorter papers. D. Apr. 27, 1901.

Porter, William David: naval officer; son of David Porter, naval officer; b. at New Orleans, La., Mar. 10, 1809; entered the U. S. navy as midshipman Jan. 1, 1823; became lieutenant Dec. 31, 1833; was the originator of the light-house system in use in the U. S.; served in the Gulf of Mexico during the war between the U. S. and Mexico; was retired 1855; re-entered the navy 1859; built and commanded the ironclad Essex in the Mississippi flotilla 1861–62; participated in the attacks on Forts Henry and Donelson; sailed down Mississippi river to New Orleans, forcing a passage by several Confederate batteries; took part in engagements at Vicksburg, Baton Rouge (where he effected the destruction of the Confederate ironclad Arkansas), Natchez, and Port Hudson, and was made commodore July 16, 1862. Owing to feeble health he took little part in subsequent naval service. D. in New York, May 1, 1864.

Por'teus, Beilby, D. D.: bishop; b. at York, England, May 8, 1731; was educated at Christ's College, Cambridge, where he obtained a fellowship and gained the Seatonian prize for poetry; became chaplain to Archbishop Secker 1762, and to George III. 1769; was appointed Bishop of Chester 1776, and of London 1787. D. in London, May 13, 1809. Author of a *Review of the Life and Character of Archbishop Secker* (1797), in which the efforts of the primate to accomplish the introduction of bishops in the American colonies were detailed and defended; *A Summary of the Evidences of Christianity*; and other works, of which a collected edition, preceded by a memoir, was published in six volumes, 1811.

Revised by W. S. Perry.

Port Glasgow: town of Renfrewshire, Scotland; on the Clyde; 20 miles W. N. W. of Glasgow (see map of Scotland, ref. 11–F); has large quays, ship-building docks, extensive manufactures of sail-cloth and ropes, iron- and brass-foundries, and considerable importation of American timber. Pop. (1891) 14,647.

Port Hamilton: a spacious harbor in the island of Kŭwŭn, one of the Nanhow group, lying S. of Korea, just N. of 34° N. lat. (see map of China, ref. 5–M). Only three of these islands are of importance. When Great Britain and Russia seemed (Apr., 1885) on the verge of war over their conflicting Asian interests Great Britain seized Port Hamilton, against the protests of China and Japan, as a coaling-station and naval port of much strategic value, commanding the Korea Strait. It was found that the anchorage-ground was poor, that adequate fortifications would cost enormously, and Great Britain (Jan., 1887) transferred the islands to China.

C. C. Adams.

Port Hudson: post village; in East Baton Rouge parish, La. (for location of parish, see map of Louisiana, ref. 9–E); on left bank of the Mississippi. Pop. about 250. Port Hudson stands on a high bluff at a sharp bend of the river. During the late summer and autumn of 1862 Confederate batteries, heavily mounted, well-protected, and strongly manned, had been erected along the bluffs for a distance of about 3 miles, completely commanding the river. On the night of Mar. 14–15, 1863, the Union fleet of four sloops-of-war and five gunboats, under Farragut, attempted to pass these batteries. Of these the Hartford and the gunboat Albatross succeeded, but the remainder were driven back, one being destroyed and four disabled. The place was invested by Gen. Banks, May 21–26, 1863, and a general assault was made May 27, which was repulsed, the Union loss being 1,995 killed and wounded; the Confederate loss was not more than 300. An effort to carry the works by storm (June 14) was repulsed with a Union loss of about 1,805. On July 7 tidings were received that Vicksburg had fallen three days before, and negotiations for the surrender of Port Hudson were at once opened. The surrender was made

July 9. There were about 6,400 prisoners of war, 51 guns, 5,000 small-arms, much ammunition, and 2 steamers were also captured. The siege had lasted forty-five days. The entire Union loss was about 4,300 men; the Confederate loss about 800, exclusive of prisoners. The capture of Port Hudson opened the entire course of the Mississippi.

Revised by JAMES MERCUR.

Port Huron: city (settled by whites in 1686, originally called Desmond, incorporated as a city in 1857); port of entry; capital of St. Clair co., Mich.; on the St. Clair and Black rivers, at the foot of Lake Huron, and on the Grand Trunk, the Chi. and Gr. Trunk, and the Flint and Pere Marquette railways; 56 miles N. N. E. of Detroit (for location, see map of Michigan, ref. 7–K). It contains 13 churches, 14 public-school buildings, public-school property valued at over $200,000, Academy of the Sacred Heart, several parochial and private schools, 5 public parks, Holly system of water-works, with supply from Lake Huron, public library, U. S. Government building that cost $250,000, hospital, a national bank with capital of $135,000, 3 State banks with combined capital of $250,000, a private bank, and 2 daily, 6 weekly, and 3 monthly periodicals. It has 16 miles of paved streets, 7 of electric railway, electric-light plant, 2 fuel and gas-light plants, 25 hotels, and many handsome business buildings. It has a large grain-, lumber-, and wool-trade. Among the industrial works are the locomotive-shops of the Grand Trunk Railway, which also has car- and repair-shops, threshing-machine manufactory, 7 grain-elevators, 3 flour-mills, 3 dry-docks, 4 foundries, 6 carriage- and wagon-shops, 4 marble-works, 5 cigar-factories, 1 planing-mill, 2 engine-works, 2 breweries, 4 bottling-works, 2 lime-kilns, and a plant for manufacturing paper from spruce wood. The city is connected with Sarnia, Canada, by a steam-ferry and by a tunnel constructed in 1888–92 to accommodate the connecting U. S. and Canadian railways. Pop. (1880) 8,883; (1890) 13,543; (1900) 19,158.

L. A. SHERMAN, EDITOR OF "TIMES."

Portici, pōr'tĕe-chĕĕ: town; in the province of Naples, Italy; on the Bay of Naples, at the western foot of Vesuvius; about 5 miles S. E. of the city of Naples (see map of Italy, ref. 7–F). Since 79 A. D. the volcano has poured its burning lava seven times over the spot on which Portici now stands, and as many times it has been rebuilt. The excavations in search of the treasures of HERCULANEUM (*q. v.*) were begun here in 1714. The modern town contains a long street, a fine square, a mole for the convenience of the shipping, a little fort which commands the roadstead, and an agricultural college, formerly a royal palace, built in 1737. The industry of Portici consists of fishing, a small coasting trade, and the manufacture of silk and ribbons. Pop. 12,272.

Port Jervis: village; Orange co., N. Y. (for location, see map of New York, ref. 7–J); at the confluence of the Neversink and the Delaware rivers, and the intersection of the boundary-lines of New York, New Jersey, and Pennsylvania; on the Erie and the Port Jervis, Monticello and N. Y. railways, and the Del. and Hudson Canal; 21 miles W. S. W. of Middletown, 88 miles N. W. of New York city. It is widely noted for the beauty of its location and surrouding scenery, and contains 2 national banks with combined capital of $230,000, a soldiers' monument (unveiled in 1886), a district-school library, repair-shops of the Erie Railroad, 2 glass-factories, 2 foundries, and boot and shoe factory, and manufactories of saws, harness, shirts, and gloves. It has a monthly, 2 daily, and 3 weekly periodicals. Pop. (1880) 8,678; (1890) 9,327; (1900) 9,385.

EDITOR OF "GAZETTE."

Portland, N. B.: a suburb of ST. JOHN (*q. v.*).

Portland: town; Middlesex co., Conn. (for location, see map of Connecticut, ref. 9–H); on the Connecticut river, and the N. Y., N. H. and Hart. Railroad; nearly opposite Middletown. It is best known for its quarries of brown sandstone. Other industries are ship-building and the manufacture of steam-governors and various kinds of tinware. It has water-works, electric lights, a national bank with capital of $150,000, a savings-bank, and a weekly and a monthly periodical. Pop. (1880) 4,157; (1890) 4,687; (1900) 3,856.

EDITOR OF "MIDDLESEX COUNTY RECORD."

Portland: city; capital of Jay co., Ind.; on the Salamonie river, and the Grand Rapids and Ind. and the Lake Erie and West. railways; 43 miles N. of Richmond, 49 miles S. by E. of Fort Wayne (for location, see map of Indiana, ref. 5–G). It is in a natural-gas region, has a large lumber-trade, and contains several manufactories. 2 State banks with a combined capital of $110,000, and a daily and 4 weekly newspapers. Pop. (1880) 1,694; (1890) 3,725; (1900) 4,798.

Portland: city (settled by the English in 1632, incorporated as a town in 1786, as a city in 1832); port of entry; capital of Cumberland co., Me. (for location, see map of Maine, ref. 10–B); on Casco Bay, and the Boston and Maine, the Maine Cent., and the Gr. Trunk railways; 63 miles S. S. W. of Augusta, 108 miles N. N. E. of Boston. It is the largest and most important city in the State, is built on a peninsula jutting into the bay, and has a picturesque harbor dotted with islands and defended by Forts Preble and Williams, and by important forts on Cushing's and Diamond islands, partially built and now in process of construction, and by a modern torpedo system. Communication by water is afforded by a daily steamboat-line to Boston and a semi-weekly line to New York city, in winter six weekly steamship-lines to Europe, and in summer two weekly lines to Europe. The city is the winter port of the ocean steamships connecting with the Grand Trunk Railway at Montreal in summer. The harbor is accessible without a pilot in all kinds of weather, and has been the scene of commercial activity, particularly in the line of trade with the West Indies, for many generations. Portland constitutes a U. S. customs district; in 1900 merchandise to the value of $759,121 was imported and domestic products to the value of $9,486,187 were exported. The city contains a U. S. custom-house of granite, a U. S. post-office and court building of white marble, an imposing city-hall of olive-colored freestone, 8 national banks with combined capital of $3,650,000, 3 trust companies, 2 savings-banks with aggregate deposits of $13,889,300, 6 private banks, and 4 daily, 11 weekly, 9 monthly, and 4 quarterly periodicals. The principal churches are the Cathedral of the Immaculate Conception (Roman Catholic), St. Luke's Cathedral (Protestant Episcopal), the Payson Memorial, the First Baptist, the First Parish, the double-spired Chestnut Street Methodist Episcopal, St. Paul's and St. Stephen's (Protestant Episcopal), and St. Dominic's (Roman Catholic). The public-school property is valued at over $600,000, and comprises 33 school-buildings. There are 9 libraries of all kinds, containing over 80,000 volumes. Those of the Maine Historical Society and the Portland Society of Natural History are in a building erected by James P. Baxter in 1889 and presented to the two societies for use in common. Among the notable buildings is the Longfellow homestead, the birthplace of the poet, on Congress Street, which was erected in 1785–87 and presented to the Maine Historical Society in 1893. The principal industries are meat-packing and the manufacture of marine boilers, foundry and machine-shop products, and boots and shoes. In 1900 the assessed valuation of the city was $44,630,960, and in 1900 the net debt was $1,323,082. The original settlement was destroyed by the Indians in 1676, and its successor by the French and Indians in 1690. In 1775 the village was bombarded and burned by a British fleet, and in 1866 a third part of the city was destroyed by fire. Pop. (1880) 33,810; (1890) 36,425; (1900) 50,145.

GEORGE S. ROWELL, EDITOR OF "ADVERTISER."

Portland: city (laid out in 1845, incorporated as a city in 1851, enlarged by the annexation of Albina and East Portland in 1891); capital of Multnomah co., Ore.; on the Willamette river, 12 miles above its confluence with the Columbia, and the N. Pac., the S. Pac., the Union Pac., and the Portland and Willamette Valley railways (for location, see map of Oregon, ref. 2–C). The city is built on sloping ground, the river dividing it nearly in the middle. A range of hills on the W., within easy walking distance, rises to an elevation of 1,000 feet. The Cascade Mountains, with the snow-capped peaks of Mt. Hood, Mt. Adams, Mt. St. Helen's, and Mt. Rainier, and the picturesque gorge of Columbia, are in plain view. Although the city is 120 miles from the ocean, its location at the head of deep-water navigation on the two rivers makes it in reality a seaport. The largest steamships are able to go direct to the city wharves at all seasons of the year, and the city has regular water-communication with the greater part of the State of Washington, with Astoria, the Dalles, Albany, Corvallis, and Dayton, in Oregon; with Lewiston, in Idaho; with Puget Sound, British Columbia, Alaska, and San Francisco; and with the principal Siberian, Chinese, and Japanese ports. Lying in the heart of a great producing region, with exceptional shipping facilities by rail and water, the city is an important center

of commercial aetivity. In 1900 the deep-sea commerce of the port was, foreign, $10,100,000; coastwise, $4,000,000—total, $14,100,000; and the shipments of produce and merchandise eastward aggregated over $8,000,000. The wholesale jobbing trade exceeded in value $110,000,000. The aggregate banking capital was over $16,000,000, and the bank clearings of the year were $106,926,526. The census returns of 1890 showed that 504 manufacturing establishments (representing 88 industries) reported. These had a combined capital of $16,808,028, employed 9,240 persons, paid $7,179,733 for wages and $12,427,071 for materials, and had products valued at $24,429,449. The principal industries, in the order of capital employed, were those connected with lumber, printing and publishing, malt liquors, furniture, awnings, tents and sails, bridges, and slaughtering and meat-packing. Portland is supplied with water from a stream 30 miles distant, which has its source on Mt. Hood; is lighted with gas and electricity; has over 125 miles of street-railway; contains a number of massive buildings, including the U. S. Government building, city-hall, Chamber of Commerce, Union Depot, and the Hotel Portland; and has 3 daily, 23 weekly, a semi-monthly, and 15 monthly periodicals. There are 30 churches; 15 public-school buildings, public-school property valued at over $600,000, the Bishop Scott Academy (Protestant Episcopal, opened 1870), St. Helen's Hall (Protestant Episcopal, chartered 1869), St. Michael's College (Roman Catholic, opened 1871), Portland Academy (non-sectarian), the medical departments of the State and the Willamette Universities, and a business college. In 1900 the assessed valuations of the city aggregated $33,000,000, and on Jan. 1, 1901, the bonded debt was $2,381,000. Pop. (1880) 17,577; (1890) 46,385; (1900) 90,426.

H. W. Scott, editor of "Oregonian."

Portland, Dukes of: See Bentinck.

Portland Cement: See Cement.

Portland, Isle of: a peninsula on the coast of Dorsetshire, England; about 4 miles by rail S. of Weymouth. It is connected with the mainland by a ridge of loose shingle, the Chesil Bank, and reaches 495 feet in height at the Verne, from which it slopes gradually to Portland Bill, its southern extremity, where there are two lighthouses. Portland is noted for its quarries of excellent building-stone, the stone of which St. Paul's Cathedral, in London, is built; other features are the old castle erected by Henry VIII.; the magnificent breakwater, with which are connected a naval station and a harbor of refuge; its prisons, capable of accommodating 1,500 convicts; Bow and Arrow Castle, ascribed to Rufus; and the Pennsylvania Castle (1800), built by Governor Penn. (See Breakwater.) Pop. (1891) 11,000.

Portland Vase: See Glass (*Glass in Artistic Use*).

Port Lavaca: town; capital of Calhoun co., Tex.; on Matagorda Bay, and the S. Pac. Railroad; 20 miles from the Gulf of Mexico (for location, see map of Texas, ref. 6–I). Indianola, the former capital of the county, a port of entry, and a town of large commercial importance, was almost entirely swept away by a flood in 1875, and what was left was destroyed by a second flood in 1886. The business of the town was then transferred to Port Lavaca, which was made the county-seat. The principal industries are fishing, oystering, and fruit-cultivation. Pop. (1890) 365; not returned separately in 1900.

Port Lou'is: capital of the British colony of Mauritius (*q. v.*); on the northwest of the island. It is well built and strongly fortified, has a good harbor, barracks, a public library, a theater, a botanic garden, and is the commercial center of the colony. Pop. (1891) 62,046.

Port Mahon' (anc. *Portus Magonis*): capital of Minorca, on the southern coast of the island (see map of Spain, ref. 6–M). It has a spacious and safe harbor, capable of accommodating a fleet of men-of-war. It was made a first-class fortress by the British, who held Minorca twice during the eighteenth century. Cattle, cotton, shoes, and honey are exported. Pop. (1887) 18,445.

Portneuf: village; Portneuf County, Province of Quebec, Canada; on the St. Lawrence at the mouth of the Portneuf river, and on the Can. Pac. Railway; 35 miles S. W. from the city of Quebec (see map of Quebec, ref. 4–C). The St. Lawrence has a beautiful appearance as it bends into the bay which forms the harbor of the village. Opposite is Point Platon with its picturesque village. There are several mills, the chief industry being the manufacture of paper. Pop. of the parish about 1,850. J. M. Harper.

Por'to Ale'gre: capital and largest city of the state of Rio Grande do Sul, Brazil; beautifully situated on the Guahyba or broadened lower part of the river Jacuhy; 38 miles from its mouth in the Lagoa dos Patos, and by the latter and the Rio Grande, 246 miles from the sea (see map of South America, ref. 7–F). The town is built partly on flat land, partly on a low promontory. There are few pretentious edifices. The outskirts, reached by horse railways, are adorned with beautiful gardens. Porto Alegre is one of the cleanest, prettiest, and most thriving cities of Brazil, and it is very healthful. Vessels which can pass the Rio Grande bar ascend to this place and load directly at wharves; and small steamboats connect the port with towns on the Jacuhy and with numerous German and Italian colonies on the branch rivers; much of the trade is in the hands of German merchants. The city is the emporium of the agricultural region in the northern part of Rio Grande do Sul, and is growing rapidly. Pop. (1894) about 45,000. H. H. S.

Porto-Ferraio, pōr'tō-fer-raa'yō: capital of the island of Elba (*q. v.*). Pop. 3,737.

Port of Spain: capital and principal town and port of the island of Trinidad, West Indies; on the Gulf of Paria (west coast of the island), fronting a small bay (see map of West Indies, ref. 9–M). It is well laid out on flat ground, and has many handsome buildings, especially in the outskirts, where the houses of the better class are surrounded by extensive gardens. The Botanical Garden is one of the finest in the British colonies. The governor's residence, a fine edifice, is in this garden. Port of Spain has most of the commerce of the colony, and is the entrepôt for much of the English trade with the northern part of South America; regular lines of steamers connect it with Europe, the U. S., the Venezuelan ports, and the Orinoco. The harbor is safe, but vessels are obliged to anchor at some distance from the shore. The climate is hot, but generally healthful. Pop. (1890) 31,858. Herbert H. Smith.

Porto Maurizio, maă-oŏ-rit'si-ō (anc. *Portus Mauritii*): chief town in the province of the same name, Italy; about 14 miles from San Remo and 41 miles by rail E. by N. of Nice (see map of Italy, ref. 4–B). It consists of an old town on a hill and a new one by the sea. The former was once well fortified and walled. The harbor is formed by two moles, and is entered from the S. S. W. There is a large production of olives and a considerable coasting trade. Pop. 6,309. The province has an area of 455 sq. miles. Pop. (1892) 142,200.

Port Orchard: naval station (name changed from Sidney, 1894); capital of Kitsap co., Wash.; on Port Orchard Bay, an arm of Puget Sound, 18 miles W. of Seattle (for location, see map of Washington, ref. 3–C). A tract of 200 acres was secured by the U. S. Government in 1891, and Congress appropriated $700,000 for the construction of a timber dry dock 600 feet long, 75 feet wide on the floor, and of sufficient depth to accommodate vessels of 30 feet draught, the largest dry dock in the U. S. Congress also authorized a survey for a canal to connect the sound at this point with Lake Washington, a fresh-water body 2½ miles inland, for the purpose of affording the station a harbor where vessels could be free from the attacks of shipworms. Pop. (1900) 197.

Porto Rico: See Puerto Rico.

Porto Seguro, Baron and Viscount of: See Varnhagen, Francisco Adolpho, de.

Portraiture, or **Portrait-art**: the fine art which has for its subjects the likenesses of men and women, and by extension ideal attempted likenesses of those who are dead. So little of what the oldest races did in this field remains to us that until Mariette's discovery in Lower Egypt of portrait-statues belonging to the third dynasty (B. C. 4449) it was believed by some that the art of portraiture was of recent origin. Coming down to historic times, the earliest portraits of which we have any mention are those Apelles made of Alexander and Antigonus. We have but little record of the subsequent history of portraiture in Greece, for nearly all traces of Greek painting have disappeared, and no well-authenticated portrait-bust or statue of antique Greek workmanship exists. The painters and sculptors of the Renaissance and the succeeding epoch were very much occupied with portrait-art. An important exception is Michelangelo, who left no portraits. Even the statues of Lorenzo and Giuliano in the Medici chapel he declared he did not intend for portraits. Raphael and his contemporaries, and their immediate successors, brought the art to its full perfection.

In Spain Velasquez is the greatest name, but less skill than his, which was supreme, would have sufficed to give pre-eminence in a country where portrait-painting was so little practiced as it was in the Peninsula. N. of the Alps, Van Eyck, Cranach, Dürer, Holbein, Rubens, Franz Hals, and Rembrandt distinguished themselves in portraiture. Holbein belongs, however, as much to England as to Germany; most of his finest portraits are in England. Since his time Germany has not produced any great portrait-painter. In France no native-born portrait-painter of any distinction appeared until the eighteenth century. Francis I. invited several Italian artists into France, chief among them Leonardo da Vinci, from whose hand the king hoped he might get other portraits equal to that of Mona Lisa del Gioeondo, now in the Louvre, on which Leonardo worked for four years, and which Francis bought of him for 4,000 golden crowns; but, as is well known, Leonardo did not paint a single picture while he was in France.

In England, Holbein may be said to have created portrait-painting; he had many imitators, some of them most skillful, yet, though the country did not produce many portrait-painters of consideration before the eighteenth century, she welcomed good painters from other lands. In Mary's time, Antonio Moro came from Utrecht, and in Elizabeth's reign Federigo Zucchero, an Italian, was in vogue. A Dutch painter, Lucas de Heere, also found employment. Later were the two Olivers, of French extraction; they were miniature-painters, and contemporary with them was Nicholas Hilliard, one of the first Englishmen by birth who gained distinction in the art. The brief visit of Rubens gave, after Holbein, the second great impetus to the art of portrait-painting in England. He remained in the island only one year, but he painted many portraits. He was followed by his great pupil, Van Dyck, who became for England a standard of excellence in portraiture. Peter Lely, a Westphalian, went to England and established himself as a portrait-painter. Besides Cromwell and many of his chiefs, he painted all the beauties of Charles II.'s court. Cornelis Janssen, of Leyden, a good painter, went over in 1618. While Lely was flourishing, Gottfried Kneller, a native of Lubeck, arrived; he had already gained some distinction in Europe. He had great success in England, and painted Dryden, Addison, and Pope, and nearly every notable man and woman of his time in the island. With the appearance of Sir Joshua Reynolds (1723–92) began a new and more fruitful period, the third important influence affecting the growth of painting, and particularly of portrait-painting, in England; and from his time to the present the history of English portraiture has never lacked great names. Thomas Gainsborough, his contemporary (1727–88), would have been a dangerous rival if he had devoted himself as exclusively to portraiture as Reynolds did, but he preferred landscape-painting, and though his portraits are charming, he is most known as one of the founders of landscape-painting in England. Another notable painter of this time was Romney (1734–1802), whose reputation has increased with time. John Opie (1761–1807) also gained considerable distinction.

The modern French school began with David (1748–1825), who was before all a so-called historical painter, but who made some excellent portraits. France, however, has never had a great artist whose name is identified exclusively with portrait-painting, or even to any considerable extent so identified. With those even who have excelled in it, it has always been held of secondary importance. Yet Gérard (1770–1837) made many interesting portraits, and those of Ingres (1781–1867) must surely outlive all but two or three of the imaginative compositions on which he thought to build his fame.

Sculpture in England has been more successful in portraiture than in ideal work. It owed its modern impulse to a Frenchman, Roubiliac (1695?–1762), who went to England in 1720, and by the very excess of his dramatic conception and the superfluous energy of his execution gave an impetus to his art in England which in a dull, pedantic time bore down everything before it. He was followed by a number of distinguished sculptors—Flaxman, Banks, Nollekens—of whom Flaxman was the greatest artist, but less known as a sculptor of portraits than the others. More recent are Westmacott, Gibson, Foley, Bell, Marshall-Wood, Boehm, and Woolner. The portrait-busts of the last two are productions of singular merit; they include busts of Carlyle and Tennyson.

In the U. S. the art of portraiture properly begins with Copley, who was born in Boston in 1737, but lived in England from 1774 till his death in 1815. His manner of painting was somewhat cold and hard, but he drew well, his color is agreeable, and he gave a good deal of life and animation to his heads. He was followed by John Trumbull, who, though he failed as an historical painter, deserves to be remembered for his miniatures. Another excellent miniature-painter was Malbone. The most distinguished name after Copley is, however, that of Gilbert Stuart (1756–1828), an artist who when at his best was one of the most excellent painters of his time. Other notable names are those of Leslie, Sully, Inman, Harding, Healy, Elliot, Baker, Huntington, Page, and Furness. Revised by Russell Sturgis.

Port-Royal (or, more properly, **Port-Royal des Champs**): an institution founded in 1204 by Matthieu de Montmoreney at Chevreuse, near Versailles, as a monastery for Bernardine or Cistercian nuns. In the course of time it became noted as an educational institution, to which the French nobility sent their young daughters, but at the same time it lost to some degree its religious character, until in the beginning of the seventeenth century the abbess, Mère Marie Angélique (see Arnauld, Marie Angélique), thoroughly reformed the establishment and revived the old religious discipline, with its rigid seclusion, poverty, and ascetieism. She was a sister of Antoine Arnauld, "the great Arnauld," Professor in Theology at the Sorbonne and an ardent disciple of Jansen, and thus the monastery became Jansenistic. It flourished, and the number of nuns increased rapidly. In 1625 the Hôtel de Clugny, in the Faubourg de St. Jacques, Paris, was bought, and a branch institution was founded here under the title of Port-Royal de Paris, and in 1626 a new and extended abbey was erected at Port-Royal des Champs. Meanwhile a number of pious and learned men had established themselves at a farmhouse near Port-Royal des Champs, called Les Granges, for the purpose of leading a secluded and ascetic life, devoted to studies and religious exercises: and when the nuns removed to the new abbey these "solitaries of Port-Royal" were allowed to occupy the old place under the immediate jurisdiction of the Archbishop of Paris. They were all Jansenists, and soon Port-Royal became famous as the center of the whole Jansenistic movement and the focus of the opposition to the Jesuits. Here the Jansenists founded a school which numbered among its pupils some of the most famous men of the time, as, for example, Tillemont and Racine, and here were prepared those formidable attacks on the Society of Jesus which startled the whole world. In 1669 the two monasteries, Port-Royal des Champs and Port-Royal de Paris, were separated, and the latter reorganized under the influence of the Jesuits; and when the nuns of Port-Royal des Champs still refused to subscribe to the papal condemnation of Jansen, they were dispersed in 1709 and imprisoned in various other monasteries of France, and the buildings of their abbey leveled to the ground. See Fontaine, *Mémoires pour servir à l'Histoire de Port-Royal* (2 vols., 1736); Racine, *Histoire abrégée de Port-Royal* (1742); Sainte-Beuve, *Port-Royal* (5 vols., 1842–78); Beard, *Port-Royal* (2 vols., 1861).

Port Royal: town; in Beaufort co., S. C.; terminus of Port Royal and Augusta Railway (for location of county, see map of South Carolina, ref. 8–E); noted for one of the earliest settlements made by the Spaniards within the present limits of the U. S., for important events during the civil war, and as the rendezvous of the North Atlantic squadron of the U. S. navy. The harbor is one of the finest in the world. A large dry-dock was completed in 1895. Pop. (1900) 601.

Port-Royal, Little Schools of: See the Appendix.

Port Saïd': town; in Egypt, at the junction of the Suez Canal with the Mediterranean (see map of Africa, ref. 1–F). No village existed here in 1859 when, near the present site, the first spadeful of earth was turned in digging the canal. Port Saïd is built mainly on earth since dug out. In 1897 the population was 42,095. Its fine harbor, entirely artificial, is formed by two moles, that on the W. over 8,000 feet long. E. A. G.

Port Sarnia: See Sarnia.

Portsmouth: town of Hampshire, England; on the island of Portsea; 23 miles S. E. of Southampton and 74 miles S. W. of London (see map of England, ref. 14–I). The limits of the municipal and parliamentary borough, which are identical, comprise, in addition to Portsmouth proper, the town of Portsea, the suburbs of Landport and Southsea, and nearly the whole of Portsea island. Portsmouth and Portsea were encircled by a fortified enceinte, a portion of which has been removed as useless since 1872; but under

the action of the defense commission appointed in 1859 a chain of works was built on modern types from 3 to 5 miles distant. This includes the Hilsea lines and the forts of Portsdown Hill on the land side, and the SPITHEAD (*q. v.*) forts on the sea side. Portsmouth proper presents for the most part an unattractive appearance, but many improvements have been made. A new town-hall was opened in 1890. Among the old buildings may be mentioned the Church of St. Thomas, originally dating from the twelfth century, and the Early English garrison chapel, restored by Street in 1867. In Portsea there is a convict prison, and Landport has a people's park, opened in 1878. Southsea is a fashionable watering-place with assembly-rooms, a pier, and an esplanade 2 miles in length.

Portsmouth harbor, which is about 400 yards wide at its entrance between Portsmouth and GOSPORT (*q. v.*), expands into a spacious basin, stretching 4 miles inward N. W. of the town. It affords anchorage to large war-vessels at all times, as there are 24 feet of water in the channel at low water. The dockyard is the most important establishment of the kind in Great Britain. It covers an area of 293 acres and contains dry-docks capable of admitting the largest vessels, warehouses, anchor-forges, iron and copper mills, rope-houses, hemp-stores, sail-lofts, etc., in addition to the twelve wet-docks, which are from 22 to 36 feet deep, lined with solid masonry, roofed over, and closed by lock-gates.

The local trade is chiefly supported by the Government establishments. Brewing is carried on, and there is considerable traffic in coal, timber, cattle, and agricultural produce.

Portsmouth's importance began with Henry VIII., the town was fortified by Edward IV., and the works were continued at intervals afterward. In 1642 it was taken by the Parliamentary forces. It returns two members to Parliament. Pop. (1901) 189,160. R. A. ROBERTS.

Portsmouth: city (settled in 1623, became Portsmouth township in 1653, incorporated as a city in 1849), port of entry, and one of the capitals of Rockingham co., N. H.; on the Piscataqua river, and the Boston and Maine and the Concord and Montreal railways; 54 miles N. by E. of Boston (for location, see map of New Hampshire, ref. 10–G). It is the only seaport in the State, is built on a peninsula 3½ miles from the sea, and has a very spacious harbor, from 35 to 75 feet deep, which is never frozen. The harbor is protected by earthworks on Gerrish's island and Jerry's Point near its entrance, and farther up are two disused stone forts, Constitution and McClary. Bridges connect the city with Kittery, Me., and with Newcastle on Green island. The U. S. navy-yard, officially known as the Portsmouth navy-yard, is on Continental island, half a mile from the city, and belongs to Kittery, Me. It comprises 170 acres of ground, has a large balance dry dock and several ship-houses, and has turned out a number of noted wooden war-vessels. The city contains a U. S. Government building, a life-saving station, and a signal-service station. There are 12 churches, 9 public-school buildings, public-school property valued at over $85,000, 2 libraries (the Athenæum, which also has a valuable museum, and the Free Public) containing over 26,000 volumes, 2 academies, 4 national banks with combined capital of $800,000, 2 savings-banks, a trust and guarantee company, and 3 daily and 3 weekly newspapers. Portsmouth has been noted for its ship-building for more than two centuries. Among the early vessels of note built there were the Falkland, 54 guns, in 1690, and the America, 50 guns, in 1749, both on orders from the British Government, and the Ranger, 18 guns, in 1777, ordered by the Continental Congress. The latter vessel was first commanded by John Paul Jones, and was the first one to carry the Stars and Stripes and to receive a salute. The city contains a number of historic buildings, a hospital, Home for Indigent Women, Female Asylum, Home for Children, board of trade, marble-works, and several breweries, planing-mills, machine-shops, shoe-factories, copper and brass foundry, and hosiery, glove, and soap factories. Pop. (1880) 9,690; (1890) 9,827; (1900) 10,637.

Portsmouth: city; capital of Scioto co., O. (for location, see map of Ohio, ref. 8–E); at the confluence of the Ohio and Scioto rivers; on the Balt. and O. S. West., the Norfolk and West., and the Cin., Ports. and Va. railways; at the S. terminus of the Ohio and Erie canal; 100 miles S. of Columbus, 114 miles S. by E. of Cincinnati. It is built on a plain partly inclosed by high hills, the ground on the opposite side of the Ohio river rising to a height of 500 feet. The region is rich in agricultural lands and in mineral resources, particularly iron ore, and the city is a shipping-point for a large variety of productions. The industrial establishments include rolling-mills, iron and steel works, extensive shoe-factories, lumber and planing mills, flour-mills, stove-foundries, several distilleries, fire-brick plants, furniture and veneer factories, and wheel-works. The city has water supplied from the Ohio river by the Holly system, electric lights, 7 public-school buildings, public-school property valued at over $180,000, public library (founded in 1879), the Ohio Military Academy (non-sectarian), 3 national banks with combined capital of $475,000, a State bank with capital of $50,000, an incorporated bank, and a daily and 5 weekly newspapers. Pop. (1880) 11,321; (1890) 12,394; (1900) 17,870. EDITOR OF "TIMES."

Portsmouth: city; capital of Norfolk co., Va.; on the east bank of the Elizabeth river and the Atlantic and Danville, the Seaboard Air Line, and the Norfolk and Carolina railways; opposite NORFOLK (*q. v.*), with which it is connected by ferry (for location, see map of Virginia, ref. 7–J). The U. S. navy-yard, officially known as the Norfolk navy-yard, is at Gosport, the southern extremity of the city. There are also a large dry dock, naval hospital, and marine barracks. The city has a steamboat line to Baltimore and regular steamship connection with the principal Atlantic ports, and with Norfolk constitutes a U. S. customs district, from which are exported large quantities of cotton, lumber, oak staves, naval stores, pig iron, and, to Northern cities, early vegetables. It contains the shops of the Seaboard Air Line Railroad, 3 State banks with combined capital of $201,500, and a daily and a weekly periodical. Pop. (1880) 11,390; (1890) 13,268; with suburbs, 19,268; (1900) 17,427. EDITOR OF "PROGRESS."

Port Townsend: city (laid out in 1852), port of entry for the Puget Sound customs district, and capital of Jefferson co., Wash.; on Quimper peninsula, between Port Discovery and Port Townsend Bays, and on the Port Townsend Southern Railroad; 65 miles N. by W. of Seattle, 90 miles E. of the Pacific Ocean (for location, see map of Washington, ref. 2–C). It is in an agricultural, mineral, and lumbering region, and is a place of large strategic importance. The U. S. Government has established Fort Townsend on the west side of Port Townsend Bay, 2½ miles by water and 5 miles by land from the city, and has reserved Point Hudson, Point Partridge, Marrowstone Point, and Admiralty Head as sites for fortifications. It has also established a quarantine station and a marine hospital. The city has gas and electric light plants, a system of water-works supplied from Little Quilcene river by gravity, several lines of street-railway, a line of daily steamers to Victoria, British Columbia, a national bank with capital of $100,000, 3 State banks with combined capital of $180,000, and 2 daily and 3 weekly newspapers. There are several foundries and machine-shops, saw and flour mills, steel, wire, and nail works, and other manufactories. Pop. (1880) 917; (1890) 4,558; (1900) 3,443. EDITOR OF "CALL."

Por'tugal, Port. pron. pōr-too-gaal' [from Portug. and Span. *Portugal* < Late Lat. *Portus Cale*, liter., the Harbor of Cale, orig. name of the city of *Oporto*]: a kingdom of Europe, occupying the southwestern part of the Iberian Peninsula, between Spain and the Atlantic (see map of Spain and Portugal). Area (of the continental portion only), 32,528 sq. miles, and of the islands of MADEIRA and the AZORES (*qq. v.*), 1,510.

Physical Features.—Portugal is not naturally divided from Spain; as a whole, it is lower than Spain, with more low ground. The northern half is essentially mountainous, and its scenery is very picturesque. The Serra da Estrella crosses the center. Its peaks attain 6,539 feet, and are covered with snow during the winter months. Southern Portugal consists of plains and rolling lands, varied toward the S. W. by spurs of the Sierra Morena. One of these spurs, the Serra de Algarve, extends to the ocean. The principal rivers rise in Spain. The Minho and Guadiana, on the frontiers, are navigated by boats. The Douro, which crosses the mountain region, is also navigable for barges, and its mouth forms the harbor of Oporto. The Tejo or Tagus crosses the southern plain, and its broadened mouth is the splendid harbor of Lisbon. Seagoing vessels ascend to Santarem, about 40 miles. The northern and southern coasts are generally rocky. Between Oporto and Cape Carvoeiro there are extensive sand-dunes, backed by marshes. Almost the only good harbors are at Lisbon and Oporto.

Climate, Soil, and Natural Productions.—The climate is mild and equable; on the coasts frosts are rare. Olives and

oranges grow well nearly everywhere, and palms flourish in the S. Rains are abundant. The available lands are generally very fertile; exceptions are the oak-barrens of Alemtejo. Considerable tracts of forest remain. The common trees are oaks, pines, and chestnuts. The cork-oak grows wild and is cultivated. The coast fisheries of sardines, tunnies, etc, compete with those of France. The most important mineral products are copper, antimony, manganese, lead, and salt from the coast lagoons; a little gold, zinc, iron, and coal are obtained.

Agriculture.—Wine is the most important product and export, including port from the valley of the Douro and various light-red wines from near Lisbon. The Portuguese oranges, olives and olive oil, figs, tomatoes, etc., are known throughout the world. Cereals (maize, wheat, rye, and a little rice) occupy the largest area. Stock-raising is increasing. Large herds of swine run almost wild in the oak-barrens of Alemtejo. Agricultural methods are backward, partly owing to ignorance and lack of tools, partly to excessive division of land and the absence and neglect of the large proprietors.

Manufactures.—Besides the numerous establishments for oil and wine making and for canning fruits, there are important factories, especially in Lisbon and Oporto. Cotton and silk thread and cloths, veil stuffs, gold and silver filigree work, shoes, gloves, etc., are made. Ship-building is now confined to a few yards.

Commerce and Communications.—The most important exports are wine, cork, fish, copper ore, and fruits. In 1891 the exports were valued at 31,872,000 milreis; the imports at 50,024,000 milreis. About one-fourth of the trade is with Great Britain. Portugal now has good roads and telegraph system and nearly 1,000 miles of railways. Over one-third of the latter belong to the state and the rest have state subventions. See PORTUGAL in the Appendix.

People and Government.—The Portuguese, like the Spanish, are descended from Celto-Iberic tribes, more or less modified by Latin, Visigothic, and Moorish blood. The language, laws, and many arts and customs have come down with little change from the Romans. The educated class is comparatively small, but has nearly all the wealth and influence. The lower classes are ignorant and superstitious, but industrious and shrewd. Population in 1890, 5,082,247. The annual increase is slight, owing to the constant drain to Brazil. The Government is a constitutional monarchy. Parliament consists of a house of peers and a house of delegates. Adult males who can read and write and have a clear income of 100 milreis possess the right of suffrage. The state religion is the Roman Catholic, but other creeds are tolerated. Primary education is nominally compulsory, but the illiterate class is still very large. Lisbon and Oporto have schools of medicine, law, fine arts, technology, etc. The University of Coimbra is one of the oldest and most celebrated in Europe.

Weights, Measures, and Coins.—The metric system is in general use. The Portuguese *libra* is 1·012 lb. avoirdupois; the *alqueire* is 0·36 bush. The *milreis* or 1,000 *reis* is equal to $1.08; the *conto* is 1,000 milreis. In expressing sums of money the milreis or dollar mark is written after the milreis but before the odd reis; thus 1,230$178 means 1.230 milreis (or 1 conto and 230 milreis) and 178 reis. The testoon or *tostão* is 100 reis—about 10 cents—and the *vintem* is 20 reis. Gold is the standard. Gold coins of 10 milreis (coroa) and 5, 2, and 1 milreis are used, and there are smaller coins of silver and bronze.

Finances.—In June, 1900, the external debt was 65,098,865 milreis; the internal debt 87,894,879. Most of the debt is now funded at 4½ and 4 per cent. Of late years there has been an almost constantly recurring deficit, with defaults or delays in payments: measures have been taken for retrenchment. The annual revenue is about 50,000,000 milreis.

History.—Portugal was one of the little kingdoms formed when the Christians began to drive back the Mohammedans. Henry of Burgundy married the daughter of Alfonso VI., and, about 1095, received her dowry, the lately conquered Portocallo, or Northern Portugal, as a fief of Galicia. By wars and conquests the region was consolidated and made independent. Henry's son, Affonso Henriques (1128–85), is called the founder of the monarchy, because he took the title of king (1139 or 1140), and drove the Moors far southward, capturing Lisbon in 1147. About 1250 the Moors were finally driven from Algarve. By a revolution in 1383 the throne passed from the line of Burgundy to that of Aviz. John II. broke the power of the nobles, and made that of the crown absolute. Exploration was stimulated by Prince Henry, the Navigator, who conceived or adopted the idea of circumnavigating Africa to reach India. Madeira and the Cape Verde islands were discovered and colonized; and Bartolomeu Diaz reached the Cape of Good Hope (1486). Portugal became the center of maritime knowledge; a papal bull and the Treaty of Tordesillas (1494) gave the eastern hemisphere to Portuguese conquest and the western to Spain. In 1497 Vasco da Gama reached India by the Cape of Good Hope; trading-posts were speedily established on the Asiatic coasts; Ceylon and the Moluccas were conquered, and within a few years the whole stream of Eastern trade was turned into Lisbon. Brazil was discovered in 1500. The soldiers and statesmen seldom returned from the East, and the laborers were drained into Brazil. King Sebastian perished with his army in a war with the Moors of western Africa (1578), and Portugal was seized by Philip II. of Spain. At once the fabric fell to pieces; the Dutch seized the Eastern trade, the African posts, and part of Brazil, and Portuguese commerce was swept from the seas. The successors of Philip failed to keep his promise to preserve the autonomy of Portugal, and a revolution, begun in 1640 and supported by England, wrested the country from Spain and gave the crown to the house of Bragança, in which it still remains. The Brazilian possessions, recovered from the Dutch, became a new source of wealth, especially after the discovery of gold and diamonds. On Nov. 1, 1755, occurred the great earthquake which destroyed Lisbon, the only severe one in the history of Portugal. In 1807 the Portuguese court fled to Brazil before the armies of Napoleon. The French were soon driven out by the British. A popular revolution in 1820 ended in the adoption of a constitution: John VI., returning from Brazil soon after, was compelled to sign this. In 1822 Brazil became independent under Pedro I., son of the Portuguese king; this blow nearly ruined Portugal. By the death of John VI. in 1826 the crown fell to the Brazilian emperor, who resigned it in favor of his infant daughter, Maria da Gloria; she was, for a time, robbed of her rights by the usurpation of Dom Miguel (1828), but Dom Pedro, having resigned the Brazilian throne, headed a successful revolt in favor of his daughter, who became queen in 1834. Several petty political revolts followed until 1852, when the constitution was revised to suit all parties. Since then Portugal has been at peace and generally advancing, but she has incurred a crushing public debt, and the growth of the republican party threatens trouble for the future. The African colonies have been expanded into large possessions and are carefully cherished, but they have given rise to boundary disputes with Great Britain.

Colonies.—The following table shows the (approximate) extent and population of the Portuguese colonies:

POSSESSIONS.	Area in sq. m.	Population.
Cape Verde, Princess, and St. Thomas islands..	2,104	131,970
West African possessions.....	489,500	2,800,000
East Africa	261,700	1,500,000
Possessions in Asia and the East Indies (Goa, Macao, Timor, etc.).....	7,900	939,320
Totals.....	761,204	5,371,290

AUTHORITIES.—*Estadistica de Portugal* (official 1892); Aldama-Ayola, *Compendio geográfico-estadístico de Portugal y sus posesiones ultramarinas* (1880); Crawfurd, *Portugal: Old and New* (1880); Herculano, *Historia de Portugal*; Stephens, *The Story of Portugal* (1891); Corvo, *Colonias Portuguezas* (1883–87); Major, *Prince Henry, the Navigator*; Salisbury, *Portugal and its People* (1893).

HERBERT H. SMITH.

Portuguese-Brazilian Literature: the literature of Brazil, from the time of its settlement down to the present. Since Brazil was colonized by the Portuguese, this literature is in the Portuguese language, and for this reason it would be possible to treat it as a part of Portuguese literature. Since Brazil has become an independent nation, however, it seems better to discuss the manifestations of Brazilian national feeling and thought in a distinct article.

I. *Colonial Period.*—During the colonial period of three centuries Brazil received nearly all its impressions of the outer world through Portugal. There were few schools except the Jesuit colleges, and hardly any libraries or books. Wealthy young men went to Portugal to study law or divinity, and either remained there or returned to take secular and Church offices. Under these circumstances there was

little chance for the growth of a distinctively Brazilian literature; the few writers of note generally followed Portuguese models. The Jesuit missionaries—commonly of European birth—were the first colonial authors. Living among the Indians they imbibed the spirit of the forests and plains, and in their letters—especially in those of Anchieta—we may trace the first germs of a national literature. The same order gave to the colony its only great genius—Antonio Vieira, who was a Brazilian by education, though not by birth. He was the first of the Portuguese orators, one of the first prose-writers, and a statesman of worldwide fame. In history the sixteenth and seventeenth centuries produced only missionary chronicles like those of Vasconcellos and Jaboatão, or local accounts of wars and discoveries, like the *Castrioto Lusitano* of Frei Raphael de Jesus, or the *Noticias* of Vasconcellos; the endless *relatorios* and *roteiros*, most of them unpublished, are valuable as documents, but mere rubbish from a literary standpoint. In 1730 Rocha Pitta, a native of Bahia, published his *Historia da America Portugueza*, the first complete and really readable history of Brazil. This was followed by the local *Annaes historicos do Maranhão* (1749), by Berredo, a Portuguese governor; the *Memoria sobre a capitania de São Vicente* (1797), of Frei Gaspar Madre de Dios, etc. In natural science, ethnology, and geography we have many scattered notices, but no special works of any note by Brazilian authors before the end of the eighteenth century; the reports of the naturalist Alexandre Rodrigues Ferreira and the engineer Ricardo Franco, who were attached to the boundary commission, 1783–93, have only been published in part in modern times. Perhaps the first Brazilian poet worth naming was Gregorio de Mattos Guerra (Bahia, 1633–96); his biting satires would have won him fame had not so many of them been defaced by obscenity. Later several poets of note clustered around the viceregal court at Rio de Janeiro, or found their way thence to Europe; such were Frei Francisco de São Carlos (1763–1829), whose saered epic, *Assumpção da Santissima Virgem*, is, in some sense, comparable to *Paradise Lost*; Antonio Pereira de Souza Caldas (1762–1814), writer of sacred odes; the mulatto José Basilio da Gama (1740–95), best known for his historical poem, *Uruguay*; Manuel Ignacio da Silva Alvarenga, whose pastorals and love-songs are still widely read; the lyric poets Domingos Caldas Barboza and Antonio Diniz; and Frei José da Santa Ritta Durão, author of *Caramurú* (1781), the first epic founded on Indian life. Antonio José da Silva (1705–39) went from Rio de Janeiro to Portugal, became famous as an author of comedies, and eventually met a tragic death at the hands of the Inquisition. Equally sad was the fate of a brilliant coterie of poets in Minas Geraes; Claudio Manuel da Costa, unrivaled for his sonnets and odes; Thomaz Antonio Gonzaga, with his melodious verses to "Marilia"; and Alvarenga Peixoto. They were involved in an alleged conspiracy in 1789; Costa committed suicide, and the others went into penal servitude. To this list we may add Botelho d'Oliveira, a native of Bahia who published his *Musica do Parnaso* in 1705. All these follow, more or less, the Portuguese classic or romantic models; but here and there we can see the true national spirit struggling for utterance, as in some passages from Botelho and Gonzaga. Santa Ritta Durão clung to a severely classic measure and style; and the incongruity of Indians who talk and act like Greek heroes is too great a strain for the modern reader; it obscures the real merit of his verse.

II. *Modern Period.*—The sojourn of the Portuguese court at Rio de Janeiro (1807–21) was marked by increased literary activity, prineipally in the prose domains of history and geography; then appeared Pizarro's *Memorias historicas*, Sanctos's *Memorias do Reino do Brazil*, Ayres de Cazal's *Corographia Brasilica*, and Velloso's *Flora Fluminensis*. The independence brought a host of political writers, brilliant orators, such as the Andradas (one of them a well-known naturalist also), and economists. The King of Portugal had left one priceless legaey to Brazil—his historical library, which became the nucleus of the great public library at Rio de Janeiro. Distinguished naturalists visited the country and wrote enthusiastically about it; and Brazilian authors began to see that their inspiration lay in the magnificent scenes about them. French literature became very popular, and doubtless had a strong influence, but in the main the best writers became nationalized. The reign of Pedro II. saw the birth of a new school, which is still in its infancy, but has a brilliant future. Almost every page of it bears the impress of tropical nature—the forests and mountains, the gigantic rivers, and vast plains of the interior; above all the Indians, who are so indissolubly connected with colonial history and country life. One poet of the first rank has appeared—Antonio Gonçalves Dias—and the brilliant coloring of his descriptive verses, combined with their tender sentiment, has made them household words in Brazil and Portugal. Poems like *Rosa no mar*, *Piaga*, *A tempestade*, and *O gigante de pedra* will live as long as the language does; and the lines beginning

> Minha terra tem palmeiras
> "Onde canta o sabiá,"

might almost be called the Brazilian national hymn. Magalhães, another poet of note, has been called the founder of the Brazilian school. It is certain that his Indian epic, *A confederação dos Tamoyos*, contains passages of rare beauty, but it lacks the fire of Dias. Among a multitude of lesser poets we may mention Casimero de Abreu, well known for his delightful love-songs; Sylvio Romero, Araujo Porto-Alegre, and Castro Alves. In romance Alencar is the best known. The popularity of his Indian stories is rather undeserved, though they contain excellent descriptive passages. Very much superior in plot, description, and character-drawing are the novels of Escragnolle Taunay. His *Innocencia* has been translated into English, but only one familiar with country life in Brazil can appreciate its fidelity to nature. Taunay's descriptive powers are also well seen in his *Retraite de Laguna* (originally written in French) and *Scenas de Viagem*, both relating episodes of the Paraguayan war. Macedo is another novelist of note. The greatest of the Brazilian historians is Varnhagen (Viscount of Porto Seguro), whose *Historia do Brazil* is a classic. Other historians of note are Pereira da Silva, Lisboa (also noted for his essays), and Fernandes Pinheiro. The historical criticisms of Capistrano de Abreu are excellent. Caetano da Silva in historical geography; Beaurepaire Rohan, Cunha Mattos, and others in geography and travels; Couto de Magalhães in ethnology; and Bocayuva and Patrocinio in journalism, are all well-known names. In natural science foreigners as yet occupy the first place. See Pereira da Silva, *Os varões illustres do Brazil* (1858); Pinheiro, *Litteratura nacional* (1862); Mello Moraes Filho, *Curso de Litteratura Brazileira* (1882); F. Wolf, *Histoire de la Littérature brésilienne* (Berlin, 1863). HERBERT H. SMITH.

Portuguese Language: the national language of Portugal, used also in the Portuguese colonies and Brazil, and (in a dialectal form) in the border province of Galicia in Northwestern Spain. The number of native speakers of the language can not be even approximately given; it is probably over 10,000,000, and may reach 20,000,000.

The system of sounds of the language is complex and ill indicated by the usual etymologieal spelling. Disregarding some minute shades we may describe it as follows: There are eleven oral vowels: two *i*'s (about as in English *machine*, written *i*, *y*, *e*; or English *hill*, written *i*); two *e*'s (one close, written *e*, *ê*; one open, written *e*, *è*, *é*); three *a*'s (one as in English *father*, written *a*, *á*; one differently described as like English *a* in *about* or French *a* in *dame*, written *a*, *â*; one about like the sound in English *hot*, written *a*, *á*); two *o*'s (one close, written *o*, *ô*, *ou*; one open, written *o*, *ó*); a *u*, as in English *rule*, written *u*, *o*; a vowel comparable with the French mute *e*, written *e*, *i*. There are five nasal vowels: the nasal of the first *i*, written *im*, *in*; that of close *e*, written *em*, *en*; that of the second *a*, written *am*, *an*, *ã*; that of close *o*, written *om*, *on*, *õ*; that of *u*, written *um*, *un*. These are not like the French nasal vowels. Noteworthy are also certain nasal diphthongs, as *ãe* and *õe* (both these end in the sound of nasal *i*). The consonants, like the vowels, are differently given by different observers; we reckon here twenty-five: *p*, *b*, a bilabial *v* (written *b*), *f*, *v*, *w* (consonantal *u*, written *u*, *o*), *m*, *t*, *d*, *l*, *n* (these four more dental than in English), a dental spirant (as in English *that*, written *d*), a gutturalized *l*, *s* (written *s*, *c*, *ç*), *z* (written *z*, *s*)), two varieties of *r* as in Spanish, one strongly rolled (written *r*, *rr*, *rh*), the other not so rolled (written *r*), both pronounced with the tip of the tongue, sibilants as in English *shut* (written *x*, *ch*, *s*, *z*) and *pleasure* (written *j*, *g*, *s*, *z*), a palatal *l* resembling English *lli* in *million* (written *lh*), a palatal *n* resembling English *ni* in *union* (written *nh*), *y* (consonantal *i*, written *i*, *e*), *k* (as in English *cool*, *key*), *g* (as in English *good*, *gild*), and (not always recognized) the nasal sound in English *sing*, *song* (written *n*, which at the same time indicates nasality of the preceding vowel).

The grammatical structure of the language is similar to that of Spanish, and the same resemblance exists for the sources of its vocabulary, though it has borrowed more from France. A peculiar feature is the inflexion of the infinitive with personal endings, which helps to make clear the person thought of. The original pluperfect is now generally a conditional, as in Spanish, but the original sense also exists. The use of Portuguese in writings preserved dates from about the end of the twelfth century. In the sixteenth century, later than in Italy and Spain, appear the beginnings of grammatical treatment. A dictionary begun by the Academy in 1793 was not carried beyond the letter A, but Bluteau's *Vocabulario portuguez e latino* (8 vols., 1712–21, with a supplement in 2 vols., 1727–28) is earlier, and the *Elucidario das palavras, termos e frases que em Portugal antigamente se usaram*, etc., of Joaquim de Santa Rosa de Viterbo appeared in 1798–99. The best historical study of phonology and inflexions is that of Cornu in Gröber's *Grundriss der romanischen Philologie*, i., 715 ff. The description of the modern sounds given above is based mainly on A. R. Gonçalves Vianna's *Exposição da pronuncia normal portugueza* (Lisbon, 1892); see also his earlier study in *Romania*, xii., 29 ff., and the articles of Prince L.-L. Bonaparte in *Trans. of the Philological Society* (1880–81), p. 23 ff. (1882–84), p. 404 ff., and H. Sweet, *ib.* (1882–84), p. 203 ff. Work on Portuguese philology, including dialects, has been done by J. Leite de Vasconcellos. F. A. Coelho, Carolina Michaelis de Vasconcellos (e. g. *Der "portugiesische" Infinitiv* in *Romanische Forschungen*, vii., 49 ff.), H. Schuchardt (especially his *Kreolische Studien* in the publications of the Vienna Academy), H. R. Lang, and others; see articles in the *Revista lusitana* and other periodicals, and the bibliographies in the *Zeitschrift für romanische Philologie*.

Dictionaries: J. L. Roquette, *Dictionnaire portugais-français* (Paris, 1855); J. de Lacerda, *New Dictionary of the Portuguese and English Languages* (2 vols., Lisbon, 1866–71); D. Vieira, *Grande diccionario portuguez* (6 vols., 1871–74); A. de Moraes Silva, *Diccionario da lingua portugueza* (7th ed. 2 vols., Lisbon, 1877–78); Caldas Aulete, *Diccionario contemporaneo da lingua portugueza* (Lisbon, 1881); J. Felix Pereira, *Vocabulario sonico* (Lisbon, 1888); F. A. Coelho, *Diccionario manual etymologico* (Lisbon, 1890); H. Michaelis, *New Dictionary of the Portuguese and English Languages* (2 vols., Leipzig, 1893, and a Portuguese-German dictionary by the same compiler, 1887–89), etc. Grammars: Elwes, *A Grammar of the Portuguese Language* (London, 1876; 2d ed. 1884); A. Vieyra, *A New Portuguese Grammar* (London, 1768 and since); C. von Reinhardstoettner, *Grammatik der portugiesischen Sprache* (Strassburg, 1878); J. Ribeiro, *Grammatica portugueza (3° anno)* (3d ed. Rio de Janeiro, 1889); E. Monaci and F. d'Ovidio. *Manualetti d' introduzione agli studj neolatini*, iii. *Portoghese* (Imola, 1881), etc. See also Romance Languages. E. S. Sheldon.

Portuguese Literature: the works in prose and verse, written in the Portuguese tongue, whether in Portugal or in the Portuguese colonies, with the exception of Brazil. (See Portuguese-Brazilian Literature.) Owing to the comparatively restricted territory and population of Portugal, her literature can not be esteemed one of the great European literatures. Moreover, the national life has not had the fullness and original energy requisite for the creation of a really independent literary tradition. Portugal has, in the main, followed intellectual movements received from abroad, and the periods of her literature must all be denominated according to these successive foreign influences. At the same time, the temperament of the people is distinctly marked with its inclination to melancholy, to reverie, to sentimental longings—in short, to what the Portuguese themselves call by the untranslatable name *saudades*; and the literature, even where its matter is entirely borrowed, has an air and a charm all its own.

First Period (1200–1385); *French and Provençal Influence.*—During this period the Spanish province of Galicia, whose dialect had not yet become distinct from Portuguese, must be included with Portugal. Although there were certainly in this considerable region indigenous intellectual traditions dating from the Roman time, and although the neighborhood of the Arabs, since the eighth century, had had its effect on culture, still the first influences tending to arouse imaginative and literary activity in modern Portugal came from the N. of the Pyrenees—i. e. from France and Provence. These influences began to be felt as early as the ninth century, when the shrine of St. James at Compostella became the chief object of veneration and goal of pilgrimages for all Western Europe. Then the wars against the Moors brought many French soldiers into the Peninsula; and after Toledo had been recovered (1085), many French clergy and scholars, and even colonists, were invited to settle in the new-won territory. Intermarriages also between the peninsular princes and nobility and the French became frequent, and finally came the establishment of the Burgundian family on the Portuguese throne. As early as the twelfth century—the great literary period of mediæval France—there was imitation among the Portuguese-Galician nobility of the courtly lyrics of their northern neighbors. The earliest of these that have come down to us, however, are of the beginning of the thirteenth century. In accordance with the essentially aristocratic character of the new poetry, the models followed were rather Provençal than French proper. During the thirteenth century the school of Portuguese-Galician troubadours rapidly developed, and, indeed, the Portuguese-Galician dialect became the regular language even for the Spanish lyric poets. The full splendor of this new art was reached in the second half of the century, especially at the court of King Dionysius (Dom Diniz, 1279–1325), who was a poet himself, and whose two natural sons were poets. The Spanish king Alfonso X., el Sabio (1252–84), had also given distinction to the style by writing his lyric poems, both sacred and profane, in the Portuguese-Galician tongue. The active production of such lyric poetry continued till about 1350, and the list of poets contains more than 150 names, many of them princes and other persons of high rank. The poems themselves, in so far as they are left to us, are contained in several songbooks, or *Cancioneiros*, of which the most important are the so-called *Cancioneiro da Ajuda*, preserved in Portugal, and the Italian *Cancioneiro do Vaticano* (*Cod. Vat.*, 4803) and *Cancioneiro Colocci-Brancuti* (belonging to Count Brancuti di Cagli). The numerous poetical forms include all the important varieties employed by the troubadours of Provence. The most serious defect of the mass of poems is their almost complete artificiality.

Contemporary with this lyric production we find traces in Portugal of general interest in the historic or romantic traditions treated in the narrative poems of Northern France and of Spain. The Arthurian legends, the heroic tales about Charlemagne and his peers, and certain of the Spanish popular historic themes were undoubtedly sung in Portugal. Perhaps at this time the famous romance of *Amadis de Gaula* began to take shape. (See Lobeira, Vasco, de.) No other considerable work, however, on any of these subjects seems to have been produced. The works in prose of this period are of slight account, being mainly either translations from Latin, French, and Spanish books, both religious and secular, or meager chronicles and genealogies of the Portuguese nobility (*Livros de Linhagens*, or *Nobiliarios*).

Second Period (1385–1521); *Spanish Influence.*—This period, intermediary between the Middle Ages and the modern world, was rather one of intellectual preparation than of actual literary achievement. A great change had to be undergone by Portugal, as by the rest of Europe, under the influence of that revival of classical studies which had been initiated in Italy by Petrarch and Boccaccio. The University of Lisbon had already been founded by Dom Diniz in 1291, and, though shifted several times from the capital to Coimbra and back again, speedily acquired great importance for Portuguese culture. During the fourteenth and fifteenth centuries we find a wide extension of the study first of the Latin and later of the Greek classics. At the same time intercourse with Italy became more constant, and Italian literary ideals gradually replaced the older French and Provençal traditions. The first effect of the readjustment was almost a cessation of poetical composition. From the middle of the fourteenth to the second half of the fifteenth century we have no Portuguese poetry of importance. Then there was developed at the royal court a school of poets, which, while not completely assimilating the new ideas, still served to introduce them. These singers, commonly called *poetas palacianos*, did not directly imitate the Italians, but instead the Spanish imitators of the Italians, like the Marques de Santillana, Juan de Mena, Jorge Manrique, etc. The number of the *poetas palacianos* was large, and included persons of the highest rank. Their verses were collected and printed in 1516 by the courtier and poet Garcia de Resende in the volume entitled *Cancio-*

neiro Geral, which contains about 1,000 poems, all written apparently after 1448.

The most noteworthy prose works of this period are the first great Portuguese chronicles. Four of these were written during the fifteenth century—those of Fernam Lopez, Gomes Eannes de Zurara, Vasco Fernandes de Lucena, and Ruy de Pina. Furthermore, there was a remarkably rich literature of translations, especially from the Latin classics.

Third Period (1521–80); *Italian Influence.*—This, the golden age of Portuguese literature, is ushered in by three writers still closely allied with the past, but at the same time innovators and indicators of tendencies destined to become dominant in the future—Gil Vicente (1502–36), Christovam Falcão (d. 1550?), and Bernardim Ribeiro (b. 1486?). The first of these was the founder of the Portuguese drama and at the same time one of the richest and most varied geniuses of his native land. The impulse to the creation of his dramatic pieces (*autos*) seems to have come from the *Autos* or *Eclogas* of the Spanish Juan del Encina (see Encina, Juan, del), published in 1496; but the Portuguese poet far outdid his models in variety and originality. His dramas, which are both religious and secular, show the most remarkable commingling of all kinds of elements—mediæval and Renaissance, popular and learned, sacred and profane. Falcão and Ribeiro, on the other hand, introduced that expression of sentimental feeling in pastoral form which, on the whole, has best fitted the Portuguese temperament. Their inspiration seems to have proceeded first from the pastoral works which the Italians began to write at the very dawn of the Renaissance (see Pastoral Poetry); but certainly they owed much to the popular pastoral songs (*serranilhas*, etc.) which are among the most characteristic products of the Portuguese genius.

The note given uncertainly by these poets was first struck with fullness and power by Francisco de Sâ e Miranda (1495–1557), the first classic writer of Portugal. After he had already become a learned man, this poet in 1521 undertook a journey to Italy and Spain with the avowed purpose of learning what was newest and best in literature and art. He remained five or six years in Italy, entering into relations with the most eminent writers and scholars, and after his return to Portugal he speedily became almost a literary dictator. Humanistic studies were, as a consequence, pursued with far greater zeal, and Portuguese poets cultivated ideals quite different from those of their predecessors. In particular, Sâ e Miranda put forward Petrarch and his Italian disciples as the only true models for lyric poets; he greatly strengthened the impulse to the pastoral form; and his introduction of comedy after the manner of the Italians and of Plautus and Terence gave the drama a new direction. His followers and imitators were many, but only one can be mentioned here, Jorge Ferreira de Vasconcellos (d. 1585), whose tragedy in the antique style, *Ines de Castro*, still remains unsurpassed in Portugal.

The poet who combines within himself all these tendencies and who gave them ultimate expression was Luis de Camões (1524–80), the greatest figure in the history of Portuguese letters. Of passionate and impressionable temperament, yet capable of feeling to the full the glories of the great period of Portuguese discovery and conquest in the East and West Indies, Camões gave utterance to his own experiences and emotions in exquisite lyrics, and to the heroic history of his country in an epic, *Os Lusiadas*, which is among the best the moderns have produced. So commanding was his genius that the succeeding generation of poets in both kinds may best be grouped under the one name *Camonistas*, or disciples of Camões.

Despite the greater importance of poetry, prose also flourished greatly in this period. Its most remarkable monuments were historical works, of which may be mentioned the *Décadas* of João de Barros (1496–1570); the *Historia do Descobrimento da India* of Fernam Lopes de Castanheda (d. 1559); the *Historia da Provincia de Santa Cruz* of Pedro de Magalhães Gandavo; the *Chronica de D. Manoel* and *Chronica de D. João II.* of Damião de Goes (1501–72); the Latin *De rebus Emanualis libri XII.* of Jeronymo Osorio (d. 1580), later made a classic in the translation of Francisco Manoel do Nascimento (publ. 1804); the *Chronica de D. João III.* of Francisco de Andrade (1540–1614); and the often too imaginative book of travels in Asia, *Peregrinacões*, of Fernam Mendes Pinto (1509–80). Of other works in prose from this time the most notable are the romances of chivalry, the number of which is great. The best of them, however, *Palmeirim de Inglaterra*, we have only in a garbled Spanish form. Worth mentioning here, though not written till about 1595, is the pastoral romance by Fernam Alvares do Oriente, entitled *A Lusitania trasformada*, based on Sannazaro's *Arcadia*.

Fourth Period (1580–1700); *Spanish-Italian Culteranistic Influence.*—As in Spain, the golden age was followed by a long period of literary decay. That curious literary movement known in Italy and France as Marinism, in England as Euphuism, in Spain as Gongorism or Culteranism, extended also to Portugal. Command of the substance of poetry having been lost, poets strove to make up for it by intricacies and artificialities of style. The large and gracious manner of the classic writers was succeeded by the tortured and laborious efforts of the makers of *concetti*. Accordingly, in all this long period we have but a few great names. Francisco Manoel de Mello (1611–66) showed both in lyric poetry and in the pastoral romance something of the old charm. Francisco Rodrigues Lobo (d. 1625) attained a certain success in the latter form. In the sacred and profane lyrics of D. Francisco de Portugal and of the nun Sor Violante do Ceo (1601–93) an occasional note of truth and power is struck. The numerous epic poets rarely produce a readable work—for example, the *Malacca Conquistada* of Francisco de Sâ e Menezes (d. 1664), and the *Viriato tragico* of Braz Garcia de Mascarenhas. The oratory of the Jesuit preacher Antonio Vieira (1608–97) could become at times direct and strong. Most characteristic of the time was the formation of numerous literary academies, after the fashion of the Italians—some of them with the most fantastic names and the strangest conceptions of literary art.

Fifth Period (1700–1825); *Pseudo-Classicism.*—Like the rest of Europe, Portugal gave the eighteenth century to the contest between the old manner of thinking and living and rapidly invading science and rationalism; and here, as elsewhere, it was France that gave rise to the revolutionary impulses. Despite all the efforts of the conservative part of society, aided by the ruthless cruelties of the Inquisition, the movement could not be stayed. Gradually here and there one of the numerous academies became a meeting-place for enlightened men eager to share the scientific advances of their time. Such were the Academia Portugueza, founded early in the century by Francisco Xavier de Menezes, Count of Ericeira, and the Arcadia Ulyssiponense, established in 1756 by Antonio Diniz da Cruz e Silva and others. At the same time literature began to adopt as models first the great French writers of the age of Louis XIV., and later Voltaire, the Encyclopædists, and to some extent Rousseau. While this process of regulating and rationalizing was going on, it must be admitted that the interest of literary art decidedly diminished. For some reason Brazil for the moment fairly eclipsed the mother-country. In the latter the chief names are Antonio Diniz da Cruz e Silva (1731–99), mentioned above, and Francisco Manoel do Nascimento (1734–1819). Serving as links to connect this with the following period, we have Manoel Maria Barbosa du Bocage (1765–1805) and José Agostinho de Macedo (1761–1831).

Sixth Period (since 1825); *Romanticism.*—The literary phenomena of the romantic movement were the same in Portugal as elsewhere. The scientific studies of the eighteenth century had greatly enlarged the range of intellectual interests, and the agitations of the revolutionary period turned the attention of the best spirits to the furthering of patriotic national life. These efforts only the more alarmed the Portuguese conservatives, and as a result many of the liberals were forced into temporary exile, thus becoming all the better acquainted with the tendencies of contemporary Europe. The true initiator of Romanticism in Portugal was João Baptista da Silva Leitão, Viscount of Almeida Garrett (1799–1854), who was equally influential in politics and in literature. It was he who established a national theater and provided it with a series of dramas full of national reminiscences and of patriotic feeling. He produced in his novel *O Arco de Santa Anna* (1846) one of the chief romantic historical novels in the language. He also encouraged the collection of popular songs and traditions, which have done much to strengthen the sense of national life among the Portuguese. Only less important than his efforts were those of Alexandre Herculano de Carvalho e Araujo (1810–77), the chief of the Portuguese historical novelists as well as an historian of the first rank. Somewhat aside from the romantic movement, on the other hand,

stood Antonio Feliciano de Castilho (1800–75), the master of an exquisite poetic style, with but little originality of ideas.

Romanticism everywhere in Europe easily degenerated into extravagance, and the succeeding generation of Portuguese writers did not escape the danger. While novelists like Rebello da Silva, Mendes Leal, and Andrade Corvo succeeded in giving something of measure to their work, too many others fell into the merest literary oddities. The poets, like Soares dos Passos (1826–60), abandoned wholesome and generous life for melancholy and dilettante sentiment. Since 1865, however, a strong reaction has set in, finding expression in the utterances of the so-called Coimbra school (*eschola de Coimbra*). The representatives of this new movement have striven to replace the triviality and vagueness of the ultra-romanticists by serious studies in the literature, art, and history of Portugal as well as of other countries. Noteworthy names here are those of the Positivist and literary historian Theophilo Braga (b. 1843), the philologist F. A. Coelho, the critic and scholar J. Leite de Vasconcellos. To pure literature belongs the poet João de Deus (Nogueira Ramos), one of the most excellent of the contemporary lyric poets of Europe.

Bibliography.—The best sketch of Portuguese literature is that of Carolina Michaëlis de Vasconcellos, in Gröber's *Grundriss der romanischen Philologie*, vol. ii., pt. 2 (Strassburg, 1894), which contains full bibliographical information. In Portuguese we have the long series of volumes by Theophilo Braga, which, though issued under various titles, form parts of the author's early conceived *Historia da Litteratura Portugueza* (1870, *seq.*). These are impaired by numerous inconsistencies and changes of view. See also Costa e Silva, *Ensaio Biographico-Critico sobre os melhores Poetas Portuguezes* (10 vols., Lisbon, 1850–56); Andrade Ferreira and C. Castello-Branco, *Curso de Litteratura Portugueza* (Lisbon, 1875–76); Barbosa-Machado, *Bibliotheca Lusitana* (4 vols., 1741–52); Francisco da Silva, *Diccionario Bibliographico Portuguez* (continued by Brito-Aranha; 15 vols. up to 1890); R. Pinto de Mattos, *Manual Bibliographico Portuguez* (Oporto, 1878); Maxime Formont, *Le mouvement poétique contemporain en Portugal* (Lyons, 1893); Candido de Figueiredo, *Homens e lettras* (1881). A. R. Marsh.

Portuguese Man-of-war: any one of the large siphonophores of the genus *Physalia*. See Siphonophoræ.

Portulacaceæ: See Purslane Family.

Port Whitby, Canada: See Whitby.

Port Wine: See Wine.

Po'rus: a king of India, ruling E. of the Hydaspes; attacked Alexander when he tried to cross this river, but was defeated, wounded, and captured. He was treated with great kindness, however, by Alexander, and restored to his kingdom, which was much enlarged. As an ally of the Macedonians he afterward supported them on their further expedition into India, but after the departure of Alexander he was put to death by Eudemus, who was left in command of the Greek army of occupation.

Pöschl, Thomas: religious leader; b. at Höretz, in Bohemia, Mar. 2, 1769; was appointed chaplain at Ampfelwang, in Upper Austria, in the beginning of the nineteenth century, and caused great commotion there and in the adjacent districts by the singular doctrines he propounded—that women could hear confession and give absolution, that a certain process of purification which produced convulsions was necessary to salvation, etc. He found many adherents, and finally formed an independent sect, the Pöschlians; but, as the wildest excesses took place in their assemblies, the police interfered. Pöschl was arrested and found completely insane, and was taken to a lunatic asylum in Vienna, where he died Nov. 15, 1837. His followers, who went so far as to offer human sacrifices, were dispersed by force.

Posei'don (in Gr. Ποσειδῶν): in Grecian mythology, son of Cronus and Rhea, brother of Zeus, and husband of Amphitrite. When the universe was apportioned out, after the conquest of the Titans, he received as his portion the empire of the sea, an element of peculiar importance in the Greek mind. He is the equal of Zeus, he surrounds and holds the earth, he is lord over all other sea divinities, he sends storms and quiets the waves, he sends earthquakes (which the Greeks thought originated in the sea), he dwells in the sea. Like the sea, he is ever prone to stormy anger; the waves are his horses (and so he was regarded as the creator of the horse, and the patron of the chariot-race); the trident, a stroke of which blasts rocks and makes water to spring forth, is his awful scepter. Relatively speaking, he is rarely depicted in art, but on this point see the article *Poseidon* in Baumeister's *Denkmäler*. J. R. S. Sterrett.

Posen, pō'zen: province of Prussia; bounded by Silesia, Brandenburg, Pomerania, West Prussia, and Poland. Area, 11,184 sq. miles. The land is a low and level plain, intersected by the Netze, the Warthe, and the Obra, tributaries of the Oder, and bounded for a short distance on the N. E. by the Vistula. It is dotted all over with small lakes, and covered to a great extent with fine forests. The soil is fruitful and well cultivated. Cattle of superior quality are reared, and large crops of wheat, rye, barley, and oats are raised. Manufactures of cloth, machinery, sugar, and tiles are carried on. Posen formed a part of Poland until the first partition of that country, when Prussia took the largest part of the present province. This was enlarged at the two following partitions, an act solemnly sanctioned at the Congress of Vienna in 1815. Nearly two-thirds of the inhabitants are Poles, who are principally Roman Catholics, while the Germans are mainly Protestants. Pop. (1895) 1,828,658.

Posen: capital of the province of Posen, Prussia; at the confluence of the Zybina and Warthe; 150 miles E. of Berlin and 90 miles N. of Breslau (see map of German Empire, ref. 3–I). The Prussian Government has made it one of its great fortified places, and surrounded it by a modern enceinte with citadel and outworks at a cost of 114,000,000 thalers. It contains many fine buildings, including a town-hall and a cathedral, many promenades and public squares, several good educational and benevolent institutions, and manufactures of tobacco, sealing-wax, wax candles, leather, furs, liqueurs, gold and silver ware, woolen and linen fabrics, arms and carriages. Posen is the seat of a Roman Catholic archbishopric. Pop. (1900) 117,014.

Posey, Thomas: soldier; b. in Eastern Virginia, July 9, 1750; removed to Western Virginia in 1769; was quartermaster of Lewis's division of Lord Dunmore's expedition against the Ohio Indians, and took part in the memorable battle of Point Pleasant Oct. 10, 1774; was in the following year a member of the Virginia committee of correspondence, and captain of a company which he raised for the Seventh Virginia Regiment; participated in the defeat of Lord Dunmore at Gwynn's island July 8, 1776; joined the Continental army at Middlebrook, N. J., early in 1777; was transferred to Morgan's famous rifle regiment; distinguished himself in an action at Piscataway, N. J., and in the battles of Bemis Heights and Stillwater under Gen. Gates; commanded the regiment with the rank of major in an expedition against the Indians in the Wyoming valley Oct., 1778; commanded the Eleventh Virginia Regiment 1779, distinguishing himself at the head of a battery at Stony Point; was present at the surrender of Yorktown; served under Wayne in Georgia; defeated the Indians June 23, 1782; resided in Spottsylvania co., Va., for many years after the war; was appointed brigadier-general Feb. 14, 1793, and served under Gen. Wayne in his campaigns against the Indians in the Northwest; removed soon afterward to Kentucky, where he became lieutenant-governor and major-general, 1809; was U. S. Senator from Louisiana 1812–13; succeeded Harrison as Governor of Indiana Territory 1813, and became agent for Indian affairs 1816. D. at Shawneetown, Ill., Mar. 19, 1818. His *Life* was published in Sparks's *American Biography*.

Posido'nius (Gr. Ποσειδώνιος): Greek philosopher of the Stoic school; historian, physicist; b. at Apamea, in Syria (128 B. C.); founded a school in Rhodes, which Cicero attended; traveled far and wide. His great work was a history in fifty-two books, a continuation of Polybius, embracing the period from 145–82 B. C. D. 45 B. C. Fragments are given in Müller's *Fragmenta Historicorum Græcorum*, vol. iii., pp. 245–296. B. L. G.

Posilipo, pō-see'li-pō [Ital. < Lat. *Pausily'pum* = Gr. Παυσίλυπον, liter., stopping or ending care]: the name of a villa of the notorious epicure Vedius Pollio, afterward extended to the entire eminence which bounds the city of Naples on the W. See Naples.

Positivism [deriv. of *positive*, in the sense of indubitable, certain]: the system of philosophy and religion founded by Auguste Comte (1798–1857). (See Comte.) In his youth he showed a strong taste for mathematics, and it was while engaged in teaching geometry in Paris that he became associated (1818–24) with Saint-Simon, the celebrated founder of a sect of world-menders. It appears to have been during this period

that he began to conceive his great scheme for the reorganization of society by philosophy. Comte maintained that the phenomena of society conform to fixed and ascertainable laws, no less than the phenomena of chemical combination or planetary rotation. To discover the laws or most general aspects of the succession of social events was therefore the great task which Comte set before himself; but from his standpoint such a task as this required systematic preparation on an immense scale, for the phenomena of human society are by far the most complicated with which investigation has to deal. In two ways the successful study of them involves a previous study of the most general aspects of all other phenomena; for, in the first place, the human units of society conform to physical, chemical, and biological laws, so that these must be known before we can give a complete account of the actions of social units; and, in the second place, each science has devices for getting at the truth about things which are to some extent peculiar to itself, so that we must look over the whole field in order to equip ourselves adequately for a research which will call into play all the devices we can bring to bear. One science, for example, succeeds pre-eminently by the use of experiment, while another, in which experiment is less likely to return finally satisfactory answers, gets along best by using the comparative method. Let us, therefore, study each method in that science which best illustrates the proper use of it, and then we shall be the better prepared to investigate the excessively complex questions presented by the phenomena of human society.

Classification of the Sciences.—Thus in the attempt to inaugurate a scientific theory of social phenomena Comte was led incidentally to work up the elements of a grand theory of scientific method. As his acquaintance with physical science was wholly at second-hand, he fell into many errors in the details of his scheme, but he nevertheless accomplished so much as to entitle him to a very high place as a writer on method. His first task was to classify the various sciences in the order of their logical dependence. Having made a division between abstract and concrete sciences, corresponding nearly to the old division between natural philosophy and natural history, Comte arranged his so-called abstract sciences in a linear series. He began with the most simple and general phenomena, to proceed step by step to those which are most complex and special. Upon this principle the inorganic sciences, as a group, were manifestly to come before those which deal with organic phenomena. For example, we can study thermal radiations and chemical reactions without taking vital forces into the account, but we can not study living organisms without appealing to physics and chemistry at every step. In the region of inorganic science Comte placed astronomy first, as dealing (in his time) only with gravitative force as manifested in the relatively simple phenomena of the mutual attractions of the heavenly bodies; whereas physics, which he placed next, treats not only of gravitative force as manifested throughout relatively complex terrestrial phenomena, but also of such modes of forces as cohesion and capillarity, and of the varieties of wave-motion known as sound, heat, light, magnetism, and electricity. Chemistry, dealing with the still more complex phenomena in which the relative positions of molecules are altered heterogeneously, resulting in new compounds with new properties, was ranked third in order. Passing then to organic science, Comte grouped together, under the head of biology, the most general aspects of nutrition and reproduction, of muscular contractility and nervous sensibility; under the last-named head he included all the phenomena of mind, leaving no place for psychology as an independent science, and setting aside altogether the study of the subjective phenomena of consciousness by introspective observation. Last in the series, as obviously the most complex and specialized of all, was ranked the science of sociology. Mathematics, on the other hand, was placed before all these sciences, the phenomena of number, form, and magnitude being universal, and capable of generalization without reference to other phenomena. The "hierarchy of the positive sciences" thus came out in the following order: (1) mathematics; (2) astronomy; (3) physics; (4) chemistry; (5) biology; (6) sociology. According to Comte, this arrangement represented not only the logical order in which the sciences depend one upon another, but also the historical order in which they have been successively developed and in which they have aided each other's advance. Thus astronomy, according to Comte, was truly a science in the days of Hipparchus, while physics became a science, in the true sense of the word, only when Galileo discovered the increment of velocity in falling bodies; chemistry was not scientific until the time of Lavoisier; biology was first organized into a coherent body of doctrine by Bichat; and sociology had to wait until all these lines of inquiry were gathered together in the hands of the founder of positivism. This Comtist classification of the sciences has fascinated many minds, but it is not at present accepted by scientific thinkers. For a full examination of this subject the reader may be referred to Herbert Spencer's essays on the *Classification of the Sciences* and the *Genesis of Science*, and to John Fiske's *Outlines of Cosmic Philosophy*, part i., ch. viii.

Methods of Scientific Inquiry.—Comte's classification, however, was not a bad one for the practical ends which he had in view. He cared much less about organizing a coherent body of doctrine concerning the various provinces of nature than about co-ordinating the methods of research which the sciences severally best illustrate. His most important step consisted in assigning to each class of phenomena its appropriate method of investigation, and in clearly marking out the limits within which each method is applicable. It is this which makes it still interesting and profitable to read his great work, even in those chapters on physics, chemistry, and biology, which in nearly all other respects the revolutions in science have rendered thoroughly antiquated. According to Comte the resources at our disposal for the inductive investigation of phenomena may be classified as observation, experiment, and comparison. In simple observation we merely collate the phenomena as they are presented to us; in experiment, we artificially vary the circumstances; in comparison, we watch the circumstances as they are varied for us on a great scale by nature. The conditions of successful observation are best studied in astronomy, where experiment is out of the question, owing to the magnitude and inaccessibility of the phenomena, and where the comparative method is only beginning to be applied. Physics and chemistry, on the other hand, are, *par excellence*, the sciences of experiment, since we can vary the phenomena almost indefinitely. In biology, experiment is also indispensable, nearly all our knowledge of the more important organic functions having been gained through vivisection and other forms of experiment; but experiment is far more complicated and difficult to interpret in biology than in physics, partly owing to the subtlety of the causes in operation, partly because the experiment itself sets in motion a new series of phenomena which are liable to mask and obscure those which we wish to observe. Hence the practical study of experimentation should not begin in biology, but in physics or chemistry, where the conditions are simpler. On the other hand, it is in biology that we can best learn the use of the comparative method, since here we have a vast hierarchy of organisms, in which various organs and their corresponding functions appear in all stages of development. It was in biology that the method of comparison was first employed upon a great scale, and since the time of Cuvier its extension over all departments of sociological inquiry, including linguistics, mythology, and jurisprudence, is perhaps the most striking event in the history of science.

The Three Stages.—Perhaps no better illustration of the use of the comparative method could be found than is furnished by Comte's first wide generalization from the facts of history. When, after his preparatory discussion of scientific methods, Comte endeavored to sum up the most prominent aspects of social progress, both intellectual and material, his first achievement was his celebrated theory of the "three stages" through which men's conceptions must pass. This theory constitutes the most essential part of the structure of positivism. He who intelligently accepts the so-called "law of the three stages" may properly be regarded as a positivist; he who rejects the so-called "law," as an inadequate and misleading description of the phenomena which it seeks to generalize, must be ranked among the antagonists of the positive philosophy.

At the beginning of his great work Comte tells us that "the mind employs successively in each of its researches three methods of philosophizing, of which the character is essentially different and even radically opposed—first, the theological method, then the metaphysical, lastly the positive. The theological system arrives at the highest perfection of which it is susceptible when it has substituted the providential action of a single Being for the capricious play of the innumerable independent deities which were primitively imagined. Likewise the perfection of the metaphysical

system consists in conceiving, instead of many particular entities, one grand entity, Nature, as the source of all phenomena. Finally, the perfection of the positive system would be to represent all observable phenomena as particular cases of a single general fact." In accordance with this general view Comte maintains that in every department of inquiry human speculation has passed through or is passing through these three stages; and, by way of welding firmly together the different parts of his system, he affirms that the order in which the respective sciences have advanced toward the positive stage is truly represented by the order in which they are ranked in his linear classification. Obviously we have here a very important theorem; for if this view of intellectual progress could be demonstrated it would follow that the conceptions of mankind must eventually become "positive" with reference to all questions, and Comte's claim to be regarded as the philosophic lawgiver for the whole future of the human race might not seem extravagant.

When Herbert Spencer's system of philosophy was beginning to attract general attention (about 1860), and while it had as yet been but partially expounded, it was very frequently confounded with Positivism. In truth the Spencerian philosophy is the very antipodes of Positivism, and a statement of their fundamental difference serves most vividly to illustrate the real character of the latter.

With regard to the doctrine of the "three stages," Spencer and his school hold a position diametrically opposed to that held by the Positivists. Between the three terminal conceptions—of God, of Nature, and of Law—as above described by Comte, Spencer denies that there is any incongruity, or that the latter supersedes the former; he maintains, on the contrary, that science, when properly understood, remains quite at one with metaphysics and theology in the assertion of Unconditional Existence as the source of Conditioned Existence. While in Comte's system, therefore, the assumed conflict between science and religion is emphasized and perpetuated, in Spencer's system it disappears entirely. The system of Spencer has by many persons been supposed to be akin to positivism, because, like the latter, it rejects as illegitimate sundry *a priori* methods of arriving at truth which have hitherto been more customarily associated with the processes of metaphysics and theology than with those of science; but this surface resemblance only shows that all modern philosophy, following out a tendency which has been apparent for two centuries, is becoming more and more thoroughly permeated by the scientific spirit of wariness in its method of reaching conclusions. The difference between positivism and evolutionism is the difference between a system that is radically revolutionary and quasi-atheistical, and a system that is conservatively progressive and in the deepest sense theistic.

Social Philosophy.—This difference is further elucidated by Comte's theory of sociology, and it serves in turn to elucidate that theory. The fifth volume of his great work is a brilliant survey of European history, in which the "law of the three stages" is applied and illustrated with admirable ingenuity. It should be read in connection with the *History of Civilization* by Guizot, which in some respects it resembles, though the latter writer, while inferior to Comte in depth of thought, yet far surpasses him in philosophic appreciation of the democratic and Protestant aspects of modern society. Along with the progress from theological to positive habits of thought, Comte joins the progress from military to industrial modes of life, and maintains—incorrectly, as evolutionists hold—that the latter change is determined by the former. This brings us to his fundamental point. He passes over the history of moral progress, and while admitting as a fact the growth of the sympathetic and social feelings at the expense of the selfish and unsocial, he yet fails to take this into the account as the preeminent factor in social changes, and always argues as if social amelioration were the product of a reformation of speculative beliefs. Instead of recognizing that the framework of society is based ultimately upon *character*, he regards it as based ultimately upon *opinion*. To this, as to nearly all the theorems of positivism, the Evolutionists of Spencer's school oppose a directly contrary theorem. They hold that, in order to improve society, it is not enough to effect a change of beliefs, but it is further necessary that there should be a gradual change in men's dispositions and prevalent motives. Now, improvement in character is a slow result of countless influences summed up in what has been called social discipline, and accordingly Evolutionists do not suppose it possible to effect a radical reformation of society—to bring in the millennium, for example—by any such movement, taken separately, as can be carried out by one man or a single generation of men; least of all, do they believe it possible to reform society by means of philosophy. The whole structure of positivism, the whole lifework of Comte, is founded on the precisely contrary belief, that society can be reorganized by means of philosophy—that in order to insure a more harmonious co-operation of human interests it is sufficient to effect a unification of men's beliefs. The evil which Comte always regarded as the grand fundamental evil to be remedied, and which is always thus alluded to by his followers, is what they are fond of calling "the intellectual anarchy of the Western World." The belief that individuality, as involving variety in opinion and behavior, is equivalent to "anarchy," and that "order" means uniformity, is profoundly in accordance with the general temper of Comte's mind. It was to put an end to this "anarchy," and to inaugurate an era of uniformity in belief and conduct, that Comte entered upon his long series of philosophical labors; and from first to last he kept this end steadily in view. All his profound studies in the philosophy of method, and all his elaborate historical generalizations, were merely as incidents in the accomplishment of this great central task.

The Positive Polity and Religion of Humanity.—In 1845 Comte's old project, of inaugurating a new philosophy which should renovate human society, assumed the form of an attempt to institute a new religion, which Prof. Huxley has happily and tersely described as "Catholicism minus Christianity," and in which Comte, instead of the pope, was to be sovereign pontiff. In one of his works, published some seven years after this time, he alludes to it as the era in his life when to the career of Aristotle, which he had hitherto followed, he added the career of St. Paul! Yet the philosophic germs of this later career, as above hinted, are apparent enough in his earlier work. There was no such break between his earlier and his later speculations as one would infer from reading Mill's *Auguste Comte and Positivism*. The early philosophic project for reorganizing society came to be transfigured into a quasi-religious project, but its general outlines underwent no further change than was necessarily implied in such a transfiguration of external aspect. The end in view still was to insure a fixed and uniform standard of social action by establishing a fixed and uniform standard of belief; but the attainment of such a standard by means of scientific methods was no longer deemed sufficient; in addition to this there must be a uniform religious impulse and a uniform cultus; but as the assumed outgrowing of the theological stage of thought involved the ignoring of Deity, and as even Comte was not able to imagine a religion without some sort of a god, it became necessary to furnish some new kind of deity as the source of this new religious impulse and the object of this new cultus. This new kind of deity, according to Comte, is Humanity, and the religious impulse of the future is to be the impulse to serve Humanity and to deserve well of it. It must be admitted that the ethical side of this conception of religion is lofty enough, but the speculative side of it may well seem too grotesque to be seriously entertained by any one endowed with the slightest modicum of that sense of humor which, next to religious faith, is the most desirable possession of a human being. Comte spent the later years of his life in rearing upon this basis a system of practical philosophy astonishingly minute in detail, which in complicated absurdity has probably never been matched by the productions of any other human mind. The ideal of society, as described by Comte, is a state in which everything—even to the minutest details of life—is to be prescribed by unquestioned authority, in which the New Pope or "high priest of Humanity" is to decide upon the age at which each man shall be married, what profession he shall choose, upon what scientific researches he shall enter, and when he shall become *emeritus* as to the general work of life. No caliph, in his wildest dreams of absolutism, ever imagined such a state of things as Comte sought to work out for his ideal society. The main features of this scheme were shaped in curious accordance with the Roman Catholic ideal as conceived by the mediæval popes. There was to be a class of philosophers corresponding to the class of priests under the old *régime*, with unlimited control over opinions. The arch-philosopher, or "high priest of Humanity," was to supersede the pope; and Paris was to be the holy city of the Positivist as Rome had been the holy city of the Roman Catholic.

A new calendar was to be instituted, beginning with the French Revolution of 1789, and like the old one was to be made up of saints' days, save that philosophers, poets, legislators, inventors, and pre-eminently deserving men of all sorts, and of all ages and countries, were to be substituted for the saints of the old calendar; and for the Virgin Mother an antitype was to be found in the ideal of Humanity, symbolized as "a woman of thirty with a child in her arms." And so on throughout a host of arbitrary details.

Subjective Synthesis.—In the very last years of Comte's life symptoms of mental aberration became unmistakable. After finishing the *Positive Polity* he began a new work, called *Subjective Synthesis*, in which it is recommended that decimal numeration should be abandoned in favor of a septimal system, because seven is a sacred number, and, moreover, being a prime number, is better fitted to inspire the human intellect with a sense of its necessary limitations! Every volume, moreover, constituting a distinct treatise, should consist of "seven chapters, besides the introduction and the conclusion; and each of these should be composed of three parts. Each third part of a chapter should be divided into seven sections, each composed of seven groups of sentences, separated by the usual break of line," etc. The author did not live to complete this work, but died soon after his first volume was published.

Comte's Followers.—At his death Comte left one great disciple, Émile Littré, one of the most consummate scholars that France has produced; but Littré was regarded as half a heretic by the thoroughgoing disciples of Comte, as he refused to follow the teacher through his later vagaries. Robinet, the eminent physiologist, became a follower of Comte; and besides this a small number of Positivists, under the leadership of Laffitte, continued for some years in Paris to profess the "religion of humanity." In Germany, positivism has never gained any footing at all; in England, only a precarious one. Among the declared followers of Comte in England are Congreve, Prof. E. S. Beesly, Frederic Harrison, and Dr. Bridges; and John Morley has been considerably influenced by him. As a rule, the positivist school is characterized by a sympathy with communists and boycotting strikers, a partiality for the short and sharp despotic method of settling social questions, a tendency to regard politics from the sentimentalist point of view, a dislike to individuality of thought, an obtuseness to the requirements of scientific method, and (in the speculative region) hostility to the theory of evolution, the doctrine of the correlation of forces, and other theories which have assumed prominence since the time when their master Comte stigmatized all such kinds of theorizing as "metaphysical" and "chimerical."

Bibliography.—The works of Auguste Comte are as follows: *Cours de Philosophie positive* (6 vols., Paris, 1830–42; since republished with preface by Littré, 1864); *Traité élémentaire de Géometrie analytique* (1843); *Traité philosophique d'Astronomie populaire* (1844); *Discours sur l'Esprit positif* (1844); *Discours sur l'Ensemble du Positivisme* (1848; afterward included in the *Politique positive*); *Calendrier positiviste* (1849); *Culte systématique de l'Humanité* (1850); *Catéchisme positiviste* (16mo, 1852); *Système de Politique positive, ou Traité de Sociologie, instituant la Religion de l'Humanité* (4 vols., 1852–54); *Appel aux Conservateurs* (1855); *Synthèse subjective* (vol. i., 1856)—all at Paris, and, except the *Catéchisme*, in 8vo. English translations: *The Positive Philosophy*, by Miss Harriet Martineau, very much abridged (2 vols. 8vo, London, 1853; New York, 1858); *Catechism of Positive Religion*, by Richard Congreve (12mo, 1858); *A General View of Positivism* (*Discours sur l'Ensemble*, etc.), by J. H. Bridges (8vo, 1865)—all in London. Part of the first volume of the *Philosophie positive*, translated by W. M. Gillespie, was published (New York, 1858) under the title *Philosophy of Mathematics*. A review entitled *La Philosophie positive*, conducted by Littré and Wyrouboff, was published six times a year in Paris, 1867–74. As auxiliary expositions and discussions of the positive philosophy, the student should consult Littré, *Auguste Comte et la Philosophie positive* (Paris, 1864); *Paroles de Philosophie positive* (1863); *Auguste Comte et Stuart Mill* (1866); Pellarin, *Essai critique sur la Philosophie positive* (Paris, 1864); Robinet, *Notice sur l'Œuvre et sur la Vie d'Auguste Comte* (Paris, 1864); Blignières, *Exposition de la Religion et de la Philosophie positive* (Paris, 1857); Mill, *Auguste Comte and Positivism* (London and Boston, 1866); Bridges, *The Unity of Comte's Life and Doctrine* (London, 1866); C. G. David (pseudonym for David G. Croly), *A Positivist Primer* (New York, 1871); Lewes, *Comte's Philosophy of the Sciences* (London, 1853); *History of Philosophy* (3d ed. 2 vols., London, 1867). Edward Caird's *The Social Philosophy and Religion of Comte* (New York, 1885) is a criticism from a metaphysical standpoint. These are the principal works out of a considerable body of literature on the subject. For hostile criticisms see Huxley, *The Scientific Aspects of Positivism*, in his *Lay Sermons* (London, 1870; reprinted in New York); Spencer, *Recent Discussions in Science, Philosophy, and Morals* (New York, 1873); and *Outlines of Cosmic Philosophy* (2 vols., London, 1874, and Boston, 1875), by the present writer. John Fiske.

Pos'se Comita'tus: a law Latin phrase, meaning literally "the power of the county." By the common law the sheriff while engaged in executing process, especially when it was criminal, or in pursuing and arresting felons, or in exercising his functions generally as the chief administrative officer charged with the duty of enforcing the keeping of the peace, was authorized to summon to his aid, if necessary, all the men above the age of fifteen years within the county, with the exception of the sick or infirm, ecclesiastics, and peers, and they constituted, in the ancient technical nomenclature, the *posse comitatus*. The same authority is given to the sheriff in the U. S., although its exercise is often regulated by statute. The ordinary cases in which such a resort is had to the active assistance of private citizens are the quelling of riots, the overcoming of forcible seizures or detainers of land, the subduing of forcible rescues made or attempted of persons arrested pursuant to the command of a proper writ, and the resistance to any forcible measures in opposition to the execution of public justice; in short, wherever a breach of the peace has attained, or threatens to attain, such magnitude that the officials themselves are unable to suppress it. Since the sheriff may call out the entire power of the county, he may likewise, under the circumstances above described, summon one or more individuals, or any number less than the whole. In Great Britain the calling out of the *posse comitatus* is expressly authorized by the Sheriffs Act, 1887, sec. 8, subsec. 2, for the purpose of resisting the execution of a writ.

Revised by F. Sturges Allen.

Postal Service: that branch of the public service which is concerned particularly with the conveyance and delivery of letters and other documents, newspapers, book-packets, etc., the issue of money-orders, and in some instances with the management of the telegraphs, savings-banks, etc., as in Great Britain.

Origin and Early History.—The beginnings of the present highly organized postal systems of the world are doubtless to be found in the lines of couriers which rulers early established for the prompt transmission of decrees and other dispatches connected with governmental affairs. The earliest known system was that established in 559 B. C. by Cyrus the Elder, King of Persia, who maintained relays of mounted men at fixed stations, ready at a moment's notice to forward the king's messages from post to post. China has maintained such a system from a very early date, and Marco Polo tells us that in his day (the latter part of the thirteenth century) the "Great Khan" maintained 10,000 post-stations, and more than 300,000 horses for the use of his messengers and couriers, who traveled "a good 200 or 250 miles in the day and as much in the night," a fresh horse and rider being supplied without delay every 25 or 30 miles. Establishments of this kind existed among the Romans in the time of Augustus, B. C. 31, and in France under Charlemagne, but the first actual letter-post for commercial purposes appears to have originated in the Hanse towns early in the twelfth century. A century later the University of Paris established an efficient postal system, which continued till the beginning of the eighteenth century. One of the earliest posts in Europe for general accommodation was that established in 1516 by Franz of Thurn and Taxis, for Maximilian, the Emperor of Germany. The office of postmaster-general became hereditary in the Counts of Thurn and Taxis, and was held by them until the dissolution of the German empire in 1806.

England.—As early as 1252 royal messengers, called nuncii, were employed in England for the conveyance of letters, and in 1470, when Edward IV. was waging war on Scotland, he established post-stations 20 miles apart, between that country and England; but it appears that until the time of Henry VIII. no regular system of posts existed in England.

Though these establishments were primarily for the transmission of the royal letters, and the conveyance of persons traveling on the king's business, the post-riders and postmasters soon found it both convenient and profitable to undertake the conveyance of private letters and private travelers, and so extensive had this practice become that Elizabeth commanded that all packets on the queen's business or the affairs of state should have precedence of private correspondence. In 1603 James I. issued a proclamation giving to post-agents the exclusive right of letting horses to travelers, and a later proclamation (1609) forbade all persons not duly authorized by the master of the posts from collecting, carrying, and delivering letters. This was the beginning of the state monopoly of letter-carrying in England.

At this time there were only four official post-routes in the kingdom, one through Kent to Dover and the continent of Europe, one to Plymouth, where the royal dockyard was situated, one to Ireland by way of Beaumaris, and one to Scotland viâ Berwick. In 1619 the Du Questres, father and son, were placed in charge of the first of these routes. Their successor, Thomas Witherings, introduced many postal reforms, and in 1635 was ordered by Charles to establish a running post between London and Edinburgh (410 miles), to go day and night, and return in six days. Witherings was succeeded by Prideaux, who not only established weekly posts all over England, but seems to have made the service self-supporting. In 1650 he undertook to pay a fixed rent of £5,000 a year for the exclusive right to run the post-office, and thus began the system of farming the postal service, which continued well into the eighteenth century.

While letters could be sent from London to many places in the country, it was not until 1680 that citizens in one part of London could communicate by letter with persons in other parts or in the suburbs. Such a system was introduced by a London merchant named William Dockwra, who divided London and its suburbs into seven districts, each with its own sorting-office, and opened between 400 and 500 receiving-offices at which messengers called every hour for letters or parcels. The amount charged for each package was 1*d*., provided it did not exceed 1 lb. in weight or £10 in value. Deliveries were made in the business parts of the city ten or twelve times a day, and elsewhere from four to eight times. The success of the undertaking excited the greed of the Duke of York, on whom the revenue of the post-office had been settled, and in less than five years from its introduction this penny post was incorporated with the General Post-office, and Dockwra was later appointed comptroller. In 1701 this rate was advanced to 2*d*., an increase legalized by Parliament in 1730. Similar posts were established in Edinburgh, Manchester, Bristol, and Birmingham in 1793; and in Dublin in 1773.

In 1780 the monopoly of letting post-horses was abolished, and four years later mail-coaches were introduced with success by John Palmer, manager of the Bath theater, and did good service for sixty years. Steamships were first used for the conveyance of mails in 1821, and railways in 1830.

United States.—The post-office existed in America from its earliest settlement. Originally it was merely a receptacle in the coffee-house, where letters arriving from abroad were deposited, to be taken by those to whom they were addressed or carried to them by their neighbors. The first legislation on the subject is found in the records of the general court of Massachusetts for 1639, and the next in the colonial law of Virginia in 1657. The former provides "that notice be given that Richard Fairbanks his house in Boston is the place appointed for all letters which are brought beyond the seas or are to be sent thither, to be left with him; and he is to take care that they are to be delivered or sent according to the directions; and he is allowed for every letter a penny, and must answer all miscarriages through his own neglect in this kind." The colonial law of Virginia required "every planter to provide a messenger to convey the dispatches, as they arrived, to the next plantation, and so on, on pain of forfeiting a hogshead of tobacco for default." Gradually a postal service was established between the several colonies along the coast, and in 1672 there was "a post to goe monthly from New York to Boston." In the year 1692 Thomas Neale received letters patent, good for twenty-one years, authorizing him to set up posts in North America, and under this grant the postal affairs of the colonies of North America were conducted by Neale's representative and his successors until 1710, when the postal service of the British empire was consolidated into one establishment, with chief offices at London, Edinburgh, Dublin, and New York. One of the earliest acts of the Continental Congress was the establishment of a post-office and post-routes from Falmouth, Me., to Savannah, Ga., "for conveying intelligence and letters throughout this continent," and to spread knowledge of the acts of Congress and the progress of the Revolution among the different colonies. Benjamin Franklin was the first postmaster-general, and under his practical management the postal service was soon extended through all the colonies. Newspapers were generally published by the postmasters of the several cities, and their papers had not only been sent free through the mails, but all others excluded. Franklin was the first to give equal privilege to all publishers; subsequently a small sum was charged as postage, which seems to have been a perquisite of the postmaster, but no regular postage on newspapers was established by law until 1792.

Postage, or fixed charges for the conveyance of letters, was first introduced in England by Witherings about 1635, when the royal sanction was first given to a scale of 2*d*. for a single letter (that is, written on only one sheet of paper) for any distance under 80 miles, 4*d*. for over 80 and under 140, and 6*d*. for distances above 140; 8*d*. to Scotland, and 9*d*. to Ireland. From that date until 1840 the basis of rate continued to be distance and not weight, except in regard to the penny post already referred to. Parliamentary regulation of rates began in 1657, and these were increased and decreased from time to time according to the exigencies of Government or of the pension-list. In 1812 the rates were for a third time increased, 4*d*. being charged for 15 miles, 5*d*. for distances over 15 and under 20 miles, 6*d*. above 20 and under 30 miles, 7*d*. above 30 and under 50 miles, 8*d*. above 50 and under 80 miles, and so on, 17*d*. being charged for any distance above 700 miles. These rates were almost prohibitory, and many curious devices were employed for the purpose of avoiding payment. In 1837 Mr. (afterward Sir) Rowland Hill began an agitation for cheaper rates, and proposed an inland or domestic rate of 1*d*. for every letter weighing not more than half an ounce, the abolition of the FRANKING PRIVILEGE (*q. v.*), more frequent mails, and speedier delivery. Three years later his agitation was successful, and penny postage became the rule for the United Kingdom. Since 1871 the rates there have been 1*d*. for a letter not exceeding 1 oz.; exceeding 1 oz., but not exceeding 2 oz., 1½*d*.; 2 oz., but not exceeding 4 oz., 2*d*.; from 4 to 6 oz., 2½*d*.; 6 to 8 oz., 3*d*.; 8 to 10 oz., 3½*d*.; and so on at the rate of ½*d*. for every additional 2 oz. Double postage is charged when not prepaid, and deficient postage entails a charge of double the deficiency. The fee for registration is 2*d*., with compensation (in case of loss) up to £5, 3*d*., with compensation up to £10, and so on, with 1*d*. additional for each added £5 of compensation, up to £50. Newspapers registered at the General Post-office and published in the United Kingdom are carried for ½*d*. each. For books the charge is ½*d*. for every 2 oz. or fraction thereof. No package of newspapers must exceed 14 lb. in weight, 2 feet in length, or 1 foot in width or depth. Book-packets must not exceed 6 by 9 by 18 inches, or 5 lb. in weight.

In the U. S. for some years after 1776 postage was paid in currency, and was increased as the currency depreciated until finally the rate was reduced and made payable in specie. The rates fixed in 1792 were: For 30 miles and under, 6 cents; over 30 and not exceeding 60 miles, 8; between 60 and 100 miles, 10; between 100 and 150 miles, 12; between 150 and 200 miles, 15; between 200 and 250 miles, 17; between 250 and 350 miles, 20; between 350 and 450 miles, 22; over 450 miles, 25. Few letters were sent at such high rates, and from 1800 to 1830 the increase scarcely kept pace with the growth of the population. Many letters were sent privately, and after the express companies were started a great many were sent by them at less than the postage, in spite of the opposition of the post-office department. The first important changes in postage were made in 1845, when a scale based on both weight and distance was introduced. The rates were for letters not exceeding ½ oz. carried for any distance under 300 miles, 5 cents; over 300 miles 10 cents; and an additional rate for every additional half ounce or fraction thereof. Newspapers were carried free for 30 miles; for over 30 and under 100, or within the State, 1 cent; over 100 miles, or out of the State, 1½ cents. The next most important change was in 1851, when a single letter weighing not more than ½ oz. was charged 3 cents for distances under 3,000 miles (5 cents if not prepaid), and 6 cents over 3,000 miles (12 cents if not prepaid). In 1855 the rate was made

3 cents for all distances under 3,000 miles, and 10 cents for distances over 3,000 miles. In 1863 the element of distance dropped out of the scale, and a uniform rate of 3 cents was charged on all domestic letters not exceeding ½ oz. or fraction thereof. In Oct., 1883, ordinary letter-postage was reduced 33⅓ per cent., and the rates are now for letters 2 cents for each ounce or fraction thereof; for postal cards, 1 cent; for second-class matter or regular publications, 1 cent a pound; for third-class or transient newspapers, and all other kinds of printed matter, 1 cent for each 2 oz.; for fourth-class, or merchandise, 1 cent an ounce. The limit of weight of third or fourth class matter, books excepted, is 4 lb. This postage must be fully prepaid on all matter except letters; on these at least 2 cents must be prepaid. The fee for the registration of letters or other articles is 8 cents.

Stamps.—The stamps used by the Counts of Thurn and Taxis are to be found in many collections, but the modern postage stamp dates back no further than 1840, when it was introduced into general use in Great Britain by Rowland Hill. Zurich and Brazil adopted the idea in 1843, the U. S. in 1847, Russia in 1848, France, Bavaria, Tuscany, Belgium, and New South Wales in 1849, and Austria-Hungary in 1850. Since then its use has become universal. See STAMPS.

Organization.—In the United Kingdom the management of the postal service is under the direction of the Postmaster-General, who is a member of the Government, frequently a cabinet minister, and goes out of office with the administration. The permanent officials are a chief secretary, a financial secretary, four other secretaries, each of whom takes charge of some separate branch, a secretary for Ireland, a surveyor-general for Scotland, and an accountant-general. During the year 1893 the postal service of Great Britain and Ireland employed a permanent force of 71,956 persons, of whom 10,465 were women, besides about 59,000 other persons employed by local postmasters, of whom 16,000 were women and girls. In the U. S. the head of the postal service is the Postmaster-General, who has been a cabinet minister since 1826. Under him are four assistant postmasters-general (appointed by the President), of whom the first is the general executive, in charge also of the dead-letter office, the free-delivery service, and the money-order system; the second has charge of the transportation of all mail matter; the third is the bookkeeper of the department and attends to the issuing of stamps and the classification of the mail matter; and the fourth manages post-office inspections, receives the bonds of postmasters, appoints fourth-class postmasters, etc. The sixth auditor is the officer of the U. S. Treasury who has charge of post-office accounts. Over 500 clerks are employed in his department, which annually audits about 450,000,000 accounts. Over 200,000 persons are employed in the U. S. postal service.

Postal Union.—At the invitation of Germany, a postal congress of all the states of Europe, the U. S., and Egypt, was held at Berne in Oct., 1874, for the purpose of considering how greater uniformity in the treatment of correspondence could be secured, how accounts could be simplified, and rates reduced, etc. A postal convention was agreed upon, which was signed by the delegates from the countries of Europe and from the U. S., was ratified by the several governments, and went into effect July 1, 1875. A postal union was organized, with a central office at Berne, under the supervision of the post-office department of Switzerland, for the purpose of considering and working out all questions in the interests of the union. These conventions are now held every three years. Instead of the varying rates theretofore prevalent, the following uniform postage was adopted for mail matter from any country of the union to any other: 5 cents on prepaid and 10 cents on unprepaid letters weighing not over ½ oz.; newspapers not over 2 oz. in weight, 1 cent; books and other printed matter and patterns of merchandise not exceeding 8¾ oz., 1 cent for each 2 oz.; postal cards, 2 cents. Prepayment is invariably required except on letters. The union now embraces nearly every country in the world except China, which has no modern postal system.

Canada.—Down to the time of the confederation in 1868 each province controlled its own postal system, but since that date the rate of domestic letter-postage is 3 cents per oz. (in the U. S. it is 2 cents). By an agreement made between Canada and the U. S. in 1875 each country receives and delivers the letters of the other at their respective inland rates without keeping account of the same, as each country retains the full amount of postage collected by it. In 1879 Canada entered the Postal Union.

The statistics for the year ending June 30, 1893, are as follows: Letters, 106,290,000 (of which 3,254,000 were registered); postal cards, 22,790,000; newspapers and periodicals sent by individuals, 24,220,000; newspapers sent from office of publication, 66,150,916; books, circulars, samples, etc., 2,626,200; and parcels, 343,000. Number of offices, 8,475, of which 1,168 issued 967,866 money-orders aggregating $12,902,976, of which $10,404,857 were payable in Canada and $2,269,635 were payable abroad.

Australasia.—The first Australasian post-office was established at Sydney in 1810, and the postmaster was allowed to charge 8*d.* for every English or foreign letter of whatever weight and 1*s.* 6*d.* for every parcel not exceeding 20 lb. Colonial letters were charged 4*d.* irrespective of weight, and soldiers' letters were free.

The first postal act was passed in 1825, but its provisions were not put into full force until 1828, when the lowest rate for a letter weighing ¼ oz. was 3*d.* In 1831 a twopenny post was established in Sydney; in 1837 a post-office was established in Melbourne, then a part of New South Wales. In Oct., 1891, the seven colonies entered the Universal Postal Union.

The following table shows the postal business of each of the colonies during 1890:

COLONY.	Post-offices.	Letters and post-cards.	Books, parcels, and packages.	Newspapers.
New South Wales	1,338	58,385,300	8,939,600	40,597,200
Victoria	1,671	62,526,448	7,684,915	22,729,005
Queensland	892	14,709,504	2,047,446	11,463,726
South Australia	609	16,794,679	1,251,416	9,460,075
Western Australia	82	2,629,698	329,871	2,135,906
Tasmania	315	5,172,824	963,167	4,941,571
New Zealand	1,058	22,877,320	4,403,181	11,137,846
Australasia	5,965	183,095,773	25,619,596	102,465,329

Registered Letters.—It would seem that in the English post-office all correspondence was registered from a very early period. An order in council dated July, 1556, and another in 1603 provide that "every post shall keepe a large and faire leger paper booke to entre our packets in as they shal be brought unto him with the day of the moneth, houre of the day or night, that they came to his handes, together with the name of him or them by whom or unto whom they were transcribed and directed." This practice was confirmed in 1792, but no receipts were given the sender until 1814. During the year ending Mar. 31, 1893, 12,132,144 letters and parcels were registered in the United Kingdom, and under the new system of registration and insurance introduced on Dec. 1, 1892, compensation amounting to £550 was paid on 507 registered packages that had been lost or damaged. Registration was introduced into the U. S. in 1854. The number of pieces of mail matter registered during 1892–93 was 15,561,410 (2,759,016 free of charge).

Free Delivery.—Until 1774 there was no free delivery in England except in a few of the larger cities and towns, and it was not until many cases had been decided by the courts against the postal authorities that letter-carriers were appointed, and the customary delivery fee of 1*d.* or more was omitted. Free delivery is now universal throughout the United Kingdom. In the U. S. the free-delivery system in cities was begun in 1863, and only in large cities. This was extended in 1887 to all cities with a population of over 10,000 or a postal revenue of $10,000.

Special delivery was introduced into the U. S. in 1885. By this a fee of 10 cents secures immediate delivery by special messenger. In 1892–93 3,375,693 pieces were mailed for special delivery, 1,500 messengers were employed, and the average time of delivering a packet was nineteen minutes. In Great Britain an "express delivery" corresponds somewhat to the special delivery of the U. S.

Parcels-post.—There is no inland parcels-post, strictly so called, in the U. S., the classification of fourth-class matter, by which books and many kinds of merchandise may be transmitted through the mails, taking its place. There is a parcels-post, however, with Mexico, Hawaii, the Windward and Leeward islands, and several of the countries of South America, and to them 48,966 parcels were dispatched in 1892–93, an increase of 8,716 over the preceding fiscal year. A parcels-post between the United Kingdom and India had long existed, but it was not until Aug. 1, 1883, that an inland parcels-post was established. The limit of weight is 11 lbs.; the rate is 3*d.* for 1 lb. or less, and 1½*d.* for every additional lb. During the year ending Mar. 31, 1893, 52,370,326 parcels were carried for £1,151,051.

Money-order System.—This had its origin in 1792 in a private venture of three English post-office clerks who, under the name of Stow & Co., used the postal facilities at their command for the transmission of small sums of money to different parts of the country. The fee in these early days was 8*d.* per £1, of which 3*d.* went to the postmaster issuing an order, 3*d.* to the postmaster who paid it, and 2*d.* to the company. In 1838 this business was incorporated with the post-office department. In the three months ending Oct. 10, 1800, 697 orders for £8,863 were issued. For the year ending Mar. 31, 1893, 10,442,918 orders were issued in the United Kingdom, amounting to £28,683,951. The system was introduced into the U. S. in 1864. During the year 1892–93 13,309,735 domestic orders, aggregating $127,576,433.65, were issued by 18,434 U. S. money-order offices, and 1,055,999 international orders, aggregating $16,341,837.86, were issued by 2,407 offices. Postal notes or orders were introduced in Great Britain in 1881, and in the U. S. in 1883. At first these were payable to bearer, but as many abuses in the way of fraudulent negotiation had crept in, the British authorities have insisted since 1892 on the insertion of the name of the payee. In the U. S. the postal-note system was abolished in 1894 and incorporated with the regular money-order system. In Great Britain in 1891 56,590,668 postal orders were issued. During 1892–93 7,753,210 postal notes, to the value of $12,903,076.73, were issued in the U. S.

Post-office savings-banks were established in the United Kingdom in 1861, and flourished in the British colonies as well as in several of the countries of Europe. In Great Britain the interest allowed is 2½ per cent.; the lowest deposit is one shilling, and one person's deposits may not exceed £30 in any one year, nor £150 in all. On Dec. 31, 1892, 10,519 post-offices were open for the transaction of a savings-bank business, and in that year the number of accounts opened was 1,036,622, the amount deposited amounting to £21,334,903, and the total amount standing at the credit of depositors was £75,853,079. Postal savings-banks were introduced into France in 1881. On Dec. 31, 1893, the accounts numbered 2,095,622, with aggregate deposits of 607,871,925 francs. See the article SAVINGS-BANKS.

Telegraphs.—In 1870 the British Government acquired possession of all the telegraph lines then existing, and placed them under the management of the post-office. The rates charged have consequently been cheapened and the number of messages sent greatly increased; in 1893 this was 69,907,848 for Great Britain and Ireland.

Statistics.—The growth of the postal systems of the world since the introduction of cheap postage has been phenomenal. In Great Britain the total number of letters mailed in 1839 was 76,000,000. In 1840, the year in which penny postage was introduced, the number was 169,000,000. In 1882–83 it had increased to 1,280,000,000, while in 1892–93 the total deliveries amounted to 2,785,270,000; of these 1,790,500,000 were letters, an average of 46·6 to each person. In India in 1856 there were only 753 post-offices; in 1892 there were 21,465, and through these passed 308,403,108 letters, post-cards and money-orders, 25,910,386 newspapers, 2,108,685 parcels, and 10,711,051 book and other packets, making a total of 347,133,230 pieces. In the U. S. the growth has been still more remarkable. In 1790 there were only 75 post-offices and 1,875 miles of post-road open, while the number of letters and transient papers delivered did not exceed 2,000,000. On June 30, 1893, the number of post-offices was 68,403 (of which 610 were free-delivery offices); the number of mail routes was 30,831, including 1,116 railway lines and 36 steamboat lines, and aggregating 453,832·83 miles in length; and for the year 1892–93 the total number of pieces of mail matter handled was 10,236,314,985, of which 7,131,627 were sent to the dead-letter office in Washington. This increase is in part due to the remarkable growth of the efficiency of the service. The railway post-office system, in which each mail car is converted into a distributing post-office, lessens very greatly the average time of transmission. In the year 1892–93 the pieces of mail matter distributed in transit on railway and steamship lines numbered 9,772,075,810.

Revenue.—The British post-office has always been a paying concern. In 1893 its income (£10,344,353) exceeded its expenditures by £2,826,756. In the U. S., on the other hand, there has long been an annual deficiency, caused chiefly by the cheap rates (1 cent per lb.) at which second-class matter is carried. During the year ending June 30, 1893, the gross revenue was $75,896,933, and the expenditures $81,074,104, leaving a deficit of $5,177,171. See FINANCE.

Offenses against Postal Laws.—A brief notice of the provisions of the postal laws of the U. S. is all that can be given here, but these provisions may be taken as giving a general idea of those in force in most countries.

It is unlawful to deposit in the mail any article intended or adapted for any indecent or immoral use, or any printed or written matter giving information where such things can be secured; also to send by mail any letter or circular concerning any kind of lotteries, or concerning any scheme or device intended to defraud and deceive the public, or to aid in obtaining money under false pretenses. The act of sending through the mail any matter having on the outside any language of a threatening, inflammatory, or libelous character, or which is obviously intended to reflect injuriously upon the character or conduct of another, is also unlawful; thus dunning-notes should not be sent on postal-cards. The use of the mail in order to defraud by, or to sell, dispose of, or furnish, any counterfeit or spurious coin, bank-notes, or other security is a crime punishable by fine or imprisonment, or both.

Opening the letters of other persons, even though not sealed, is forbidden by law. This may be done only under a warrant particularly describing the thing to be seized. It is an offense punishable by a fine of not more than $100 to knowingly and willfully obstruct or retard the passage of the mail. Statutes also exist imposing imprisonment at hard labor for embezzlement or destruction of mail matter by postal employees, for stealing from the mail by other persons, and for robbing any mail from a mail-carrier or agent.

See Lewins, *Her Majesty's Mails* (London, 1864); *History of Penny Postage* in Hill's *Life of Sir Rowland Hill* (1880); Hyde's *The Royal Mail: its Curiosities and Romance* (London and New York, 1885); *A Hundred Years by Post*, and *The Post in Grant and Farm* (London, 1894); Joyce, *History of the Post-office* (London, 1893); Marshall Cushing, *The Story of Our Post-office* (Boston, 1893); and the *United States Official Postal Guide.* R. LILLEY.

Postlim'iny [from Lat. *postlimi̇nium*, liter., condition after having crossed the threshold; *post*, after + *limen, li̇minis*, threshold]: in Roman law, return from a state of capture and its consequences, or restoration to former political and other rights. Capture of a Roman in war, as well as of any one else, was held to make him a slave; and as a slave could make no will nor have any civil rights, the captured Roman's rights of property, citizenship, even of family, would be by this calamity not merely suspended, but brought to an end. The right of testament was saved from the effect of capture by the fiction of the Cornelian law, according to which the soldier was conceived of as having been killed in battle while yet a free Roman. The rights of citizenship, family, and property were saved by the *jus postliminii*, also a legal fiction, by which, if he had freed himself during war or had been restored by treaty, it was assumed that he had never been away. This doctrine of postliminy has been imported from the Roman into the international law, unnecessarily perhaps, to explain the revival of the title of an original owner to his property upon its recapture. Thus a ship if retaken (but by U. S. usage not after condemnation by a prize-court) reverts to the original owner, subject to salvage. (See RECAPTURE.) In like manner is restored the sovereignty of a territory which has temporarily passed into the power of an invader, but later drives him out or is abandoned by him. Nevertheless, many non-political acts of the temporary sovereign which are in the line of lawful government are binding after the restoration. Revised by T. S. WOOLSEY.

Post-mortem Examination [*post mortem* is Lat. for after death]: the examination of the body to determine the cause and manner of death. In cases of poisoning the nature of the poison and possibly the manner of its administration may be determined; in death from violence the examination will often reveal the nature of the weapon used in the infliction of the wounds and the relative positions of the victim and assailant at the time. Such examinations are also made in order to study the lesions which are produced in various organs as the result of disease. The brain is removed and examined by making an incision across the top of the head between the ears, dissecting back the scalp, and sawing through the skull. All of the thoracic and abdominal viscera are examined by making a single long incision which passes from the root of the neck to the symphysis. After a thorough examination and description all the organs are replaced, and the body carefully cleaned and

sewed up. The incisions are made in such a manner that no trace of them is visible when the body is again dressed.

W. T. Councilman.

Post-office: an office where letters, etc., are received for transmission to various destinations, and from which letters that have been received are delivered. The name is also applied to that department of the public service which is charged with the reception, conveyance, and delivery of letters, etc. See Postal Service.

Post-tertiary Period: See Pleistocene Period.

Potash: See Potassium.

Potassæ Bitartras: See Cream of Tartar.

Potassium [Mod. Lat., from Eng. *potash*; *pot* + *ash*]: a metallic element discovered by Davy in 1807 while experimenting on the action of a powerful electric current on molten caustic potash (potassium hydroxide, potassic hydrate). *Potash* is potassium carbonate, a constituent of wood-ashes, from which caustic potash (KOH) is obtained. Lavoisier first suggested that the caustic alkalies were compounds of oxygen, but the evidence was furnished by Davy's experiments. It was later shown by Brunner that the metal can be made by distilling at a white heat an intimate mixture of potassium carbonate and charcoal, and this method is now used for the purpose of preparing the metal on a large scale. Potassium occurs in many minerals, principally in feldspar, which is very widely distributed in nature. It occurs in combination with chlorine as carnallite and sylvite in the great deposits at Stassfurt, Germany; in combination with sulphuric acid and aluminium as alum; with nitric acid as saltpeter or potassium nitrate. Potassium is found, further, in combination in all soils in consequence of the natural decomposition of the minerals containing it. It is taken up by the plants, and when vegetable matter is burned it remains behind, principally as the carbonate. When the ash is treated with water the carbonate dissolves, and by evaporating the solution thus obtained the carbonate remains behind in impure condition. Potassium occurs further in the form of a salt of tartaric acid in grape-juice, and is deposited from this. The deposit is called crude tartar. An intimate mixture of potassium carbonate and charcoal, which is used in the manufacture of potassium, is made by heating this crude tartar in a closed vessel. To make potassium, the intimate mixture thus obtained is placed in a wrought-iron retort connected with a closed flat receiver of sheet iron. The retort being heated to a high temperature, the metal distills over into the receiver, which, at the end of the operation, is placed under petroleum.

Potassium has a bright metallic luster on its freshly cut surfaces, but this quickly tarnishes on account of the ease with which moisture acts upon it. The metal is soft, and lighter than water. When thrown upon water the latter is decomposed, the products of the action being potassium hydroxide, KOH, and hydrogen. The heat evolved is sufficient to set the hydrogen on fire, and at the same time a little of the potassium is burned, so that the flame has the characteristic violet color of potassium flames. The symbol of potassium is K; its atomic weight 39.

Compounds of Potassium.—Potassium chloride, KCl, as already stated, is found in the deposits at Stassfurt as sylvite, and in combination with magnesium chloride, $MgCl_2.KCl + 6H_2O$, as carnallite. *Potassium bromide*, KBr, is largely used in medicine. It is prepared by artificial methods. The *iodide*, KI, is also extensively used in medicine and in photography. The *hydroxide* or *hydrate*, KOH, commonly called caustic potash, is made by treating the carbonate in solution with lime. The solution thus obtained is drawn off and evaporated in iron or silver vessels. Solid caustic potash is a white, brittle substance. In contact with air it absorbs water and carbonic acid. It decomposes Fats (*q. v.*), forming Glycerin (*q. v.*) and soaps. (See Soap.) It is an extremely energetic Base (*q. v.*). The *sulphides* of potassium are formed by melting together potassium carbonate and sulphur. *Acid potassium tartrate* (see Cream of Tartar). *Potassium nitrate* (see Saltpeter). *Potassium carbonate*, K_2CO_3, is the principal soluble ingredient of wood-ashes and is extracted by treating the ashes with water. Formerly all the potassium carbonate made was obtained from wood-ashes, but at present not more than half of the supply comes from this source. The other sources are the residues from the manufacture of beet-sugar, potassium sulphate and chloride, and wool-fat. *Potassium silicate* is prepared in solution by dissolving sand in potassium carbonate or hydroxide. It is prepared on a large scale by melting together quartz-powder and purified potash. It is known as *water-glass*, or, to distinguish it from that made with sodium carbonate or hydroxide, *potash water-glass*. *Potassium ferrocyanide* or *yellow prussiate of potash*, $K_4Fe(CN)_6$, is a beautiful yellow compound obtained by heating refuse animal matter, such as horn, hoofs, blood, etc., with impure potassium carbonate and scrap iron. The salt is of great value, as it is the starting-point in the preparation of all the cyanides, and is used in the manufacture of Prussian blue.

Regarding the relations of potassium salts to the growth of plants, see Agricultural Chemistry. Ira Remsen.

Medicinal Uses of Potassium Compounds.—Potassium hydroxide (caustic potash), from its strong chemical affinities, is powerfully caustic to living tissues. It unites with water and with albuminous substances, and from its deliquescence and high diffusive power rapidly penetrates the tissues, and thus carries its destructive effects very deeply. The slough is black, slimy, and pultaceous. Taken internally, alone or in strong solution, it is a violent corrosive poison. The antidote is some organic acid, such as acetic (vinegar), citric, or tartaric. In weaker solution caustic potash swells and softens epithelium, producing a slippery feel to the fingers. It is used in surgery as a caustic, being fused and run into cylindrical moulds about the size of a goosequill, so as to form conveniently shaped sticks. A solution of specific gravity 1·065 is official in the *United States Pharmacopœia*, and may be used for the general purposes of alkaline medication; but alkaline salts of the same base are preferable, and this solution is therefore employed more in pharmacy than in medicine. *Potassium carbonate* and *bicarbonate* are strongly alkaline, and have essentially the physiological properties of solution of caustic potash. They are used externally in weak solution as lotions in skin diseases to remove dried epithelial crusts and scabs and control the excessive secretion of such diseases as eczema. They are not much given internally. They are sufficiently alkaline to be poisonous in large doses. *Potassium acetate* and *citrate*, though of neutral reaction, become converted into carbonates in the blood through decomposition of the organic acids. They thus tend to increase the alkalinity of the blood, to alkalize the urine, and especially to diminish the quantity of uric acid present in the system. They are used medicinally in rheumatism, gout, and uric-acid gravel to diminish the excess of acidity characteristic of those diseases, and in dropsy and deficient secretion of urine to produce diuresis. Solution of the citrate, freshly made by saturating lemon-juice with potassium carbonate and drunk during effervescence, is a favorite mode of giving the salt for the above purposes, and is also a very refreshing fever-draught, for allaying nausea, and for reducing over-action of the heart in acute febrile states. *Potassium and sodium tartrate* (Rochelle or Seignette salt) is of low diffusion power, and in large dose is purgative simply, producing, like other cathartic salts, watery stools. In smaller quantities, as a drachm, given considerably diluted, it is absorbed and its acid decomposed, and then under the form of carbonate it produces the effects and may be used for the purpose stated for potassium acetate and citrate. It is also employed as a purgative, and is most commonly given in the form of the *seidlitz powder* (*pulvis effervescens compositus* of the *United States Pharmacopœia*). A seidlitz powder consists of 2 drachms of the Rochelle salt and 40 grains of sodium bicarbonate, put up in a blue paper, and 35 grains of tartaric acid, put up in a white paper. The contents of the two papers are to be separately dissolved in about 2 fluid-ounces of water, and the solutions mixed and drunk during their effervescence. *Acid potassium tartrate*, or cream of tartar, is a powerful diuretic, and in full dose is purgative. It ought not to be used, therefore, for alkaline internal medication, like the acetate or citrate. *Neutral potassium tartrate* is also purgative, but, from its disagreeable taste, the acid tartrate is medicinally preferable. *Potassium sulphate* is purgative, but is harsh and may be poisonous, and is therefore little used. *Potassium nitrate* (niter or saltpeter) is irritant, and in large dose poisonous, inflaming the stomach, causing vomiting and purging, and also having an effect, common to many of the stronger potassium compounds, of affecting the heart, enfeebling its power, and even causing death by syncope. Niter is used in medicines as an ingredient of cooling saline draughts in fever, to reduce over-action of the heart, and was at one time largely employed in acute rheumatism. Niter has nothing to do with the so-called *sweet spirit of niter*, which is a peculiar

ethereal compound containing nitrous ether and alcohol. *Potassium chlorate*, though of high diffusion power like niter, is less freely soluble, and is hence not so strongly irritant, yet it is the most poisonous salt of potassium, except the cyanide, producing, in addition to local changes, a rapid breaking down of the blood and intense inflammation of the kidneys. This salt is peculiar in being largely excreted by the salivary glands and increasing their secretion. Medicinally, its use is almost confined to inflammatory and ulcerative diseases of the mouth and throat, over which it often has a remarkable power. A saturated solution may be gargled, or a few of the crystals may be held in the mouth and allowed slowly to dissolve. It should not be swallowed, except in very small quantities.

The other potassium salts used in medicine derive peculiar powers from their several acidifying principles. *Potassium cyanide* is intensely poisonous, and has essentially the properties of Hydrocyanic Acid (*q. v.*). *Potassium ferrocyanide* has but feeble physiological action, and is practically used only in pharmacy and the arts. The properties of *potassium iodide* will be found described under Iodine (*Medicinal Uses of*). *Potassium bromide* has peculiar powers over the nervous system, in addition to possessing the properties of potassium salts in general, of enfeebling the heart and tending to cause diuresis. The nervous influence is first a mere blunting of reflex excitability, cerebral and spinal, passing to complete paralysis if the drug be administered too long in inordinate quantities. The production of an eruption on the face like acne, and moderate salivation with a fœtid breath, are minor effects following the continued use of the drug. This salt is largely used in medicine to allay morbid nervous irritability, and is of special curative power in epilepsy, for the treatment of which it is the best remedy yet found. *Potassium sulphide* is used in medicine for the sulphur it contains. (See Sulphur, *Medicinal Uses of.*) *Potassium bichromate* is irritant and caustic, and internally a corrosive poison. It is official in the *Pharmacopœia* for pharmaceutical use, being employed for the preparation of sodium valerianate. It is also used rarely in medicine. *Potassium permanganate* in concentrated solution is slowly caustic, but the medicinal use of the salt is as a disinfectant and emmenagogue. As a disinfectant it acts by oxidation through giving up some of its own oxygen, and in weak solution is an excellent disinfectant application to wounds, foul sores, and ulcers.

Revised by H. A. Hare.

Potato [from Span. *patata*, *batata*, from Haytian, *batata*, sweet potato]: the most widely cultivated and valuable of esculent tubers. It is the *Solanum tuberosum*, the typical species of a typical genus, of vast extent and widely differing characteristics (see Nightshade Family), and is allied to several powerful narcotics, such as tobacco, henbane, and belladonna, as well as to other esculents, such as the tomato, egg-plant, and capsicum. The potato is a native of the elevated tropical valleys of Chili, Peru, and Mexico, and a form of it, scarcely distinct (var. *boreale*), occurs as far N. as Southern Colorado. It probably was carried to Spain from Peru early in the sixteenth century, and introduced into Virginia from Florida by the Spanish explorers, and into Great Britain from Virginia by Sir John Hawkins in 1565, though the credit is usually assigned to Sir Walter Raleigh, who was never in Virginia. It is found in several varieties in a wild state in Peru, Chili, and the island of Chiloe, the wild plant bearing still a close resemblance to the cultivated, except in the abnormal development of the tuber in the latter. The common potato was described in 1597 under the name of *Batata virginiana* by Gerard in his *Herball*, and in the following century it was cultivated on a small scale in the Netherlands, Burgundy, and Italy, and on account of its great yield was recommended by the Royal Society of London in 1663 for introduction into Ireland as a safeguard against famines; but it was not until near the middle of the eighteenth century that it acquired any real importance in Europe outside of Ireland. It was little regarded in Virginia, and seems to have been unknown in New England until the eighteenth century, when it was carried thither from Ireland. The potato is not mentioned in *The Complete Gardiner*, a work published in 1719, and as late as 1771 only two varieties, a white and a red, were mentioned in the most important English work on gardening, and they were considered chiefly as food for swine and cattle. The roots are distinct from the tuber, which is in reality an underground stem, naturally of considerable size, and abnormally developed by cultivation, through the accumulation of starch for the use of the plants growing from the *eyes* or buds. Under proper trimming and management the branches above ground may be made to assume several of the characteristics of the tubers.

The potato is a perennial plant, with smooth herbaceous stems, from 1 to 3 feet in height, with pinnate leaves, flowers varying in breadth from an inch to 2 inches, and in color from bluish white to purple, and consisting of a wheel-shaped corolla, more or less veined, bearing a globular purplish fruit or seed-ball of the size of a gooseberry, and an herbage characterized by a narcotic smell, and practically useless, though it may be eaten by cattle, and, like spinach, by man. One of the leading qualities of the potato is an extraordinary productiveness, far exceeding that of any esculent with which it can be placed in competition, an equal amount of ground yielding, according to Humboldt, thirty times greater weight of potatoes than of wheat. Potatoes consist almost wholly of starch, and are accordingly deficient in nitrogen, and ill-adapted for an exclusive article of diet. They are hardy, and grow well throughout a vast extent of the earth's surface. In the U. S. they yield best in the extreme north, especially in New York and New England, and also in Canada; and in Europe are successfully cultivated up to 60° N. lat. in Sweden. Formerly planted exclusively by hand in hills 3 or 4 feet apart, they are now dropped extensively in drills. Where large quantities of potatoes are grown, various mechanical devices are in use for dividing the drills and throwing up the tubers, ready to be gathered by hand. There is a bitter principle subsisting in the potato which may be considered as somewhat poisonous, and which is aggravated by the action of light to such a degree as to turn green: this principle must be removed by cooking before the tuber is fit for food; hence the water in which such potatoes have been boiled should never be employed in the preparation of other food. The particular variety of potato can be secured only by planting the tubers. The seed of a single ball will often produce many varieties of potatoes, and can not be depended upon to propagate the parent stock. The varieties most esteemed in the U. S. in the first half of the nineteenth century seemed to receive a complete check by the potato-rot of 1845, and they afterward practically fell into discsteem, and were replaced by others. The best of the old favorites was probably the Mercer or Neshannock (so called from having originated on Neshannock Creek, Mercer co., Pa.); its place in point of popularity was thereafter filled by the Jackson, White Garnet, Chili, Peach-blow, and Early Goodrich, most of which were originated by Rev. Chauncey E. Goodrich, of Utica, N. Y., to whom the world is largely indebted for the improvement of this important plant. Later, Early Rose, Beauty of Hebron, Burbank, and other varieties, became popular and superseded the old ones; and these varieties are in turn giving place to others. Varieties of potatoes soon disappear or "run out." The early varieties of potatoes now seldom produce seed-balls, and the late sorts are less productive of seed than formerly. This is due to the excessive deflection of the vital energy to tuber production in the highly improved varieties, and the failure of the flowers is particularly marked in the early kinds, probably because the energy is deflected to the tubers before the flowers are formed.

There are several serious enemies to the potato-plant, of which the best known is the Colorado Potato-bug (*q. v.*). The blight or rot has been somewhat prevalent since its first destructive appearance about 1840, although it is not equally bad in all years. The true potato blight and rot is caused by a fungus known as *Phytophthora infestans*, and it is readily kept in check by frequent and thorough sprayings with Bordeaux mixture. (See Fungicide.) It is thought, however, that some forms of blight and rot are due to a bacterium, the exact nature of which is not known.

The potato crop is less important in the national economy in the U. S. than in Europe. The crop of Europe aggregates more than the entire wheat crop of the world. The average annual production in the U. S. from 1881 to 1890 was 169,809,053 bush., while that of a like period in France was 396,746,138; in Austria, 306,984,697; in Germany, 891,732,040; in Russia, 300,315,070; in the United Kingdom, 228,093,397. In 1893 the U. S. exported $708,757 worth of potatoes and imported $1,998,708 worth. For further information, consult the experiment station bulletins, Carman's *New Potato Culture*, and Terry's *A B C of Potato Culture*. See also Food.

Revised by L. H. Bailey.

Potato-bug: a name applied indiscriminately by farmers to a great many different insects that attack the potato. Among them are the following: *Boring in the stalk*—the stalk-borer (*Gortyna nitela*); the potato-stalk weevil (*Baridius trinotatus*). *Feeding upon the leaves*—the potato-worm (*Sphinx 5-maculata*); the three-lined leaf-beetle (*Lema trilineata*); the cucumber flea-beetle (*Haltica cucumeris*); over half a dozen species of blister-beetles, belonging to the genera *Lytta* and *Epicauta*; and finally the Colorado potato-beetle (*Doryphora 10-lineata*), a hemispherical yellow beetle about one-third of an inch long, with ten black stripes on the elytra. This last alone is treated in this article. See Entomology.

Few insects have attracted greater attention than has this species since 1860. First described by Thomas Say, who found it common on the upper Missouri in 1824, it was afterward scarcely heard of till 1859. It fed originally on the sand-burr (*Solanum rostratum*), a wild plant belonging to the same genus as the potato. It was first found falling in large numbers on the cultivated potato about 100 miles W. of Omaha, Neb., in 1859. In 1861 it invaded Iowa; in 1862, Southwest Wisconsin; in 1864 and 1865 it crossed the Mississippi to the western part of Illinois; in 1866 it occupied most of the U. S. W. of a line drawn between Chicago and St. Louis; in 1867 it reached Southwest Michigan and Western Indiana; in 1868 many parts of Ohio, and from that time on kept spreading from year to year, until, in 1874, it touched the Atlantic seaboard at numerous places, and in 1875 was common from Virginia to Maine. It thus traveled over 1,500 miles in a direct line within 16 years, and spread over an area of something like 1,500,000 sq. miles. Though most injurious during the first few years of its advent, it always remains where it has once obtained a foothold.

Natural History.—The insect hibernates in the perfect or beetle state. As vegetation starts in spring the insect issues from the ground, and long before potatoes are up, or even planted, it may be seen flying in search of food and company. It frequently works into a sprouting hill of potatoes as these are raising the soil, and feeds upon the tender sprouts and tubers; and as soon as the plant shows itself the female begins to lay her oval orange eggs in clusters of from ten to forty, each attached by one end to the under side of a leaf or to a stem. With favorable weather there hatches, in the course of a week, from each egg a small, dark red, hunchbacked larva, which becomes paler and acquires a double row of lateral black spots as it advances toward full growth. This period arrives in about three weeks from hatching, and the larva finally burrows into the ground, where it becomes a pupa, and finally a beetle in from seven to ten days, the whole cycle of its transformations from the egg to the beetle requiring rarely more than a month. In the latitude of St. Louis there are three broods annually, the last brood of beetles issuing from the ground early in the fall. The migratory habit is often very noticeable in this last brood of the beetles, and for weeks they may be seen flying in bevies or traveling on foot in immense armies. The beetle feeds less than the larva, but is, nevertheless, very tenacious of life. The period of oviposition covers about a month for each female, and the number of eggs produced by each averages about 500. While the species feeds by preference on plants belonging to the genus *Solanum*, and it is doubtful whether it could thrive for any length of time on other plants than those of the family *Solanaceæ* yet in its march across the U. S. it has adapted itself in an emergency to a number of other species. In the article Entomology (*q. v.*) there is an illustration of the insect in its various stages.

Natural Enemies.—With the insect's advance the number of its natural enemies has increased. The rose-breasted grosbeak often effectually clears a potato-patch of the pest, and the domestic chicken has in some sections acquired a taste for it. The crow, the quail, the skunk, the toad, and some species of the long-legged harvestmen or "grandfather graybeards" (*Phalangium*) feed upon it. The most efficient aids, however, are found in its own class. Over two dozen of these have been described. The only true parasite known to infest it is a tachina-fly (*Lydella doryphoræ*) belonging to the Diptera, and having the general appearance of a common house-fly. Certain asilus-flies—a family of the same order—pounce upon and suck out the juices of the beetle. In its own order a number of ground-beetles (*Carabidæ*) devour it, and several species of lady-bird (*Coccinellidæ*) feed greedily on its eggs. Among bugs (*Heteroptera*) several species are also very efficient, piercing the beetle, and more particularly the larva, with their strong beaks, and sucking out the vitals. These are especially the spined soldier-bug (*Arma spinosa*), the many-banded robber (*Harpactor cinctus*), and the ring-banded soldier-bug (*Perillus circumcinctus*).

Methods of Combating it.—The first beetles and eggs to appear should be destroyed, but great care must be had to discriminate between the eggs of the ladybirds, which resemble those of *Doryphora* in color and mode of attachment, but are invariably somewhat smaller. Numerous mechanical means—machines used by hand, and even by horse-power—have been devised to knock the insects off the vines and collect them; and during very hot and dry summer weather in the more western parts of the U. S. the insects perish when merely knocked on to the ground. The only cheap and effective way of protecting the plants when once the insect has been allowed unduly to multiply is by the use of Paris green or London purple. This poison is now very generally employed, either as a powder with about twenty-five parts of some diluent, such as ashes, lime, bran, or flour—the last the best; or in suspension at the rate of a tablespoonful of the pure green to 3 gal. of water, and with a certain portion of molasses or other cheap sticky substance to facilitate adhesion.

This article would be incomplete without a reference to the bogus Colorado potato-beetle (*Doryphora juncta*), which so closely resembles the species under consideration that it was formerly often mistaken for it, even by good entomologists. In *juncta*, as compared with *10-lineata*, the eggs are paler; the larva is paler, with but one row of lateral

Bogus Colorado potato-beetle: *a a*, eggs; *b b*, larva; *c*, beetle; *d*, enlarged elytron; *e*, enlarged leg. Colors, *a*, whitish yellow; *b*, cream yellow, brown, and black; *c*, black, yellow, and brown.

black dots, instead of two; the beetle has the second and third black stripes on the elytra (counting from the lower edge) joined at the ends, instead of the third and fourth; the punctures of elytra more regularly in rows, and the legs with pale instead of dark tarsi, and with a black spot on the thighs. It feeds on the nettle (*Solanum carolinense*), has always existed in the southern half of Missouri eastward, and never touches the cultivated potato.

Revised by J. S. Kingsley.

Potato-fly: See Cantharis.

Potato, Sweet: See Sweet Potato.

Pote'khin, Alekseĭ Antipovich: author; b. at Kineshma, government of Kostroma, Russia, July 1, 1829. After finishing his studies he settled in St. Petersburg. He has described with unsparing fidelity the darker side of the life of the lower classes. Among his novels are: *The Peasant Woman*, *For Money* (a description of factory life), and *Young Inclinations* (1879). Many of his peasant tales are excellent, for instance, *Tit Sofronov Kazanok*, *The Sick Woman* (1876), *Under the Spell of Money* (1876), *Before the Community* (1877), *Village Leeches* (1880). On account of the sharp criticism of Russian conditions which they provoke, his dramas have not been allowed by the censors to be put on the stage. Among the best known are *The Voice of the People not the Voice of God* (1853), *Ill-gotten Goods do not Prosper* (1854), *Tinsel*, *The Severed Limb*, *A Profitable Undertaking* (1870), *A Love Match*, and *The Guilty Woman*.

A. C. Coolidge.

Potem'kin, Gregor Alexandrovitch: Russian minister of state; b. in 1739 of a family of Polish nobility on its estate in the government of Smolensk; entered the Russian army, and was ensign in the imperial body-guard when he attracted the attention of Catherine II., shortly after her accession to the throne, by his handsome person. He was appointed gentleman of the bedchamber by the empress, and superseded Orloff as her lover. This intimacy did not last long, and he was absent from court for some time, serv-

ing in the war against Turkey, but on his return enjoyed a greater influence than ever. By his entire freedom from jealousy and by his mastery of the art of making himself interesting and indispensable, he retained his influence over the empress to his death. Not only the empress herself, but foreign monarchs—Frederick the Great, Maria Theresa, and Joseph II.—loaded him with honors and riches and submitted to all his whims; and as an alliance with Russia at this time began to be of the utmost importance to the neighboring states—Sweden, Poland, Prussia, Austria, and Turkey—he, as the dispenser of this alliance, played an important part in the politics of Europe. That he had some ability is shown by the success of many of his undertakings, but in private life he was capricious, vain, and licentious, and his public career affords no proof that he possessed a high order of statesmanship. Among the acts of his ministry were the foundation of the cities of Kherson, Kertch, Nikolaiev, Sebastopol, etc., the creation of a Russian fleet in the Black Sea, the Turkish wars which resulted in the acquisition of the Crimea, Caucasus, etc. D. on the road between Jassy and Nikolaiev, Oct. 15, 1791. See Cérenville, *Vie de Prince Potemkin* (1807); *Memoirs of Potemkin* (London, 1814); and de Ligne, *Mémoire de la Cour de Russie* (1859). Revised by F. M. Colby.

Potential [from Lat. *poten'tia*, power, possibility, deriv. of *pos'se*, be able]: in mathematics, a scalar function, usually called V, of the co-ordinates of a point, first introduced by Laplace in the discussion of gravitation in his *Mécanique Céleste*. The name *potential* was given to it by George Green, in his now famous *Essay on the Application of Mathematical Analysis to the Theories of Electricity* (Nottingham, 1828). Green almost created the theory as we have it, but so completely buried was his essay for nearly twenty years that most of its important theorems had in the meantime been rediscovered by Gauss, Charles, Sturm, and Thomson.

The introduction of the term *potential* into practical and even elementary electricity is a remarkable example of the influence of pure mathematics on the development and rationalization of a science. It is entirely probable that the extensive use of the term potential, and the ideas which it directly or remotely represents, have been due in great degree to the predominant influence on scientific thought of the principle of the conservation of energy. See Energy.

The *mutual potential energy* of a system of two bodies in any given position is the amount of *work* done by their mutual repulsion in separating them to an infinite distance. When the bodies mutually attract their potential energy is conventionally negative. Work, which is the measure of energy, is the product of the force acting and the component of the motion produced in the direction of the force.

The *potential* at any point, due to any attracting or repelling agent, is the mutual potential energy between it and a *unit quantity* of the agent placed at that point. Thus the gravitational potential at a point is the work required to remove unit mass of matter from the point to an infinite distance.

Potential is applied to central forces, and generally, though not necessarily, to those varying as the inverse square of the distance. Thus the force at P, due to the acting agent q, distant r from the point, is $\frac{q}{r^2}$ if the unit quantity is so chosen as to render the constant in the expression for the force equal to unity. The work done in moving the unit quantity at P a distance dr along a line of force is $\frac{q}{r^2}dr$. A *line of force* is a line tangential at each point to the direction of the force.

If we integrate the above expression between the limits r and infinity, the work done will by definition be the potential at P, or $\int_r^\infty \frac{q\,dr}{r^2} = \frac{q}{r}$.

If the potential at P is due to several acting masses, then the total potential at P is the value of $\frac{q}{r}$ for all the acting masses conjointly, or $V_P = \Sigma\frac{q}{r}$. Thus the electrical potential at the center of a sphere, charged with a quantity of electricity Q, is $\Sigma\frac{q}{R} = \frac{1}{R}\Sigma q = \frac{Q}{R}$, where R is the radius. See Electricity.

From the definition of the potential at a point it follows that the excess of the potential at the point A over that at B is the work which must be expended against the acting forces in moving unit mass from B to A. The word *mass* here denotes the acting agent of any kind. The work done is independent of the path traversed; otherwise it is obvious that by moving unit mass back and forth along suitable paths between the two points an infinite amount of work might be done without any expenditure of energy.

An *equipotential surface*, in gravity a level surface, is one having the same value of the potential at all points. There is therefore no difference of potential on the surface, and no work is done in moving any mass of the acting agent from one point to any other on an equipotential surface. Hence there is no component of force along such a surface, or it is perpendicular to all the lines of force meeting it.

Let there be two equipotential surfaces with potentials V_1 and V_2; then the work done in displacing unit mass from any point on one surface to any point on the other is $V_1 - V_2$. It is independent of the position of the points on the two surfaces and the path traversed from one point to the other.

The work done in transferring a mass, m, from one surface to the other is $m(V_1 - V_2)$.

Force is a function of potential. Consider two equipotential surfaces indefinitely near each other, their distance along a normal being dn. Let F be the force along this line. Then $Fdn = V_1 - V_2 = -dV$, if V_1 and V_2 are the indefinitely near values of the potentials on the two surfaces.

Therefore $F = -\frac{dV}{dn}$, or the force at any point is equal to the negative derivative of the potential with respect to the normal to the equipotential surface passing through the point. The force along any line may be similarly expressed. Let α be the angle which the line makes with the normal to the equipotential surface, and let ds denote the portion of the line lying between the two indefinitely near surfaces. Also let F_s be the force along the line. Then $F_s = F\cos\alpha = -\frac{dV}{dn}\cos\alpha$. But $\cos\alpha = \frac{dn}{ds}$. Hence

$$F_s = -\frac{dV}{dn}\cdot\frac{dn}{ds} = -\frac{dV}{ds}.$$

Thus the component of the force in any direction is the partial derivative of the potential in this direction. In other words the force along any line is the rate at which the potential decreases per unit length of the line.

Potential plays a paramount part in the study of electrical phenomena. Positive electricity tends to flow from places of higher to places of lower potential. Hence the surface of a charged conductor *in electrical equilibrium* is an equipotential surface. Moreover, all points of such a conductor have the same potential. The potential of a sphere is therefore the same as the potential at its center, or $\frac{Q}{R}$.

The *capacity* of a conductor is the quantity of electricity required to raise its potential from zero to unity; and since the potential increases directly as the charge, it follows that the capacity equals $\frac{Q}{V}$ (quantity per unit potential). Since the potential of a sphere is $\frac{Q}{R}$, dividing Q by $\frac{Q}{R}$ we have R as the capacity, or the capacity of a sphere is numerically equal to its radius. A sphere of unit radius has unit capacity.

The *energy* of a charge may be expressed as a function of the potential. If a quantity of electricity, Q, is transferred from potential V_1 to V_2, the work done during the flow, or the energy converted into other forms, is $Q(V_1 - V_2)$, V_1 being greater than V_2. If, however, a conductor has its potential raised from zero to unity by a charge, Q, then the potential energy stored up is $\frac{1}{2}QV$; or, since $Q = CV$, the energy of the charge is $\frac{1}{2}CV^2$. This may be demonstrated as follows: Let dQ be an element of the charge; to transfer it from a place of zero potential to the conductor at potential V_o requires that work be done upon it equal to $dQ\,V_o$. But since $Q = CV_o$, $dQ = C\,dV_o$. Hence

$$dQ\,V_o = C\,V_o\,dV_o, \text{ and } \int_o^V C\,V_o\,dV_o = \tfrac{1}{2}CV^2.$$

Now the capacity C is a constant. Therefore the potential energy of the charge is proportional to the square of the potential to which the conductor is raised by the charge. If the capacity of a charged conductor could be doubled, both the potential and the stored energy would be reduced to one-half.

In current electricity the difference of potential between two points plays a most important *rôle*. It is numerically equal to the work done in carrying a unit of electricity in the positive direction from one point to the other. Thus the potential difference between the terminals of a battery when the circuit is closed is the energy represented by the passage of a unit of electricity from the positive pole around through the external circuit to the negative. The total energy transformed during the passage of Q units is Q times the potential difference. This remains true whether the energy expended in the transfer is converted into heat because of the ohmic resistance, or whether a portion does mechanical work by means of a proper motor device in the circuit, or whether the energy is in part stored up by electrolysis, or whether it is stored up by producing that strain in the ether called a magnetic field

The potential difference between two points on a circuit is numerically equal to the electromotive force (written E. M. F.) producing the current flow from one point to the other, so long as the circuit joining the points contains no source of E. M. F. In such portion of a circuit the current flows from higher to lower potential, but within the region where the E. M. F. has its origin the current flows from lower to higher potential, being so impelled by the cause there acting to produce an electric flow.

In any part of a conducting circuit the loss of potential is jointly proportional to the electrical resistance and the current strength. This loss is a fall of potential so long as no source of E. M. F. is encountered. It may exactly counterbalance the gain due to the E. M. F.'s encountered. In this case there will be a current flow produced by an E. M. F. without any potential differences. Potential differences are therefore due to E. M. F.'s rather than the reverse.

Potential differences are established by contact of dissimilar substances, by chemical action, by heat, by pressure, in physiological processes, and by the relative movement of a conductor and the lines of force surrounding a magnet.

A potential difference produces in insulators or dielectrics a displacement stress by which electricity is displaced in the direction of the potential decrease. If the medium is of such a nature that it can oppose or resist this stress it is called a non-conductor; but if it yields to the electric stress the medium is a conductor, the potential energy of the state of strain is converted into heat, and a continuous current flows so long as the potential difference is maintained.

For fuller information the following authors should be consulted: Clausius, *Die Potentialfunction und das Potential*; Mascart and Joubert, *Leçons sur l'Électricité et le Magnétisme*; Thomson and Tait, *Treatise on Natural Phitosophy*; Peirce, *Theory of the Newtonian Potential Function*; Maxwell, *Electricity and Magnetism*; Cumming, *Theory of Electricity*; Mathieu, *Théorie du Potentiel et ses Apptications à l'Électrostatique et au Magnétisme.*

HENRY S. CARHART.

Potentil'la [dimin. of Lat. *potens*, powerful, from its supposed virtues]: a genus of herbs and shrubs of the family *Rosaceæ*. There are many species, mostly herbs, about forty of which are natives of the U. S. The plants known as cinquefoil, five-finger, and tormentil belong to this genus. They have a highly astringent property, which is useful in medicine, and in the Orkneys and Lapland their roots have been employed in domestic tanning and dyeing.

Poten'za: chief town of the province of Potenza, Italy; on a hill near the river Basento (anc. *Casuentus*); 103 miles E. by S. of Naples (see map of Italy, ref. 7–G). The chief buildings are the cathedral, the seminary, and the hospital of San Carlo. It takes its name from the ancient *Potentia*, which was founded by the Lucanians on a site lower down the hill. It was almost totally destroyed by an earthquake on Dec. 17, 1857. There is now little activity of any kind here, though the neighboring country is agriculturally rich, producing silk, honey, and cheese. Pop. (1892) 18,500.—The province (formerly called Basilicata) has an area of 3,845 sq. miles. Pop. (1892) 541,865.

Potgieter, EVERHARD JOHANNES: critic and poet; b. at Zwolle, Holland, June 27, 1808; d. at Amsterdam, Feb. 3, 1875. His earlier life was given to trade, first at Amsterdam, then at Antwerp, and finally at Amsterdam once more. His tastes, however, were always literary, and he speedily became acquainted with a circle of brilliant young writers. In 1837, in company with certain of these, he founded the best of the Dutch reviews, *De Gids*, of which he was editor for thirty years. The influence of this periodical on Dutch letters has been very great; and Potgieter, with his friend and fellow contributor, Bakhuizen van den Brink, became the head of the new school that was trying to do away with the artificiality of style and triviality of matter all too prevalent in Dutch literature in the first half of the nineteenth century. Besides a number of short stories, he wrote a vast number of critical articles and a considerable body of poetry. In 1864 he issued a collection of the former, entitled *Proza* (2 vols.); and later two volumes of the latter, *Poëzy* (2 vols., 1868–69). After his death Joh. C. Zimmerman issued six volumes of his literary remains—*Verspreide en Nagelaten Werken: Proza, Poëzy, en Kritische Studien* (1875–85). Later still the same editor printed his entire *Werken* in 18 vols. (Haarlem, 1885). A. R. MARSH.

Pothier, pō'ti-ā', ROBERT JOSEPH: law-writer; b. at Orleans, France, Jan. 9, 1699; was educated in the College of the Jesuits, and afterward studied law in the University of Orleans, and in 1720 was made one of the counselors, or magistrates, of the presidial (a local court of last resort), which position his father had held before him; in 1749 became Professor of Law in the University of Orleans, and wrote many treatises on the law, among the best known of which are *Pandectæ Justinianæ* (3 vols., 1748–52), often reprinted; *Maritime Contracts*; *Contracts of Sale*; *The Law of Obligations of Contracts*, etc. Of all French legal writers he is the one oftenest and most confidently cited as an authority, and fully three-quarters of the Civil Code is taken almost verbatim from his works. Many posthumous works by him were published, which, however, are of much less value than his others. D. at Orleans, Mar. 2, 1772. F. S. ALLEN.

Pot-hole: an approximately vertical and cylindric cavity in rocks, produced by a whirling current of water. The cutting is done by sand-grains, and especially pebbles and bowlders, which by their weight are kept at the bottom and whirled about by the water. While the whirling motion can not be directly seen, it is inferred from the circular character of the holes, and from the fact that some of them are channeled about the periphery of the bottom as though cut by a diamond drill. Pot-holes occur on the beds of streams whose steep grades give them high velocity, and they are often many feet in depth. It is believed that they are formed also beneath glaciers, where crevasses permit streams of water to plunge from the surface to the base. As the ice moves forward crevasses are successively formed at the same spot, and the plunging water is thus enabled to excavate deeply. There is a series of holes referred to this action near Cohoes Falls, N. Y., and one of these was determined to have a depth of over 60 feet.

The deep pool usually found beneath a cataract is closely allied to the pot-hole, in that it is excavated by stones driven violently by a plunging stream of water; but the motion in this case is not ordinarily gyratory, and the excavation is less symmetrical. G. K. GILBERT.

Poti: Russian fortress; in the Trans-Caucasus, on the Black Sea, at the mouth of the Rioni (see map of Russia, ref. 12–F). It was captured from the Ottomans (1809), but restored at the treaty of Bucharest and finally ceded to Russia by the treaty of Adrianople (1829). This stronghold is exceedingly important as commanding the shore route between Persia and Russia. Pop. (1890) 4,813. E. A. G.

Poto'mac: a river of the U. S., forming through its whole course the boundary between Maryland and Virginia, and West Virginia. It is formed by the junction of two branches, of which the northern rises in the Alleghanies of West Virginia, and the southern in the Shenandoah range, Va. It resembles a bow in form, is nearly 400 miles in length, receives as tributaries from Virginia the Shenandoah, Savage, and Monocacy rivers, is an estuary from 6 to 8 miles wide for 100 miles of its lower course, and enters Chesapeake Bay 75 miles from the Atlantic. Washington, D. C., the national capital, is situated upon its left bank, 125 miles above its mouth, to which point the tide ascends, and it is navigable for large vessels. Above Washington are several falls. The scenery of the upper Potomac is remarkably picturesque, especially the junction of the Shenandoah at Harper's Ferry. On its lower course are the birthplace and the residence of Washington, and in its whole extent it formed an important strategical line during the civil war.

Potomac Formation: the lowest of the geological formations representing the Cretaceous period on the Atlantic coast of North America. The rocks are variegated clays, friable

sandstones, gravel, and sand, with many alternations, forming a series from 5 to 500 feet thick; they rest unconformably on crystalline rocks and on upturned and eroded strata of the Newark system, and are overlaid by fossiliferous Eocene and Neocene strata. The group forms a belt about 10 miles wide in Maryland but narrowing southward, which has been traced from the Delaware along the west side of Chesapeake Bay, and to the E. of Washington and Richmond, to Weldon, N. C., a distance of 300 miles. The Raritan formation in New Jersey, which includes the Amboy and Woodbridge clays, is thought to belong to this terrane, as are also the Tuscaloosa formation of Alabama, and the Trinity beds of Texas and Arkansas. Great numbers of fossil leaves, principally of broad-leaved trees, have been found in these rocks in Virginia, Maryland, and New Jersey; a few freshwater shells and the bones of large reptiles, allied to Jurassic species, have also been discovered. Consult W J McGee, *Am. Jour. Sci.*, vol. xxxv. (1888); *Twelfth Annual Report*, U. S. Geol. Survey (1890–91), pp. 421–424; W. M. Fontaine, Monograph No. 15, U. S. Geol. Surv.; O. C. Marsh, *Am. Jour. Sci.*, vol. xxxv. (1888). ISRAEL C. RUSSELL.

Potosí, pō-tō-see′: a city of Bolivia; on the side of the Potosí Mountain, a peak of the Eastern Cordilleras; 47 miles S. W. of Sucre (see map of South America, ref. 6-D). It is one of the highest inhabited places in the world, being 13,324 feet above sea-level. The climate is cold and changeable, though not unhealthful to regular residents; owing to the rarefied atmosphere new-born children often die or become deaf. Silver lodes were discovered here in 1546, and were long the richest known deposits in the world; up to 1864 they had yielded the sum of $2,919,899,400. The deposits are far from being exhausted, but, owing to the great depth to which shafts have been sunk and the difficulty of drainage, most of them have become unprofitable by the mining systems now in vogue; about 2,000 shafts have been abandoned. The yield in 1890 was 196,365 oz. During the eighteenth century Potosí, with its immediate vicinity, is said to have had a population of 170,000. The fine mint and the cathedral attest its former grandeur. Pop. about 12,000. It is the capital of the department of Potosí, which embraces that portion of the Bolivian mountain region adjacent to the Argentine Republic and Chili, with an area of 85,046 sq. miles (claimed), and a population (1888) of 237,755. It is noted principally for its silver mines, including, besides Potosí, those of Porco and Huanehaca, the latter now the most productive in Bolivia. Gold and tin are also mined. HERBERT H. SMITH.

Potosí, Mexico: See SAN LUIS POTOSÍ.

Potsdam: city; in the province of Brandenburg, Prussia: at the confluence of the Ruthe and the Havel, 17 miles S. W. of Berlin (see map of German Empire, ref. 3-G). It is well laid out and well built, having many fine streets, public squares, promenades, public edifices, gates, bridges, and monuments. It contains large barracks and other military establishments, educational and benevolent institutions, and a great number of royal palaces and summer houses, old and new, some of which are built on a grand scale and surrounded with extensive gardens and parks. Here is an astro-physical observatory, founded 1874, with two equatorial refractors, for spectroscopic, photographic, and other observations. Potsdam was founded by the elector Frederick William, who built a palace here in 1673, but its modern splendor is principally due to Frederick the Great, while each of his successors contributed to the embellishment and extension of the town. Its industries comprise market-gardening, manufactures of firearms, and the production of sugar, chocolate, tobacco, and cotton and woolen goods. Pop. (1895) 58,455.

Potsdam: village; St. Lawrence co., N. Y.; on the Racket river and the Rome, Watertown and Ogdensburg Railroad: 22 miles E. of Ogdensburg (for location, see map of New York, ref. 1-H). It is principally noted for its extensive quarries of sandstone of a geological formation to which the name of the village has been given. The region traversed by the Upper Racket river affords an immense supply of lumber which is floated in rafts down the stream. Potsdam has a Holly system of water-works, improved sewerage, electric lights, a State normal and training school, agricultural fair grounds, public library, a national bank with capital of $200,000, a State bank with capital of $50,000, several foundries, machine-shops, saw-mills, furniture-factories, agricultural implement works, and other manufactories, and three weekly newspapers. Pop. (1880) 2,762; (1890) 3,961; (1900) 3,843. EDITOR OF "COURIER AND FREEMAN."

Potsdam Sandstone: in geology, a formation of the Cambrian period occurring in New York and Canada N. of the Adirondack Mountains. It is the basal member of the NEW YORK SYSTEM (*q. v.*), and was long supposed to be the oldest American Palæozoic formation. The name has been applied also to sandstones at the base of the Palæozoic series in various other parts of North America, but it has now become known, from a comparison of fossils, that not all such sandstones are of the same age as the Potsdam. According to Walcott the Potsdam sandstone is the chronologic equivalent of certain limestones occurring S. of the Adirondacks and in Vermont, of the Knox shales of Tennessee and the Connasauga shales of Alabama, of the St. Croix sandstone in Minnesota, of the basal sandstone in Dakota, Montana, Wyoming, and Colorado, of the Gallatin limestones of Montana and the Hamburg limestone of Nevada, of the Tonto group of Arizona, and of the Katemcy group of Texas. Other Cambrian formations of the U. S., so far as determined, are of earlier date. In the district N. of the Adirondacks the sandstone has a maximum thickness of 500 feet. It is rather thinly bedded, and is usually yellowish brown or reddish brown. It is extensively quarried for paving blocks and to less extent for flagging and building stones. See CAMBRIAN PERIOD, and consult Bulletin No. 81, U. S. Geological Survey. G. K. GILBERT.

Potstone: a variety of talc, sometimes wrought, like soapstone, into pots, stoves, and kettles. It abounds in Europe, and is coarser and more granular than the best soapstone.

Pott, AUGUST FRIEDRICH: comparative philologist, b. at Nettelrede, in Hanover, Nov. 14, 1802; studied philology at Göttingen; was appointed professor in Halle in 1833. The *Etymologische Forschungen*, his greatest work, was published in 1836 (2d ed. 5 vols. and index vol., 1859–76). He also wrote *Die Zigeuner in Europa und Asien* (2 vols., Halle, 1845); *Die quinaere und vigesimale Zälmethode* (1847); *Die Personennamen und ihre Entstehungsarten* (1853; 2d ed. 1859); *Anti-Kaulen* (1863); *Die Sprachverschiedenheiten in Europa an den Zahlen nachgewiesen* (Halle, 1868); *Wurzelwörterbuch der indog. Sprachen* (1867–73, and in *Etymolog. Forschungen*, 2d ed. vol. ii., part 2); *Wilhelm von Humboldt und die Sprachwissenschaft* (2 vols., Berlin, 1876; 2d ed. 1880); and important articles in journals, collected in full by Horn in *Bezzenbergers Beiträge*, xiii., 338 ff. D. at Halle, July 5, 1887. Revised by A. GUDEMAN.

Pott, PERCIVAL: surgeon; b. in London, England, 1713; was apprenticed in his sixteenth year to a surgeon of St. Bartholomew's Hospital, with whom he served six years; in 1745 was made assistant surgeon, and from 1749 to 1787 was surgeon to St. Bartholomew's Hospital. His investigations into the causes of certain forms of spinal disease are classic. Some of his publications are *A Treatise on Ruptures* (London, 1756); *Observations on the Nature and Consequences of Wounds and Contusions of the Head, etc.*, (1760); *Remarks on that Kind of Palsy of the Lower Limbs which is Frequently found to accompany a Curvature of the Spine* (1779). D. Dec. 22, 1788. S. T. ARMSTRONG.

Pottawatomi Indians: See ALGONQUIAN INDIANS.

Potter, ALONZO, D. D., LL. D.: bishop; b. at La Grange, N. Y., July 10, 1800; graduated in 1818 at Union College, and afterward married the only daughter of President Nott; became a college tutor 1819, and held a mathematical professorship in Union College 1821–26; took deacon's orders in the Protestant Episcopal Church 1821; was advanced to the priesthood 1824; was rector of St. Paul's, Boston, 1826–31; Professor of Moral Philosophy and vice-president of Union College 1831–45; became Bishop of Pennsylvania in 1845; was one of the founders of the Episcopal Hospital and the Divinity School, Philadelphia. Author of *Political Economy* (1841); *Handbook for Readers and Students* (1847); *Discourses, etc.* (1858); *Religious Philosophy* (1870), and other works. D. in San Francisco, Cal., July 4, 1865. Revised by W. S. PERRY.

Potter, ELIPHALET NOTT, D. D., LL. D.: educator; son of Bishop Alonzo Potter; b. at Schenectady, N. Y., Sept. 20, 1836; graduated at Union College 1861; studied theology; took orders in the Episcopal Church; was pastor of churches at Bethlehem, Pa., and Troy, N. Y.; built at the former place three churches, and at the latter two chapels; became Professor of Christian Evidences at Lehigh University 1866, and president of Union University (formerly called Union College) 1871, adding the duties of chancellor of that

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institution 1872. He resigned in 1884, and became president of Hobart College, Geneva, N. Y. He was elected Bishop of Nebraska, but declined the office. He is author of *Parochial Sermons*, and has also prepared a work on *Christian Evidences at the Close of the Nineteenth Century*. Revised by W. S. Perry.

Potter, Henry Codman, D. D., LL. D., D. C. L.: bishop; b. at Schenectady, N. Y., May 25, 1835, the son of Bishop Alonzo Potter; graduated at the Protestant Episcopal Theological Seminary, Virginia, 1857; became rector of Grace Church, New York, 1868; bishop of New York, 1887. He is the author of *Sisterhoods and Deaconesses at Home and Abroad* (New York, 1871); *Gates of the East: a Winter in Egypt and Syria* (1876); *Sermons of the City* (1881); *Waymarks 1870–1891; being Discourses with Some Account of Their Occasions* (1892).

Potter, Horatio, D. D., LL. D., D. C. L. Oxon.: bishop; b. at La Grange, N. Y., Feb. 9, 1802; a brother of Bishop Alonzo Potter; graduated at Union College 1826; took deacon's orders in the Protestant Episcopal Church 1827; was advanced to the priesthood 1828; was Professor of Mathematics in Washington (now Trinity) College, Hartford, Conn., 1828–33; became in 1833 rector of St. Peter's, Albany; in 1854 became provisional bishop, and in 1861 Bishop, of New York. Bishop Potter's episcopate was wise, conservative, and in the main conciliatory. D. in New York, Jan. 2, 1887. Revised by W. S. Perry.

Potter, John, D. D.: archbishop; b. at Wakefield, Yorkshire, England, about 1674; educated at the Wakefield free school; entered University College, Oxford, in 1688; published a volume of *Variantes Lectiones* on one of the works of Plutarch (1693); became fellow of Lincoln College 1694; edited Lycophron's *Alexandra* 1697; was ordained in the Anglican Church 1697; published his principal work, *Archæologia Græca* (2 vols., 1697–98); became chaplain to Archbishop Tenison 1706; Regius Professor of Divinity at Oxford 1708; Bishop of Oxford 1715, having just finished his edition of *Clemens Alexandrinus*, and became Archbishop of Canterbury 1737. D. at Lambeth, Oct. 10, 1747. His *Theological Works* appeared in 3 vols., 1753. Revised by W. S. Perry.

Potter, Paul or Paulus: painter; baptized at Enkhuizen, Holland, Nov. 20, 1625. He studied art with his father at Amsterdam, and subsequently at Haarlem under Jacob de Weth. He painted at Delft two years, then went to The Hague, where he married in 1650; settled in Amsterdam in 1652; d. there, Jan. 17, 1654. Among his best-known works is that at The Hague called the *Young Bull*, painted in 1647; a finer but smaller picture of the same subject is at Buckingham Palace. His works are to be found in the principal collections at The Hague, Amsterdam, St. Petersburg, Copenhagen, Paris, Turin, and London. A portrait of Paul Potter by Van der Helst is in The Hague Museum. W. J. Stillman.

Potter, William James, A. B.: clergyman and author; b. at Dartmouth, Mass., Feb. 1, 1830; educated at Friends' Boarding School, Providence, R. I., Bridgewater, Mass., Normal School, Harvard College, Harvard Divinity School, and in Germany; taught in district schools one year; usher in Bristol Academy one year; instructor in Cambridge High School two years; was pastor of the Unitarian church, New Bedford, Mass., thirty-three years, including one year spent in military service (1863–64) with title of hospital chaplain; detailed for special service under the Secretary of War: aided in establishing the American Free Religious Association; was its secretary from its origin, 1867, to 1882, and its president 1882–93; editor of *The Index* 1880–87; author of *Twenty-five Sermons of Twenty-five Years* (1885), a highly representative expression of later Unitarian thought; *A History of the First Congregational Society in New Bedford* (1888); *Four Discourses Suggested by the Life and Tragic Death of Abraham Lincoln* (1865), and various sermons, essays, and addresses, many of which may be found in *The Radical*. J. W. Chadwick.

Pottery and Porcelain [*pottery* is from Fr. *poterie*, deriv. of *pot*, pot; *porcelain* is from O. Fr. *porcelaine*, from Ital. *porcellana*, a sea-shell, sea-mussel, hence fine clay, porcelain, deriv. of Lat. *porcus*, in its obscene sense of pudenda muliebria, to which the shell of the sea-mussel was compared]: *pottery* denotes, first, objects made of material (generally clay) which is moulded while soft and then baked until it becomes hard; second, a place where such objects are produced; and third, the art and process of their manufacture. In a narrower and more customary sense, the word pottery is applied only to the coarser varieties of such objects; porcelain comprising the finer, translucent, or semi-translucent kinds. Both are generally made of clay, and are keramic ware (see Keramics), but the terms are stretched to cover some wares that are not clay wares.

Materials.—Clay is very widely dispersed over all the continents and the larger islands of the world, and everywhere has been used for making vessels since the most remote antiquity. It is easy to mould by hand or by tools, keeps its shape well if kept moist, and can be remoulded as often as desired. When baked, or *fired*, it hardens without serious shrinkage or deformation, and will then keep its shape permanently. Different kinds of clay give different colored baked wares; thus at Apt, in Provence, there are beds of pale-brown clay, which have been in use during the eighteenth and nineteenth centuries by potters in that town, and which furnish the *terrines*, or covered pots in which various delicacies for the table are put up, these terrines being almost exactly of the same color as the unbaked clay. While the clay described above, and that of which yellow bricks and cream-colored terra-cotta are made, is hardly changed in color by firing, on the other hand, all clays which contain much iron turn red in the oven; thus common red bricks are not red before firing, but generally of a pale mud-color. The clay which forms the chief ingredient of porcelain is called Kaolin (*q. v.*). This is white and mealy, and consists of decomposed feldspar. Clay made very thin, to be applied to the surface of a piece of pottery and baked with it, is called *slip*. The piece may be dipped in the slip, or the slip may be poured on from the nose of a can, as when used to make stripes and bands for ornament. The glaze or enamel with which the clay body is covered in many kinds of pottery and porcelain is more diverse in composition. The extremely thin glaze of some fine kinds of ancient pottery has not been successfully analyzed. The equally thin glaze on the hard *stoneware* of which vinegar-jugs, Selters-water bottles, English beer bottles, etc., are made, is produced by throwing common salt into the oven, where it is decomposed, the soda of the salt combining with the alumina of the clay to form a thin, hard silicate. Other kinds of stoneware, and some kinds of soft earthenware, are covered with a lead glaze, made from white lead, flint, fragments of glass, and other materials in smaller quantities. These are ground together to a very fine powder, and mixed with water to form a thin paste, which is applied to the surface by dipping, or with the brush. The glaze of porcelain is made of a mixture of quartz and kaolin, or of feldspar and kaolin, with small quantities of other ingredients. In all glazes the requirements are that they shall combine readily with the surface of the body, and cling to it, that they shall fuse and become vitrified at a lower temperature than that needed for firing the body, and that the surface, when baked, shall be hard and insoluble in ordinary liquids. It is also generally a requisite that the glaze should not contract so much in the firing as to crack; but the *crackle*, which is so great an ornament to many Oriental wares, is produced by allowing the glaze to shrink and separate, and then, in some cases, filling the cracks with color before another firing.

When a glaze is opaque and put on rather thickly, it is called *enamel*. The most common enamel is stanniferous—that is, made in part of an oxide of tin. Such an enamel is perfectly opaque, pure white, lustrous, and with a soft surface which receives color well, so that good painting on the surface of such an enamel is often more beautiful than the painting on porcelain. It is sometimes impossible to tell in ancient pieces whether the thick white coating is enamel or slip. The pigments used for painting on pottery and porcelain are fusible or vitrifiable colors. These have often a very different appearance before firing to that which they are to give to the finished piece.

Processes of Manufacture.—The chief implement used by the maker of pottery or porcelain vessels is the *potter's wheel*, a horizontally revolving disk, upon which the lump of clay is held, and which the workman revolves at his wish. By the rotary motion a true roundness is given to the vessel, and the soft clay is shaped and reshaped very quickly by a skillful hand, the vase or jar being drawn out larger, or spread broader, or modified in its shape by a touch as it whirls. The simplest potter's wheel is turned by hand, but other arrangements are made to turn it more easily, or without the effort of the potter, and the best form seems to be one with a treadle for the foot, acting on the vertical axis,

to which are attached the flat disk for the clay, at the top, and a fly-wheel at the bottom. Handles and spouts are

Fig. 1.—The potter's wheel.

moulded separately, either by hand or in plaster moulds, and stuck on to the body while still soft. Elaborately modeled ornaments, figures of men and animals, and the like, whether attached to vessels or forming ornamental objects by themselves, are made with the sculptors' modeling tools.

When the shaping is done, the piece is allowed to dry somewhat before firing, but care must be taken not to let it dry so much as to crack. Common earthenware is fired only once. Glazed and enameled wares are fired once for the body and once for the covering. Painted wares are fired a third time for all colors which are applied upon the glaze, and a fourth time, always with decreasing temperatures, for gilding. The firing (see Kiln) is sometimes repeated more frequently, because the degree of heat and the length of the exposure may greatly modify the color which a pigment will furnish, and because retouches and alterations need new baking. Moreover, different workmen employ different processes: thus much Japanese porcelain is fired before the under-glaze colors are applied, then fired for those colors, all before the first glaze has been put on. Some of the celebrated colors, or the cloudings and stainings of color, are the result of accidents occurring in spite of all care and skill, and some of these accidental colors it has been found impossible to reproduce at will.

Decorating is chiefly accomplished by painting with a brush, the pigments being earthy or metallic, usually metallic oxides. Borax and other materials are used as fluxes,

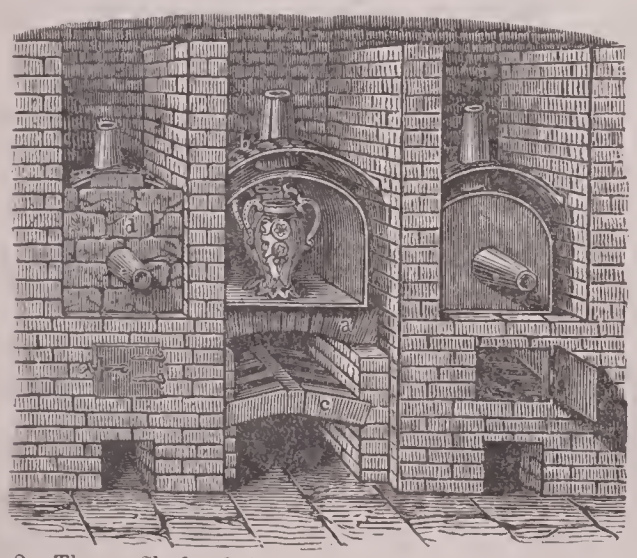

Fig. 2.—The muffle for fixing the colors on decorated porcelain.

and some kind of oil is used to facilitate the laying on. The color when fired becomes glass, either in a solid mass of some thickness or in a mere film. Some colors are applied upon the body under the glaze, but few can bear the great heat necessary for firing the body. Some painting is done upon the unbaked but dried surface of the stanniferous enamel when applied to the body; the color for this must also be very resistant. Other work is done upon the enamel after baking, and for this the low heat of the muffle is sufficient. Gold is applied with a brush, as powder, and is burnished after firing. Luster is generally metallic, the metal being very finely divided, so as to give its effect when laid on as a paint and fired without burnishing.

Besides painting with the brush, some effects are produced by putting on the color in mass and letting it trickle down the surface until stopped and fixed by the heat of the kiln. Other similar effects are got by blowing color from a tube, or splashing or sprinkling it in drops. Sometimes an accidental form, as of a seeming cloud or mountain, produced by splashing or smearing, has given a suggestion for a design, which has then been carried out deliberately. Sometimes the decoration is in form as well as color, the one aiding the other, as when a vase is covered with a raised pattern, simulating basket-work, which is then heightened with color and gold.

Earthenware. Unglazed.—What is called *prehistoric* ware is that to which no approximate date can be given with any certainty, and which is not even associated with an epoch which can be fixed. Thus the burial-mounds of Europe and America have furnished enormous numbers of vases of different kinds which can not be dated at all. Under ordinary conditions, earthenware which is well baked will last indefinitely under ground, and a burial-vase found to-day in France or England may be of a time only just before the Roman occupation or centuries older than that. Vessels found in these depositories are sometimes filled with bones and ashes of the dead, sometimes they are vessels for drinking or for food, and sometimes they seem to be merely ornamental. All are made simply of clay, and this, while still soft, has been impressed with patterns of different sorts or even cut through, the openings being arranged for decorative effect. These impressions and cuttings are fixed by the baking of the clay, and endure as long as the vessel lasts. Circles have been made by the impression of a ring, perhaps the end of a round stick with the center cut away; groups of dots or punctures have been made by a stick with a notched end, or cut into teeth in its length; zigzags and bands have been drawn with a sharp point; in short, there are found all the devices which would suggest themselves to a savage having soft clay before him and desiring to ornament it. The forms of these vases are often rather graceful, though rude, and evidently modeled by hand alone, and the ornament well applied and effective.

The next step is to ornament the vessels with *slip*, or clay thinned with water and applied to the surface. This may be a finer and whiter clay, and in this way effective patterns are produced. Handles and purely ornamental strips and lumps of clay, whether of the same clay as the body of the piece or of the finer slip, are often applied. The slip may be used also to fill up patterns impressed deeply into the surface.

One of the most remarkable uses to which earthenware was put in ancient times is that of inscribed tablets. In Mesopotamia immense numbers of these square tiles have been found, impressed with characters which have been read by modern scholars. They are practically books, and whole libraries of these are known and are gradually yielding up their record of times which can be fixed approximately at from 4000 or 4500 to 2000 B. C. This land of the Euphrates and Tigris, Syria, Cyprus, parts of Asia Minor, and Greece have yielded a great amount of what is called *archaic* pottery—that is, ware which can be associated with other monuments, such as bronzes and gems, and in this way dated approximately, though belonging to a time little known by historical records. These pieces have been made on the potter's wheel, and are therefore fairly regular and smooth. Their forms are varied endlessly and are often very beautiful, and impressed ornaments, like those of the prehistoric pottery, but far more neatly worked, are freely used. Patterns are also made in white or yellow slip on a darker body, and these are very effective. Painting is used also, the colors being earths, such as ocher. The painting is very thin, and is rather a staining of the surface. It is applied upon the body and upon the slip alike.

In later times unglazed earthenware has been less used for ornamental vessels, because more decorative kinds of ware have been made, but statuettes and groups, architectural ornaments and the like, have been made by the Etruscans, by the ancient Greeks, and by all the peoples of Europe and Asia from antiquity to the present. Earthenware used in this way is generally called *terra-cotta*. Great numbers of such sculptures in unglazed terra-cotta exist in public museums, and among these is much fine art of a very refined type of various dates from the Egyptian and Etruscan burial-urns to the portrait-busts made by sculptors in Europe

and America at the close of the nineteenth century. There is constant use of unglazed earthenware for bricks, roof-tiles, drain-tiles, and other articles of utility.

Earthenware, Glazed and Enameled.—The utility of glazing is that it makes porous-clay vessels water-tight, but it is employed equally for decorative effect and to protect surface decoration in colors. Sometimes this glaze is a mere film; thus in fine Greek vases its thickness can hardly be seen in the fracture; it is a mere glassy film. Sometimes it is solid and opaque, as thick as very stout paper, and covers up the body of the ware so that this can not be seen at all, as in MAIOLICA (*q. v.*). Sometimes it is thick and yet translucent, as in some Chinese and Japanese wares of which the body is impressed with deeply sunk patterns, the glaze usually of what is called a celadon green, showing a deeper color where it fills the sunken lines.

This class is the largest, and includes the greatest number of sub-classes. Perhaps nine-tenths of the keramic ware which students and collectors prize belongs to this class. The painted Greek vases are of this class, because the black coating which makes up so important a part of their system of decoration, though its exact composition is disputed, is clearly of the nature of an enamel; and because the glossy surface of the whole vase has been produced by the use of a very thin glaze. In the fine Greek vase (Fig. 4) the figures are of the color of the yellowish-red clay, the background black, made of the enamel mentioned above, put on with the brush, and worked around the figures. Many vases of the same epoch are known which are entirely covered with the black glaze, and depend upon their form and slight ornaments in relief for their effect. This example (Fig. 4) is one of the so-called red-figured vases which are considered as belonging to the finest class of Greek keramic art, and of the fourth century B. C. Vases earlier than this, but still later and finer than the *archaic* ware described above, and fully glazed, had the figures in black on the red ground. No kind of earthenware known is more interesting than these Greek vases, thousands of which have been found in Southern Italy, in Greece, and in other Mediterranean lands. They give the only clear notion of what Greek painting must have been. In themselves, too, they are of great artistic value, as their forms are of incomparable grace, and the figure subjects, however formal and incomplete the pictures may seem, have very important artistic qualities. It seems certain that this great industry had ceased altogether long before the Christian era. No such vases were produced under the Roman empire, although sculpture and painting, glass and metal-work, and most of the fine arts of the Greeks were still flourishing.

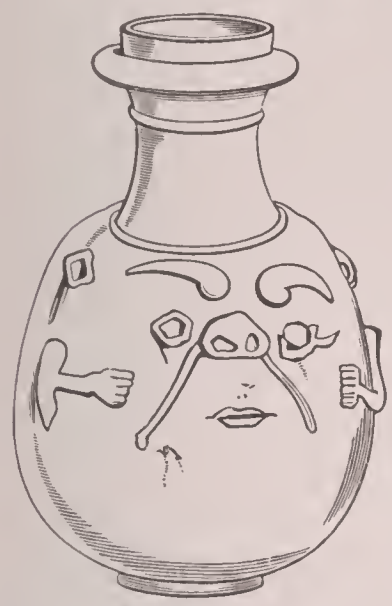

FIG. 3.—Egyptian bottle of unglazed ware, ornamented with grotesque head of the god Bes.

Greek painted vases were called Etruscan in the eighteenth century, probably because those found in the tombs of ancient Etruria were the first to attract notice. It is known now that they were brought from Greece in large numbers. There was also a real Etruscan pottery. Most of the pieces known are unglazed black ware, but some vases exist which have a thin glaze nearly like that of the Greeks.

Under the Roman dominion, glazed pottery was made in many parts of the empire. The type of it is the red ware, of fine texture and smooth surface, generally rather soft and easily broken, and covered with a very thin glaze. This is called Samian ware, from the Isle of Samos, but there is no certainty as to its place of manufacture. Early in the nineteenth century it was discovered that a ware very similar to this was made at Arezzo, in Tuscany, and the Samian ware was probably made in many places, varying slightly in color and character. It was often adorned with arabesque and figures in relief.

Ware with a thick and opaque enamel was not used by the Greeks, nor, apparently, under the Roman empire, but it had been used by the Egyptians at an early date, and the most splendid specimens of it known had been made before the Parthenon was built. Persia, always a center of fine decorative art, had possessed from the time of Darius large friezes of life size, human figures, and animals in relief, decorated with enamels of the most brilliant coloring.

FIG. 4.—Birth of Athene, on a Greek pelike, from Vulci.

The Louvre now has a number of the figures, and their beauty and brilliancy almost exceed belief. Other specimens of this art, from the somewhat more recent palace of Artaxerxes Mnemon, are almost equal in merit. These colored reliefs, twenty-three centuries old, are the finest known instances of color applied to architecture, as well as unequaled pieces of enameled earthenware. In Persia this splendid art was not allowed to die out, and specimens of it of all ages are known. In the eleventh and following centuries of the Christian era the Persian vases, dishes, hanging lamps for mosques and the like, and the imitations of them made in Rhodes and other parts of the Levant, were the most beautiful keramic wares made anywhere to the W. of China, and the influence of the designs and manufacture of these was felt throughout the south of Europe. In Spain, Sicily, and the Balearic islands a beautiful ware, decorated with a few simple colors and a free use of metallic lustrous glazes, was made; this is known as Hispano-Moresque ware. In Italy, in the fourteenth and following centuries, the splendid ware called MAIOLICA (*q. v.*) was made, perhaps surpassing Persian ware in beauty, especially as regards the metallic luster, which is the most vivid and striking of all keramic decorations.

FIG. 5.—Etruscan wine-pitcher, of black ware: Perseus and the Gorgons.

Earthenware with an opaque enamel was next to conquer the North. In France, after the great achievements of PALISSY (*q. v.*), a number of less peculiar and abnormal kinds of faïence were produced. What is known as Rouen ware reached its greatest development in the seventeenth century. The faïence of Nevers, that of Moustiers-la-Reine, succeeded; then the potteries of Strassburg, those of Niederwiller in Lorraine, Marseilles, and Sceaux. In the eighteenth century enormous quantities of these

wares, decorated with bouquets and festoons and figures in color on a white ground, were made in France and Germany. Some attempts were made to imitate the rich and solid coloring of maiolica, and some Oriental designs were copied, but generally a delicate and light-colored style prevailed. Dutch ware, known generally as Delft, is of the same epoch. The Delft pieces most commonly met with are painted in blue on a white ground, in imitation of Chinese porcelain, but there is also a great deal of it decorated in several colors with gold. There are many, also, which are painted with scenes of life, landscapes, and animals both domestic and wild. The forms of the pieces during the seventeenth century are generally very simple and refined, with some tendency toward imitation of the shapes of Chinese pieces of the best styles. There are also many *plaques*, or flat slabs, for hanging on a wall, and these are often painted with pictures of an elaborate sort.

FIG. 6.—Proto-Samian cup, with an amazonomachia in relief, from Athens.

In England but little artistic faïence was made. The "ironstone china" and other varieties of what the French call *faïence fine*, together with Wedgwood ware, are mentioned below under *Stoneware*. Inexpensive tableware is often decorated with transferred patterns. These are first printed upon paper and then transferred from the paper to the unbaked ware. Cheapness is secured in this way, but the process has nearly ruined English pottery as a decorative art, and has done great harm on the Continent.

In China and Japan the abundance of porcelain and (in Japan) of the hard and durable stonewares of yellow body has always kept down the supply of glazed earthenware; moreover, less of it is known in the West because of the attractiveness of those above-named keramic vases. It may be said that for the common needs of life the Orientals use hard earthenware with only a very thin siliceous glaze, and that this kind of pottery approaches common stoneware so closely that it is impossible to draw the line between them. These peoples of the extreme East are such skilled potters that they use all processes freely, very often to the confusion of the Western student of keramics. Thus a very ornamental kind of ware is made with a dark-brown and very hard body, the surface of which is very smooth and fine but not glossy; upon this a white or buff porcelaneous glaze is applied in places, so that the two colors contrast with one another. A statuette, for instance, will have the flesh of the brown earthenware and the dress of the whitish glaze, and this glaze may then be painted in many colors. Completely covered faïence, where no part of the body shows, is also made. Decorative pieces are sometimes brought to the West. The great "porcelain tower" near Nanking, which was destroyed in the Tai-ping rebellion, was faced with faïence, covered with thick enamel, and richly painted, some of the white bricks being a true porcelain.

Stoneware.—Much the most famous variety of this hard and thoroughly baked pottery is that known as Cologne ware, or as *Grès-de-Flandres*. During the seventeenth century splendid vessels were made of this, the forms most varied and fantastic, the ornamentation applied in relief by means of a great number of stamps, and the color-effect limited to the combination of a cold blue in places with the soft gray of the ware itself. This is the more interesting that the pieces differ so slightly from the commonest vessels of daily use. The finest Cologne ware tankard is only a common vinegar jug or beer mug somewhat adorned, and it is the more valuable to the student of design on that account. *Wedgwood ware* should be considered in connection with stoneware because of the non-porous character of the paste. The chief kinds are cream-ware or queen's-ware, of a light buff, colored throughout the body, used for fine dishes and other table utensils; jasper, which was generally either blue or white, very uniform and fine grained, and capable of taking the sharpest edges and neatest impressions, and therefore used for bas-reliefs small and large; basalt, a black paste, also very fine, and used for ornamental vases, but also for tea-sets and the like; crystalline, in which are included imitations of natural agates, porphyries, and marbles, the colored veins going through the body. From 1780 to 1810 Wedgwood's pieces were exported largely to the Continent, and were used freely in England. Bas-reliefs in white on a blue ground were used for buttons and brooches, and larger ones were set into mantels and the paneling of rooms, or hung up like the plaques of Delft and Moustiers. Vases, sometimes mounted in gilt metal, and often set upon high pedestals, were sent as ceremonial gifts, and used for the decoration of the most stately apartments. John Flaxman (see FLAXMAN, JOHN) was employed upon the bas-reliefs, and some of his portrait medallions and groups in white "jasper" are of real interest as sculpture. The most important single piece made by Wedgwood is an imitation of the famous Portland vase, of which a number of copies were made. Other English wares, distinguished by the French writers as *faïence fine*, and known in England by various special names adopted by the makers, are half way between stoneware and artificial porcelain, their composition partaking of both. The paste is light-colored and solidly baked, and the glaze is thin and transparent. It is rare that they have much artistic merit, but they are excellent as tableware. Some of them approach closely to Wedgwood's queen's-ware in appearance.

The yellow ware of Japan, known to the West chiefly as Kioto and Satsuma pottery, is very hard and not porous in the body, and has a very thin and transparent glaze not changing the color of the piece. It is therefore more nearly stoneware than earthenware. Vases and dishes, statuettes, and groups of this beautiful ware are very well known. The artistic merit of the decoration is of many degrees; there are some pieces in which the delicacy and softness of effect entitles the ornament to be considered as beautiful and as truly appropriate to keramic ware as any that is known, but most of the pieces are somewhat more harsh in color, and the painting often tends toward extreme minuteness and the display of technical skill.

PORCELAIN.—This appears to be the discovery of the Chinese, and all its highest attainments are due to that people. Few persons are aware of the endless variety of decoration to be found in Chinese porcelain, for no collection in any public museum contains nearly all the varieties that exist. Japanese porcelain is hard and fine, and exquisitely made and finished, but there are only three or four styles of painting used in its decoration, while the Chinese styles can be counted by hundreds. There are many vases and plates in Western collections which are painted most artistically and delicately with flowers, groups of men and women in rich costumes, and other subjects, all vivid colors treated in the most judicious manner. Blue painting on white, when carried to its highest pitch of excellence, is extraordinarily decorative. The fault of too great sharpness of outline and of too sudden contrast between pattern and background is not to be found with the best pieces. Of Japanese porcelains the best known is also the finest—viz., the "Old Japan" or Hizen porcelain, painted in blue under the glaze and then enameled colors and gold upon the glaze. The general effect is a combination of dull blue and dusky red with pale gold, on a brilliant white ground.

Porcelain was first made in Europe by Böttger in the employ of the Elector of Saxony about 1710. Previous to that time a factory kept up by the Medici at Florence had made a few pieces of a ware very like a real porcelain, and long thought to be so, but now known to be not a clay ware. The sight of the Saxony porcelain excited afresh the makers of fine pottery in France and England, and many attempts to imitate this and the Oriental porcelains were made. These attempts resulted in soft porcelain (*pâte tendre*), and in English artificial porcelain, both very complicated in their make, with many ingredients in the body and the paste, but hardly clay wares. About 1770 the secret of the kaolin or true porcelain clay became known in France, and from that time real porcelain was made at Sèvres; but the artistic qualities of Saxony and Sèvres porcelain are by no means equal to the skill shown in the manufacture or to the enormous prices paid for fine pieces. The Saxony porcelain—generally called Dresden, or, more properly, Meissen, from the town where the factory is situated—that of Vienna beginning about 1745, and that of Berlin from about 1750 may all be considered rivals of Sèvres porcelain in the favor of collectors. The German pieces are generally still less artistic and appropriate in design than those of France, but these, as well as the Sèvres, command admiration for their delicate finish and the wonderful skill of the makers and decorators of the finer pieces. Each of these factories has always been a Government enterprise,

and the most important productions are generally to be seen in palaces, having been sent as gifts from one court to another.

Exceptional Wares.

Egyptian Green Ware.—This curious ware, commonly called "porcelain," is almost wholly composed of sand, half melted, held together by a little plastic material, and glazed with silex; in other words, it is a half-made glass, and is very easily broken. It is of a beautiful green or blue tinge, and decorated with simple patterns, generally in a darker blue.

Henri Deux Ware.—This extraordinary pottery was a mystery to students until Benjamin Fillon located its manufacture in the east of France, calling it Faïence d'Oiron, from a village in the department of Deux-Sèvres. It is now called Faïence de St.-Porchaire, from a village in the Charente-Inférieure. There are only fifty-three pieces of it known, of which about a dozen are in one glass case in the Louvre: all of the same general style of make and design; all are without doubt the product of one and the same private workshop. The great peculiarity of the decoration is the inlaying of clay of one color in a clay body of another color. Little metal stamps, like bookbinders' stamps, were used for this, the clay being removed from the parts cut out by the stamps, and the clay of a different color put in, after which the whole was fired, and then glazed and fired again.

Soft Porcelain.—The early Sèvres ware brings enormous prices, mainly because of its rarity, but it is really somewhat more refined in effect because of the slight absorption of the colors by the paste. As was said above of Chinese porcelain, so European real or hard porcelain seems to many persons harsh in its sharp-edged and strongly contrasting colors, while *pâte tendre* is softer in its gradations.

English Porcelain.—This, in its different varieties—Derby, Chelsea, Bow, "Spode," Worcester, Lowestoft—is generally made of an artificial mixture, and is rather glass than keramic ware. It is rarely fine in design, the more expensive pieces being very clumsy in form, and painted and gilded in execrable taste, and the cheaper pieces ruined by having the colored patterns transferred to their surface from prints on paper. This is a way of getting an appearance of decoration cheaply, but no process is more devoid of true ornamental effect. Some fine Derby ware statuettes and groups have been sold in the biscuit, unglazed and uncolored, and these are very attractive, the example of Wedgwood ware and Flaxman's designs carried out in this material having influenced English work more as to sculptured form than in other ways.

Modern Wares.—At the close of the nineteenth century there are so many different wares and so many different processes of manufacture, many of these latter being also kept secret, that classification is extremely difficult. Generally the forms are ugly, partly because the art of modeling simple and suitable teapots and cups has been lost by the workmen, and only a trained artist can satisfy himself without inartistic additions and attempts at novelty, partly because the demand for extreme neatness and uniformity makes all natural grace impossible. The decoration in color and gold is usually disagreeable from its hard monotony. In France, however, some simple faïence is decorated with flower patterns, of which the outline is printed or transferred, but the filling in with natural-seeming colors is done by hand. At a higher price are made some tea-sets and the like, which are painted entirely by hand, a spray of roses or other flower being laid across each plate, very well drawn and colored, though not very well arranged as decoration. One exceptional style of decoration is that called *à pâtes rapportées* or *pâte sur pâte*, in which pure white semi-translucent reliefs are raised on a colored ground, the color showing through the thin edges, and the relief growing more purely white as the *pâte* grows thicker. This has been in use since 1852; it is often called by the name of Solon, who produces it for a London dealer, but it is also made at Sèvres. In the U. S. some private persons have painted clever designs of wild plants variously grouped. The Rookwood pottery, of Cincinnati, turns out large and small decorative pieces of great variety of forms. These, and the tableware, are decorated with very able painting of natural-looking sprigs and bouquets in white, buff, gray, etc., on a ground of dark brown, dark green, and similar colors passing into one another by gradations. Gallé, of Nancy, in France, makes ornamental vessels of the most extraordinary and unexpected designs, always interesting but often more novel than beautiful. Delaherche, of Paris, makes noble vases decorated with strong dark-colored glazes with fine gradation, somewhat like Chinese single-colored porcelains. Massier, of the Gulf Juan, near Toulon, makes the most exquisite pieces, decorated with mere zigzags and cloudings, and half-seen bouquets, but this ware is unfortunately extremely soft, and its paste is scratched by a touch. The royal factory of Copenhagen turns out dishes and vases painted with landscape effects, birds, etc., in pale grays and white, some of which are very decorative in a subdued way. The Japanese makers of the close of the century are also vying with one another in the production of extremely delicate and highly ornamented pieces, as well as tableware, and the cheapness of even their very beautiful productions is remarkable. Tiles for wall decoration are made in endless variety in Europe and the U. S., the best in color being French, but some of those with figure subjects and heads in low relief made in the U. S. are extremely effective.

Pottery and porcelain are made at many places in the U. S. At East Liverpool, O., are about thirty different establishments, some of which produce decorative wares. At Trenton, N. J., are perhaps as many separate establishments. At Cincinnati, O., are two or three commercial manufacturing establishments, besides the private associations, in which much very novel and sometimes successful artistic work has been produced. Besides these there are works in New Hampshire, at Keene; in Massachusetts, at Cambridge, Chelsea, and East Boston; in Connecticut, at Hartford; in New York, at Utica, Greenpoint (Long Island), Syracuse, and the city of New York; in New Jersey, at Perth Amboy and Menlo Park; in Pennsylvania, at Beaver Falls, Morrisville, Pittsburg, Phœnixville, Spring Mills, and Philadelphia; in Maryland, at Baltimore; in West Virginia, at Wheeling; in Georgia, at Atlanta; in Kentucky, at Covington; in Ohio, at Akron, Steubenville, and Zanesville; in Indiana, at Indianapolis and Anderson; in Illinois, at Peoria; in Wisconsin, at Edgerton. According to the U. S. census of 1890 the value of the clay and pottery products of the 707 establishments which reported was $22,057,090, excluding bricks and tiles.

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1875), uncritical, but finely illustrated; du Sartel, *La Porcelaine de Chine*; Stanislas Julien, *Histoire de la Porcelaine de Chine*. A recent and thorough work on pottery and porcelain in the U. S. is by E. A. Barber, and has many illustrations. For general works on pottery and porcelain, besides the books named under KERAMICS. see Brongniart, *Traité des Arts céramiques* (Paris, 1844); W. Chaffers, *Marks and Monograms on Pottery* (London, 1863); Treadwell, *Manual of Pottery and Porcelain* (New York, 1872); Eliza Meteyard, *Wedgwood and his Works* (London, 1873); Champion, *Two Centuries of Ceramic Art in Bristol* (London, 1873); Beckwith, *On Pottery* (New York). RUSSELL STURGIS.

Pottinger, pot'in-jer, Sir HENRY: diplomat; b. in County Down, Ireland, in 1789; went in 1804 as a cadet to India, where he rose through all the grades of the service; was political resident in Cutch and Scinde 1824–39: was made a baronet Dec., 1839; went to China as ambassador and superintendent of British trade 1841; co-operated with Admiral Parker in effecting the capture of Amoy and other places; concluded the treaty of peace of Aug. 29, 1842, which opened five Chinese ports to the commerce of all nations; was appointed governor of Hongkong Apr., 1843; became privy councilor on his return to England May, 1844; was governor of Cape Colony 1846–47, and governor and commander-in-chief of Madras presidency 1847–54. Author of *Travels in Beloochistan and Sinde* (1816). D. at Valetta, Malta, Mar. 18, 1854.

Pot'to: a name applied to the KINKAJOU (*q. v.*).

Pott's Disease of the Spine: See SPINAL CARIES.

Pottstown: borough; Montgomery co., Pa.; on the Schuylkill river, the Schuylkill Canal, and the Phila. and Reading and the Penn. railways; 18 miles E. S. E. of Reading, 40 miles W. N. W. of Philadelphia (for location, see map of Pennsylvania, ref. 6–I). It is in an agricultural and mineral region, and is widely known for its manufactures, particularly of iron and steel. Besides the plant of the Pottstown Iron Company, which includes furnaces, rolling-mill, steel-works, and machine-shops, and that of the Philadelphia Bridge Company, there are 3 rolling-mills, a steel-mill, 2 nail-factories, a furnace for pig-iron, boiler-works, agricultural-implement works, 5 cigar-factories, 3 carriage-factories, 2 planing-mills, and other industrial works, including in the borough and its vicinity more than 20 creameries. The borough contains 22 churches, public-school property valued at over $115,000, Normal Institute, Hill School, 2 school libraries (High and Hill) containing over 5,000 volumes, 3 national banks (combined capital of $600,000), and 2 daily and 2 weekly newspapers. Pop. (1880) 5,305; (1890) 13,285; (1900) 13,696. EDITOR OF "DAILY NEWS."

Pottsville: borough; capital of Schuylkill co., Pa.; on the Schuylkill river, and the Lehigh Valley, the Penn., the People's, and the Phila. and Reading railways; 35 miles N. W. of Reading, 93 miles N. W. of Philadelphia (for location, see map of Pennsylvania, ref. 5–H). It is in the extreme southern part of the great Schuylkill anthracite coal-field, where shafts have been sunk in the valleys to a depth of 1,600 feet to reach the underlying coal-beds, while on the mountain-sides the coal-beds crop out, and it is the chief shipping-point of this coal region. It was here that anthracite coal was first successfully used for smelting purposes in 1839, and the prize of $5,000 offered by wealthy Philadelphians to the individual who would succeed in smelting iron ore with anthracite coal was awarded to the Pottsville furnace. There are 3 national banks with combined capital of $800,000, a State bank with capital of $200,000, a trust company with capital of $250,000, and a private bank. The public-school property is valued at over $300,000. There are excellent public schools, comprising besides the lower grades 2 grammar schools and a high school, and a commercial business college, 2 private schools, and 2 parochial schools. There are 3 libraries (Athenæum, Public School, and the Schuylkill County Law) containing over 10,000 volumes, and 3 daily and 7 weekly newspapers. The churches and chapels number 23. The borough has gas and water works, electric lights, electric railways connecting the adjoining towns, and a steam-heating plant. The industrial works include furnaces, rolling-mills, stove and other foundries, several boiler, engine, and machine shops, pottery, bolt and nut factories, planing-mills, spike-mills, shirt and stocking factories, large breweries, an extensive silk-mill, and bridge-works. Pop. (1880) 13,253; (1890) 14,117; (1900) 15,710. BAIRD HALBERSTADT.

Pouched Rat: See GOPHER.

Poughkeepsie: city; capital of Dutchess co., N. Y.; on the eastern bank of the Hudson river; 75 miles N. of New York and 69 miles S. of Albany (see map of New York, ref. 7–J). It is the eastern terminus of the Poughkeepsie and Eastern Railway, and is on the lines of the N. Y. C. and H. R. Railroad and the Philadelphia, Reading and New England Railroad, which last here crosses the Hudson river on a cantilever bridge at an elevation of 212 feet. (See BRIDGES.) Connection also is here made with the West Shore Railroad by ferry. Poughkeepsie was settled by the Dutch at the close of the seventeenth century. The first substantial building was erected not far from 1705. The Legislature of New York met in Poughkeepsie in 1778 to accept the articles of confederation adopted by delegates from the thirteen States. Here also on July 26, 1788, a State convention, through the eloquent and patriotic endeavors of Alexander Hamilton, ratified the national Constitution. The city is partly upon a hillside sloping to the river, but largely upon table-land extending eastward to Vassar College, 2 miles away. At the N. is College Hill, whose summit is 500 feet above the town. The whole of this hill, excepting the reservoir-grounds, has been given to the city by one of its citizens as a public park; its area is nearly 100 acres. The city is lighted by electricity, and its streets are traversed by electric cars, by which communication is held with Vassar College and Wappinger's Falls, a manufacturing village 8 miles below. Poughkeepsie is distinguished for its seminaries of learning, of which VASSAR COLLEGE (*q. v.*), Riverview Military Academy, Eastman's Business College, and Lyndon Hall are prominent. It has 23 churches, 6 national banks, a savings-bank, a public library, Orphan Asylum, Old Ladies' Home, Old Men's Home, hospital, and many other charitable institutions, while to the N., just outside the city limits, is the Hudson River Hospital for the Insane. There are many important and flourishing manufacturing interests, and 4 daily, a semi-weekly, 3 weekly, and 2 monthly periodicals. The city is supplied with water from the Hudson. Pop. (1880) 20,207; (1890) 22,206: (1900) 24,029.

Poulp [from Fr. *poulpe*]: a common name for any species of eight-armed Cephalopod. See MOLLUSCA.

Poultice: a soft composition of bread, flaxseed, meal, slippery-elm bark, or herbs, applied warm or at as high a temperature as the part to which it is applied will bear, in order to hasten inflammation and produce suppuration. Cold poultices or other cataplasms—for instance, of cotton-wool steeped in water—are applied to prevent inflammation or mitigate pain.

Poultney: town; Rutland co., Vt.; on the Poultney river, and the Del. and Hudson Railroad; 7 miles S. by W. of Castleton, 18 miles S. W. of Rutland, the county-seat (for location, see map of Vermont, ref. 7–B). It is in an agricultural region, and has several slate-quarries, slate-manufactories, foundry, machine-shops, the Troy Conference Academy (Methodist Episcopal, chartered in 1834), a national bank with capital of $50,000, and a weekly newspaper. Pop. (1880) 2,717; (1890) 3,031; (1900) 3,108.

Poultry [from O. Fr. *pouleterie*, deriv. of *poulet*, chicken]: domestic fowls, either gallinaceous or aquatic. Of the former there are sixty-eight breeds, each bred to a standard of points and possessing certain characteristics of color, form, and habits. The standard breeds are classified as American, Asiatic, Mediterranean, Polish, Hamburg, French, English, Game, Game Bantam, Bantam, and Miscellaneous.

American.—The American class comprises the Plymouth Rocks, Wyandottes, Javas, Dominiques, and Jersey Blues. The Plymouth Rocks are subdivided into White, Buff, and Barred varieties, the Javas into Black, White, and Mottled, and the Wyandottes into White, Golden, Silver, Buff, and Black. They are of medium size, and vary in color. With the exception of the Dominiques, which have rose-combs, they possess single straight combs which are serrated. The fowls of the American class are good layers. The color of the eggs is usually light brown, sometimes nearly white. The hens are persistent sitters.

Asiatic.—In this class are included the Light Brahmas, Dark Brahmas, Partridge Cochins, Black Cochins, White Cochins, Buff Cochins, and Langshans. They are the largest of the gallinaceous fowls, the Light Brahmas leading in weight. All fowls of this class have feathered legs, and all have single combs, with the exception of the Light Brahmas and Dark Brahmas, which possess pea-combs. They are

FANCY POULTRY.

hardy, large, and adapted to confinement. The hens are excellent layers and mothers.

Mediterranean.—To the Mediterranean class belong the Leghorns, Minorcas, Andalusians, and Black Spanish. The Leghorns are subdivided, according to the color of the plumage, into black, white, brown, dominique, and buff. There are also two varieties known as rose-comb brown and rose-comb white. The Minorcas are separated into two varieties—white and black. The fowls of the Mediterranean class are small, of active habits, unfitted for confinement, and are excellent foragers on a range. They are not sitters. They rank first as layers, but are deficient in size and attractiveness as market-fowls. Like all non-sitters, they lay eggs entirely white in color.

Polish.—The fowls of the Polish class are non-sitters, and are excellent layers during spring and summer, but are not very hardy. They are valued chiefly for their beautiful plumage. They possess large crests, and some varieties have beards. The Polish breeds are subdivided into the white-crested black, golden, silver, white, bearded golden, bearded silver, bearded white, and buff laced.

Hamburg.—This class includes the Hamburgs and Red Caps. They have rose-combs, are small, lay white eggs, and are non-sitters. They are not adapted to confinement, but are excellent foragers on a range. As table and market fowls they are not in favor, and also lack in hardiness. They are beautiful in plumage, and are second to the Polish as ornamental fowls. The Hamburgs are separated into golden-spangled, silver-spangled, golden-penciled, silver-penciled, white, and black.

French.—The French class comprises the Houdans, Crèvecœurs, and La Flèches. They are non-sitters and excellent table-fowls, but are unable to endure severe winters and damp weather. The fowls of the Houdan breed, however, are raised successfully in some sections of North America. The Houdans and Crèvecœurs possess crests and beards, while the La Flèche is without either. The Houdan possesses a fifth toe on each foot.

English.—The Dorkings compose the English class, being separated into white, gray, and colored. For the table they are unrivaled. The chicks are difficult to raise, and the adults are not well adapted to the climate of the U. S. The Dorking has five toes on each foot, is very compact in body, and the eggs are white in color. The females are excellent sitters and mothers.

Game.—To this class belong the Malays, Sumatras, Black-breasted reds, the various Duckwings—brown, white, pyle, and Indian. Games intended for combats in the pit differ from the standard varieties in being bred without regard to color or form, as courage is more essential. The Game fowls are excellent for the table and have an abundance of "breast meat." The females are superior sitters and mothers, but are not above the average as layers.

Bantam.—The Game Bantams do not differ from the standard Game fowls except in size. They are esteemed as pets. Cocks should not exceed 22 oz. in weight nor hens 20 oz. The Black-breasted reds are the favorites. Of Bantams other than Game are the Pekin (or Cochin), Booted, Japanese, white-crested White Polish, Rose-comb Black, Rose-comb White, Golden Sebright, and Silver Sebright.

Miscellaneous.—The miscellaneous class includes the Sultans, Silkies, Frizzles, Russians, and breeds that are considered oddities. They possess no merit of importance, with the exception of the Russian, which is a desirable breed for the market, the hens also being excellent layers and mothers.

Characteristics of Breeds.—As cattle have been classified into breeds, as milk, butter, and beef producers, so do the breeds of fowls differ in points of merit. The same breed can not be superior as egg-producers and in furnishing choice meat for the table, as egg-production is antagonistic to the production of meat of the best quality. The Asiatic class is composed of fowls that have been reared in confinement for many years until their wings have been so reduced in size as to render flying impossible, while the size of the body has been increased. These fowls fatten very readily, and if judiciously managed produce eggs during all seasons. As the motive power of the wings is in the muscles of the breast, the amount of "breast meat" has been lessened and the quality of the flesh is inferior, although their large size is an advantage in making an attractive display in market.

Fowls of the active breeds, such as the Leghorns, Hamburgs, and Minorcas, convert a large proportion of their carbonaceous food into force, and consequently they do not fatten as readily as the large breeds. They are non-sitters, although experiments demonstrate that hens of all breeds become broody when they have too much food and become fat. Fowls of American breeds are hardy, and while not equaling those of the Mediterranean class as layers nor rivaling the Dorkings in quality of flesh, they are above the average in both respects, but are liable to become overfat unless fed carefully during the winter. They are partially adapted to confinement, but, like fowls of all breeds, thrive best on a range. The best breeds for egg-production, considering hardiness and adaptability to climate, are the Leghorns, Minorcas, Wyandottes, Plymouth Rocks, Brahmas, and Langshans, in the order named. If the object is to produce poultry for market the breeds should be selected without regard to their laying qualities. Considering hardiness as a factor, the best breeds for market are the Plymouth Rocks, Light Brahmas, Cochins, Wyandottes, and Langshans, the last-named breed, however, not possessing the desired yellow skin and legs. For the table the Dorkings and Games are unexcelled, but they are too difficult to raise for market, owing to rapid feathering when very young.

Turkeys and Guinea-fowls.—There are six breeds of turkeys—the buff, bronze, slate, white, black, and Narragansett. The leading breeds are the bronze and white, the others being rare and possessing no especial merit. The bronze is the heaviest, the required weight of the adult male being 32 lb. and that of the female 22 lb. There are three varieties of guinea-fowls—the pearl, white, and bronze. They are not recognized in the list of domestic breeds and find no sale in market. On farms, however, they are regarded as excellent layers and their flesh is considered delicate. The period of incubation is the same as that of the turkey, and their habits are nearly the same in the domesticated state.

Aquatic Fowls.—Geese are separated into the Toulouse, Embden, African, Canada, Egyptian, White China, and Brown China breeds, all rare except the first two. Of ducks there are the Pekin, Aylesbury, Rouen, White Muscovy, Colored Muscovy, and Cayuga, all well-known breeds. The Call and East Indian are very small and are seldom kept on farms. The crested duck is bred more as a novelty than for practical purposes. The Muscovy ducks differ from the others in requiring a longer period for incubation and in producing sterile progeny when crossed with other breeds; the cross-bred female lays eggs which will not hatch. It is therefore doubtful if the Muscovy is really a duck; its period of incubation and habits approach more nearly those of the goose. See Goose and Duck.

Feeding.—Laying hens require food of a character entirely different from that suitable for non-producers. An egg is composed of 12½ per cent. of albumen, 21 per cent. of oil and fat, and 10 per cent. of mineral matter, the greater proportion of the egg being water. As grain is deficient in lime and is largely starch, it has a tendency to fatten rather than to supply the elements composing the egg. Digestion and assimilation are promoted when the food is varied, and egg-production is increased when the ration is well balanced. The individual characteristics of the hens must be considered, as no two hens are alike even when of the same breed, one requiring more food than another and preferring kinds that may not be acceptable to her companions. Bulky food—such as chopped grass, clover, vegetable tops, cooked potatoes, and turnips—is essential because grain is too concentrated. Pounded bones, meat, and milk should always be included in the ration, as they are highly nitrogenous and seldom fail to promote laying.

It is difficult to prescribe a routine course of feeding. During the winter season the first essential is warmth, which is promoted by shelter and a liberal supply of grain. Ground food, scalded, is excellent as a morning meal, or the ground grain may be mixed with clover hay which has been cut very fine and scalded. The allowance of food should be light, and to induce the hens to exercise a small quantity of millet seed should be scattered in cut straw, leaves, or litter of any kind. No food should be given at noon. Late in the afternoon about 1 lb. of chopped lean meat or ground bone may be allowed twenty hens, after which wheat or corn, or both, should be scattered over the ground in order that the hens may exercise in securing it. Troughs should not be used except when feeding moistened ground grain. During the summer months the hens can secure all food required on a range, as grass, seeds, and insects will be abundant. Water should be at all times where it can be procured easily by

the fowls. No fixed allowance of food for a flock can be determined upon, especially when the food is varied. It will require about 5 pecks of corn, or its equivalent, to support a hen for a year.

Turkeys and guinea-fowls thrive best on a range, and are capable of securing the whole of their food during the greater portion of the year. A meal, composed of corn or wheat, given at night, will induce them to come up regularly to roost near the dwelling-house. In winter they should have grain twice a day. Geese and ducks are partial to green foods, and if grass is abundant they will have no difficulty in securing food in summer. A meal of cooked turnips, thickened with bran, given twice a day in winter, with a supply of chopped clover hay, scalded, will keep them in good condition.

Care of the Young.—Chicks are hatched at a temperature of 103°. Hens seldom become broody during the winter season, and many poultrymen resort to incubators and brooders during that period. No food is required for thirty-six hours after hatching. The chicks should be given dry food in preference to dough of any kind. Oatmeal, or rolled oats, should be kept in a little trough before them, and three times a day they should be fed on a mixture of equal parts, by weight, of corn meal, middlings, sifted ground oats, and ground meat, moistened and cooked as bread. When ten days old they should receive cracked corn, wheat, finely cut clover (scalded), cooked potatoes or turnips, or anything that will be acceptable. They should be kept warm and dry; water should be given in vessels that permit them to wet their beaks only. Young turkeys require food that is highly nitrogenous, as they grow feathers so rapidly as to become debilitated, while the least dampness is injurious. They may be fed in the same manner as chicks, but, in addition, should be given chopped eggs that have been boiled, finely chopped onion-tops, milk curds, and cooked lean meat. Goslings and ducklings require soft food, such as cooked turnips or potatoes, with ground grain of any kind, given in troughs. Water must be supplied freely for drinking purposes, but they should not be allowed on ponds until well feathered, as they may become chilled and perish.

Management.—Lice and disease are the chief drawbacks. If the poultry-houses are kept clear of lice the fowls can then rid themselves of vermin by the use of the dust-bath. Drenching the poultry-house with an emulsion of kerosene is the most effective remedy. Large gray lice destroy many young chicks and turkeys; anointing the heads with a few drops of sweet oil is the remedy. Roup is the most prevalent disease among gallinaceous birds, and exists in many forms, the symptoms being hoarse breathing, swelled eyes and heads, discharge from the nostrils, and in the malignant or contagious form it is accompanied with a very foul odor, the birds gradually drooping. There is no remedy for the disease, the most economical method being to destroy the sick birds and thoroughly to clean and disinfect the premises. Cholera is a rare disease, the supposed cases being mostly indigestion resulting from overfeeding. There is no sure remedy for cholera, but good results have been obtained by adding a teaspoonful of liquid carbolic acid to each quart of drinking-water. The symptoms are greenish droppings, intense thirst, prostration, and death or relief within forty-eight hours. Chicks should not be kept with adults until well advanced in growth, and pullets intended for laying the next season will thrive best when not with the young cockerels. The poultry-house should be cleaned daily, and if the flock is confined in yards it will be an advantage to have two yards for each flock, so as to change from one yard into the other. The unoccupied yard should be used for growing green food, the top soil being turned under; in this way the yards can be kept clean. Poultry will always give the best results on a range, and an orchard serves the purpose well. Although prices of eggs are higher in winter than in summer, the small cost of the food and the larger number of eggs secured afford a greater profit on poultry and eggs in summer than in winter. Poultry-houses should be well lighted with windows, as fowls will not remain in a dark poultry-house during the day even if the weather is stormy. The decimal system will serve to guide in making many estimates. Only ten hens should be allowed with one male, ten chicks in one brood are a sufficient number, and ten hens should have a house 10 feet square. Ten weeks is enough for a chick to make sufficient growth to reach the market, and the pullets of the large breeds should begin to lay when ten months old.

Although aquatic birds prefer to have access to a body of water, yet they are very susceptible to dampness, and will thrive best when kept in houses having board floors, upon which straw should be placed. Turkeys always seek high roosts, and should be given an open shed with the roosts near the roof as a protection against storms. When compelled to roost in the open air they become liable to roup, a disease which destroys a large number of them.

PATRICK H. JACOBS.

Pound: See AVOIRDUPOIS and WEIGHTS AND MEASURES.

Pound-nets: See FISHERIES.

Pound Sterling: a denomination of English money, equal in value to 20 shillings, or 240 pence, into which a pound of silver was anciently divided, thus giving origin to the term "pound." The word "sterling" is of obscure origin, but probably is derived from *Easterling*, the popular name of the Baltic and German traders who visited London in the Middle Ages. The silver penny was first called Easterling. See COINAGE.

Poussin, GASPARD: See DUGHET.

Poussin, poo'săn', NICOLAS: painter; b. at Villers, in Normandy, June, 1594. Quintin Varin, of Les Andelys, taught him painting. He went to Paris at the age of eighteen and studied there for a time. He was not able to get to Rome till the age of thirty. There he lived with Du Quesnoy, afterward called Il Fiammingo; this artist was of much service to him in the development of his style. Poussin studied anatomy in Rome and attended the academy of Domenichino. He endured great poverty until Cardinal Barberini, who had been ambassador in France and Spain, took him under his protection on his return to Rome, and commissioned him to paint two pictures—*The Death of Germanicus* and *The Capture of Jerusalem*. The patronage of the cardinal brought him good fortune and when, after an absence of sixteen years, he returned to Paris he was introduced to Louis XIII. by Cardinal Richelieu. The king gave him the appointment of court painter with rooms in the Tuileries and a salary of 120 francs a year. He returned to Rome to fetch his wife, but as Louis XIII. died about this time Poussin spent his remaining years in Rome. He died Nov. 19, 1665, and was buried in San Lorenzo in Lucina. More than 200 prints have been engraved after his pictures. Poussin had an immense influence in landscape-painting. Gaspard Dughet was his brother-in-law and pupil. W. J. STILLMAN.

Pout: See BIB.

Pouter: a breed of pigeons characterized by the great dilatation of the gullet, which can be distended with air until the neck assumes a globular shape. This is simply the swelling of the neck seen during the act of cooing, carried to a greatly exaggerated condition by selection. The legs are long and feathered, tail and wings long, the latter pointed and weak. The pouter has one more pair of ribs and two more presacral vertebræ than ordinary pigeons. F. A. L.

Powder: See EXPLOSIVES and GUNPOWDER.

Powderly, TERENCE VINCENT: labor leader; b. at Carbondale, Pa., Jan. 22, 1849; attended a district school; was switch-tender on the Delaware and Hudson Railroad 1862–64; car-repairer 1864–66; served apprenticeship at machinist's trade 1866–69; removed to Scranton, Pa., 1869; worked as a machinist until 1877; elected mayor of Scranton 1878; re-elected 1880, 1882; elected general master workman, Knights of Labor, 1879, and held office until 1894; admitted to the bar 1894. He has lectured on industrial questions in the principal cities of the U. S. and Canada; has published *Thirty Years of Labor*, and is a contributor to *The Journal of the Knights of Labor*, *The North American Review*, and other periodicals.

Powell, BADEN, F. R. S.: mathematician and theologian; b. at Stamford Hill, near London, Aug. 22, 1796; educated at Oriel College, Oxford, and graduated 1817; took orders in the Church of England; became vicar of Plumstead 1821; was Savilian Professor of Geometry at Oxford from 1827 till his death in London, June 11, 1860. He contributed to scientific periodicals, wrote mathematical treatises, and among his other works are *The Connection of Natural and Divine Truth* (1838); *The Order of Nature considered in Reference to the Claims of Revelation* (1859); and an essay *On the Study of the Evidences of Christianity*, in the celebrated volume entitled *Essays and Reviews* (1860).

Powell, F. YORK: See the Appendix.

Powell, JOHN WESLEY, Ph. D., LL. D.: geologist and anthropologist; b. at Mt. Morris, N. Y., Mar. 24, 1834. The

son of a Methodist minister, his youth, in Ohio, Wisconsin, and Illinois, was attended with hard work, exposure, and privation. He studied as he had opportunity at Illinois, Wheaton, and Oberlin Colleges, teaching meantime and making scientific collections. During the civil war he rose from the ranks to a lieutenant-colonelcy in the Second Illinois artillery, and lost his right arm at Shiloh. In 1865 and 1866 he served as professor in the Wesleyan College and the Illinois Normal University successively, and during the next year he led an exploring party through the hitherto unvisited canyon of the Colorado river. The success of this expedition caused Congress to authorize a survey of this mysterious river and the Rocky Mountain region and to place Maj. Powell at its head. In 1879 the four separate surveys operating in the Territories were consolidated, named the U. S. Geological Survey, and made a bureau of the Department of the Interior, and the same year the Bureau of Ethnology was organized with Maj. Powell as its chief, as a part of the Smithsonian Institution. The next year, on the retirement of Clarence King, Maj. Powell became director of the survey also. The reports and monographs issued under his direction have been the handsomest and most valuable publications of the Government, and in 1891 the French Academy awarded to him and his scientific corps the famous Cuvier prize. He has received degrees from Harvard and Heidelberg, is a member of the chief scientific societies of the U. S., of some of which he has held the presidency, and has been made honorary or corresponding member of the important scientific societies in all countries. In the summer of 1894 he resigned his position as director of the Geological Survey, but retained that of the Bureau of Ethnology. Among his best known books are *Exploration of the Colorado River* (1875); *Report on the Geology of the Uinta Mountains* (1876); *Report on the Arid Region of the United States* (1879); *Introduction to the Study of Indian Languages* (1880); *Studies in Sociology* (1887); *Canyons of the Colorado* (1893).

Powell, Maud: See the Appendix.

Power, Henry, M. B. Lond., F. R. C. S.: ophthalmologist; b. at Nantes, France, Sept. 3, 1829; studied medicine at St. Bartholomew's Hospital, London, becoming in 1851 a member, and in 1854 a fellow, of the Royal College of Surgeons; subsequently became a member of the council and vice-president of that body; was appointed ophthalmic surgeon and lecturer on diseases of the eye at St. Bartholomew's Hospital; was lecturer on physiology at the Westminster Hospital, and edited the 6th, 7th, 8th, and 9th editions of *Carpenter's Principles of Human Physiology*; was examiner in natural sciences for the Universities of Oxford and Cambridge; was co-editor of *A Biennial Retrospect of Medicine and Surgery* from 1865–74. While he has practiced his specialty, ophthalmology, he is equally well known as a physiologist. His important works are *Illustrations of some of the Principal Diseases of the Eye* (London, 1868) and *Elements of Human Physiology* (1884). S. T. Armstrong.

Power, Tyrone: actor; b. in County Waterford, Ireland, Nov. 2, 1797; removed to Wales in early life; made his *début* at the Cardiff theater; retired from the stage for several years; played in the principal cities of England, including London; excelled in the delineation of Irish characters. During his last engagement at the Haymarket theater Power's salary was advanced to £150 per week. He made successful tours in the U. S. 1833–35 and 1840–41, and embarked for Europe Mar. 11, 1841, in the steamship President, which was never heard of afterward. He wrote two novels and *Impressions of America* (2 vols., London, 1835).

Power-loom: See Loom.

Power of Attorney: a written instrument conferring upon one person the power to act for another. It is a deed, or sealed instrument, at common law; but modern statutes frequently dispense with the seal. It ordinarily contains the name of the principal, the name of the agent, a precise statement of the authority conferred, with a declaration that the principal ratifies and confirms all authorized acts of the agent, and the seal and signature of the principal. Often it gives to the agent the power to substitute a third person in his stead. A power of attorney may be revoked, unless the power is coupled with an interest. See Agent.

Francis M. Burdick.

Power, Polyphase Transmission of: See the Appendix.

Powers: in the real property law of England and the U. S. an authority vested in one person to dispose of an estate which is vested in another. It may be created by the deed or will by which the estate itself is conveyed, and the power to make a further disposition of the estate may be reserved by the person making the conveyance, or may be conferred by him on the grantee of the estate or on a stranger. A usual mode of creating a power at common law is for the grantor or donor of the estate to convey it by deed or will to A for life, at the same time giving A the power to appoint, by deed or will, the person who should have the estate after A's death. Here the grantor of the estate is called the *donor* of the *power*. A is known as the *donee* or *appointer*, and the person designated by A to take the estate after the termination of his own life-estate is called the *appointee* under the power.

The effect of the execution of the power by A is to vest the estate at once in the appointee, and the latter is considered to have derived his estate, not from A (who was never seised of it himself), but from the original donor, and through and by virtue of the will or deed by which the power of appointment was created.

The institution of powers was one of the devices of the great land-owners for tying up estates for the benefit of their families and for restricting, to some extent, the alienation of the estates by their immediate descendants. They owed their origin to that highly artificial but flexible system of conveyancing which resulted from the operation of the Statute of Uses. (See Uses.) They have greatly diminished in importance but are still in use in England and in the U. S., though in many of the States their use is much restricted by statute. The principal employment of powers at the present time is to confer on executors or trustees the authority to sell lands under a will, for the payment of debts, legacies, or for other purposes. Where such a power is given, without any estate in the land, it operates by way of executory devise in favor of the person to whom the land is sold under the power, and the purchaser takes as devisee under the will and not by way of conveyance from the trustee or executor. The fee in the meantime goes to the heir until the power is executed; but where the land itself is devised to the trustee or executor for the purpose of the sale, the purchaser derives his title from him and not from the will.

The leading treatise on this intricate branch of the law is Sugden on *Powers*. See also *American and English Encyclopædia of Law*, article *Powers*. George W. Kirchwey.

Powers, Hiram: sculptor; b. at Woodstock, Vt., July 29, 1805. In 1817 his parents removed to Cincinnati, O., where he lived until 1835, and where he began his life work by learning to take casts from models and by making wax figures for a museum. In 1835 he went to Washington, D. C., where he constructed a revolving *jet d'eau* for the Capitol grounds, and modeled the heads of several distinguished men, including J. Q. Adams, Jackson, Van Buren, Webster, Calhoun, and Preston. After spending two winters in Washington, Powers, with the assistance of friends, removed to Florence, Italy, in 1837. His busts acquired a reputation for fidelity to nature and the highest possible finish, and the insufficiency of his pecuniary resources obliged him to confine himself to this branch of his art to the extent of his orders; but he devoted every spare moment to ideal work, and the *Greek Slave*—finished in 1843, and purchased by Alexander T. Stewart—secured for its author a certain position among modern sculptors. Many repetitions of this statue were made, most of them for England. In the winter of 1872–73 his already declining health became so impaired that he was obliged to discontinue work, and on June 27, 1873, the sudden rupture of a blood-vessel closed his life. Besides the above-named works, Powers executed a large number of ideal busts of great merit, as well as many statues; among the latter, those of Washington, *The Fisher Boy*, *America*, *Eve Disconsolate*, and *The Last of the Tribes*. Revised by Russell Sturgis.

Powers, Mechanical: See Mechanical Powers.

Powhatan': the principal chief of several confederate clans or tribes of Eastern Virginia at the time of the settlement of Jamestown in 1607, usually called "emperor" by the early writers, though the number of his subjects was estimated at only 8,000. He was hostile to the English, with whom he repeatedly came into collision. Powhatan's principal residence was at Werowocomoco on York river, within the present limits of Gloucester County, where he maintained considerable pomp, being always attended by a body-guard of four warriors. D. in Apr., 1618.

Pownall, Thomas, LL. D.: statesman; b. at Lincoln, England, in 1722; graduated at Cambridge 1743; became secretary to the commissioners for trade and plantations 1745; went to New Jersey as secretary of that province 1753; became lieutenant-governor 1755; was a member of the colonial congress which met at Albany in 1754 to devise measures of defense against the French; was Governor of Massachusetts 1757–60, of South Carolina 1760–61, after which he became director-general of the office of control; sat in Parliament, where he opposed in many well-considered speeches the rash policy of the crown toward the American colonies; published *The Administration of the Colonies* (1766); *A Topographical Description of the Middle British Colonies* (1775); and many other works on archæology and politics. D. at Bath, England, Feb. 25, 1805.

Poynter, Edward John: historical painter; b. in Paris, of English parents, Mar. 20, 1836; studied at the Royal Academy, London, and under Gleyre in Paris; Royal Academician 1876; Slade Professor of Fine Arts at University College, London, 1870–75; director of the art schools at South Kensington Museum 1875. One of his most celebrated works is *Atalanta's Race* (1876), and he has executed noteworthy frescoes in St. Stephen's church, Dulwich, and mosaics in the Houses of Parliament. Studio in London.
W. A. C.

Pozzi, pŏt'sĕe, Samuel Jean, M. D.: gynæcologist; b. at Bergerac, Dordogne, France, Oct. 3, 1846; studied medicine in Paris, graduating M. D. in 1873; in 1875 became associate professor in the faculty, and in 1877 surgeon to the hospitals; paid special attention to gynæcology, and is one of the most prominent of European specialists. His most important work is *Traité de gynécologie clinique et opératoire* (Paris, 1890).
S. T. Armstrong.

Pozzo di Borgo, pot'sō-dĕe-bōr'gō, Carlo Andrea: diplomat; b. at Alata, in Corsica, Mar. 8, 1764; studied law at the University of Pisa, and settled as an advocate at Ajaccio, where he lived in great intimacy with Joseph and Napoleon Bonaparte. This friendship soon cooled, however, and the relation between the former friends assumed a very bitter character when Pozzo di Borgo espoused the cause of Paoli, who showed great confidence in him. In 1791 he represented Ajaccio in the National Assembly, and sided with the Girondists, but returned to Corsica in 1792; held a high position in the government of the island during its occupation by the British, and fled, after their expulsion, to London. Here he became the agent of the French *émigrés*, and began his flying missions from one court to another to form plots and coalitions against France. In 1803 he entered the Russian diplomatic service, and the interest which Alexander I. took in him gave an opportunity of gratifying his hatred of the Bonapartes. The intimacy which sprang up between Napoleon and Alexander after the Peace of Tilsit brought him for a moment into great danger, and he went first to Austria and then to England, never ceasing to work for the downfall of Napoleon. In 1812 the Czar recalled him to St. Petersburg. He induced Alexander to continue the war in 1813, and he persuaded the allies to reject Napoleon's offers of peace. He wrote the famous proclamation which preceded the entrance of the allies into France—that they waged war against Napoleon, not against the French people—and he had at last the triumph of signing the Treaty of Paris in 1815 as Russian ambassador. After the fall of Napoleon he remained in the Russian service, and enjoyed great esteem from the Russian court, though perhaps not always full confidence. In 1825 the Emperor Nicholas made him a count. He was for several years ambassador in Paris, where he was the oracle of the doctrinaires and detested by the radicals. In 1834 he was appointed ambassador in London, but retired from public life in 1835. D. in Paris, Feb. 15, 1842. See Vuhrer, *Notice biographique sur le Comte Pozzo di Borgo* (Paris, 1842).

Pozzuolana, pŏt-soo-ō-laa'nă: a rock possessing the properties of hydraulic lime or cement, so called from the village of Pozzuola, near the base of Mt. Vesuvius, where it was first discovered. The word is applied to the pozzuolanas proper, tras or terras, the arènes, some of the ocherous earths, and the sands of certain graywackes, granites, basalts, etc. Their principal ingredients are silica and alumina, the former largely preponderating, and most of them contain small quantities of soda and potash, and the oxides of iron and manganese. When finely pulverized, even without previous roasting, and combined with a paste of common lime, a hydraulic mixture is produced which will compare favorably with the mortars of hydraulic lime and sand. Pozzuolana itself was known to both Vitruvius and Pliny, and it was extensively used by the Romans before their day. Vitruvius gives a formula which, with slight variations, has been followed in Italy ever since: 12 parts of pozzuolana, well pulverized; 6 parts of quartzose sand, well washed; and 9 parts of rich lime, recently slaked. This constitutes the mortar. To this is added 6 parts of broken stone, porous and angular, when it is intended for concrete or monolithic masonry.

Tras closely resembles pozzuolana, and is employed substantially in the same way. It is found on the Rhine between Mayence and Cologne, and in various localities in Holland. The arènes are a species of ocherous sand, containing so large a proportion of clay that they can be mixed into a paste with water without the addition of lime, and used in that state for pisé work, as well as for common mortar. Mixed with rich lime, they yield hydraulic mortars of considerable energy. Many of the natural pozzuolanas are improved by a slight roasting, and an artificial pozzuolana may be produced by subjecting clay to a slight calcination. Brick-dust mixed with common lime gives a feebly hydraulic mortar. Forge scales from the smith's anvil, the slags from iron-foundries, and the ashes from lime-kilns, containing cinders, coal, and lime, are artificial pozzuolanas.
Revised by Mansfield Merriman.

Pozzuoli, pŏt-soo-ō'lĕe (Gr. Δικαιαρχία; Lat. *Puteoli*): town in the province of Naples, Italy; on the northern shore of the Bay of Pozzuoli, about 6 miles W. of the city of Naples (see map of Italy, ref. 7–F). The streets are narrow and irregular, and many of them very steep. Among the buildings there is little of interest except the cathedral of St. Proculus, which occupies the site of a temple erected to Augustus by L. Calpurnius. The neighborhood of Pozzuoli, however, abounds in interest for the archæologist. The famous temple of Serapis consisted of a rectangular court inclosed by forty-eight massive columns, and having in the center a round temple with sixteen Corinthian pillars of African marble. The statue of Serapis is now in the National Museum of Naples. The amphitheater erected in the time of the Flavian dynasty accommodated 30,000 spectators. There are besides minor ruins, among which are a temple of Neptune and a temple in honor of Hadrian, which was built on the site of Cicero's villa. In 194 B. C. Puteoli was colonized from Rome, and afterward became the most important commercial port in Italy. Later it was sacked by Alaric (410), Genseric (455), Totila (545), and the Turks (1550), and ruined by earthquakes in 1198 and 1538. In 1888–90 military engineering works, a branch of the Armstrong works at Newcastle, were established here. Agriculture, fishing, soap-making, etc., are carried on. Pop. 11,967.

Practice: in law, the form and manner of conducting suits or prosecutions (whether legal or equitable, civil or criminal) through the necessary steps according to the principles and rules governing in the several courts. The scope of the meaning of the term is not definitely settled, but it is generally used as excluding the principles and rules of both pleading and evidence, and referring rather to the formal method and course of bringing matters pleaded to trial and proof, and of enforcing judgment. The jurisprudence of every civilized country, ancient or modern, has established certain formal modes in which proceedings before public tribunals must be conducted, as being in general promotive of public justice, and contributing to private convenience. The rules of practice are to a large extent fixed by custom or statute, but the judges of the different courts are very generally intrusted with a large discretionary power of changing them. See the general treatises of Chitty and Daniell (Chitty, common practice law; Daniel, chancery, or equity, practice) and the numerous special treatises on the practice of the various courts.
F. Sturges Allen.

Pradier, James: sculptor; b. at Geneva, Switzerland, May 23, 1792. In 1809 he entered the studio of Baron Lemot, and by special favor was exempted from the conscription even in the height of Napoleon's demands upon his empire. In 1813 he won the Grand Prix de Rome by his bas-relief of *Philoctetes and Ulysses in Lemnos*. He then spent the usual time of five years in Rome, and on his return exhibited a *Nymph*, now in the Museum of Rouen, and other works. During another stay in Italy, before 1823, he produced three statues, which were bought by the Government for the Luxembourg Museum—a *Venus*, a *Psyche*, and a *Son of Niobe*. Then came a number of important works

for the churches of Paris and Versailles, a *Venus* now in the Museum of Orleans, a group of the *Three Graces* which stands in the Museum of Versailles, the colossal allegorical statues of *Strassburg* and *Lille* on the Place de la Concorde in Paris, several statues for the fountain of Molière near the great National Library, the *Twelve Victories* of the tomb of Napoleon in the Church of Les Invalides, statues for the funeral chapel of the royal family at Dreux, four bas-reliefs, *Fame* for the Arc de Triomphe, and a great number of smaller works in public and private collections. He was always as classical as he knew how to be, but his work has a feminine grace which he did not find in his Græco-Roman models. D. at Bougival, near Paris, June 14, 1852.

RUSSELL STURGIS.

Pradier-Fodéré, PAUL LOUIS ERNEST: publicist; b. at Strassburg, July 11, 1827; studied law in Strassburg, and was admitted to the bar of Paris in 1857, and made Professor of Public Law in the Armenian College of Moorat; appointed in 1874 by the Peruvian Government to organize the instruction in the studies of political and administrative sciences in the University of Lima. At the end of the war with Chili he returned to France and was made *conseiller* (judge) of the court of appeal of Lyons June 3, 1882; Chevalier of the Legion of Honor. He has published, besides other works, *La Question de l'Alabama et le Droit des Gens*; *Commentaire sur le Code de Justice Militaire*; *Traité de Droit International Public, Européen et Américain*; *Droit de la Guerre et de la Paix* (translation of the work by Grotius); *Précis de Droit Administratif*; *Traité de Droit Commercial*.

F. STURGES ALLEN.

Pradon, prăă'dōñ', NICOLAS: dramatic poet; b. at Rouen, France, 1632; went early to Paris and devoted himself to literature. Of very mediocre poetic gifts, he was yet able to enjoy a great temporary reputation as a tragic poet, profiting by the jealousies excited by the popularity of Racine. His *Phèdre et Hippolyte* (1677), played a few days after the *Phèdre* of Racine, appeared, by an intrigue of Racine's enemies, to have a striking triumph over it, which led Racine to renounce the drama. D. in Jan., 1698. A. G. C.

Praed, prād, WINTHROP MACKWORTH: poet; b. in London, July 26, 1802; educated at Eton; was the associate of John Moultrie and H. N. Coleridge in editing *The Etonian*; entered Trinity College, Cambridge, and graduated 1825; contributed to Knight's *Quarterly Magazine*; was called to the bar 1829; sat in Parliament as a Conservative for St. Germain, and subsequently for Great Yarmouth and Aylesbury; became secretary of the board of control 1834, and afterward recorder of Barnstaple and deputy high steward for the University of Cambridge. He wrote essays and graceful *vers de société* for the magazines. D. in London, July 15, 1839. His *Poems* were edited in New York by R. W. Griswold (1844), and, with a *Memoir*, by W. H. Whitmore (2 vols., 1859), and a complete edition, with a memoir by Rev. Derwent Coleridge, was issued by his sister, Lady Young (2 vols., 1864). His prose essays were published in 1887 and an edition of his political poems in 1888.

Præneste: See PALESTRINA.

Præraphaelites: See PRERAPHAELITES.

Præ'tor [= Lat., for **præitor*, one who goes before, deriv. of *præire*, go before; *præ*, before + *ire*, go]: in ancient Rome, a magistrate created by the Licinian law of 367 B. C. as "lesser colleague" of the two consuls. In practice, however, the functions of the prætor were quite exclusively judicial. He was obliged to remain in the city, and from this fact was called the *prætor urbanus*. About the middle of the third century B. C., with the increase of the city's population, an additional prætor was named and given jurisdiction over the foreigners resident at Rome, and hence called the *prætor peregrinus*. With the expansion of Roman territory new prætors were added until in the reign of Claudius (41–54 A. D.) there were eighteen, though not all of them exercised judicial functions. In the early part of the first century B. C. the custom was inaugurated of practically extending a prætor's term of office by sending him out as governor of a province on the expiration of his year of service in the city. By their decisions as judges, and especially by their edicts or official announcements of the principles on which jurisdiction would be based, the prætors became most important agents in the development of the Roman law.

G. L. HENDRICKSON.

Prætorians [from Lat. *prætō'rium*, or *cohors prætō'ria*, prætorium, prætorian cohort, orig. the body-guard of a general (Lat. *prætor*, prætor, general), later of the emperor]: the personal guard of the Roman emperors. During the time of the republic the general in command had a guard, a *cohors prætoria*, which consisted of picked soldiers from the legions, whose only mark of distinction from the common soldiers was the bravery or devotion which had commended their selection. At the end of a campaign this guard was always dissolved and its members returned to the legions. Augustus, however, transformed (in 27 B. C.) his *cohors prætoria* into a standing body of troops, consisting of ten cohorts, each numbering 1,000 men (horse and foot), of which he kept three in Rome for service in the palace, while the rest were stationed in the neighborhood of the metropolis. Tiberius gathered all the cohorts to Rome for the sake of maintaining a better discipline, and built them a fortified camp in the northeastern corner of the city, and Vitellius increased their number to sixteen cohorts. Originally, only Italians were employed in this guard, but later others were admitted from regions which had become thoroughly Romanized. The term of service was sixteen years; the pay double that of the legions; the rank of a private of the guard equal to that of a centurion in the legions; and when the time of service expired each soldier received 20,000 sesterces. In the hands of ambitious and unscrupulous prefects their political influence was often superior to that of emperor or senate. They were the murderers of many of the emperors, none of whom could maintain themselves without their aid, and their voice was often the controlling one in determining the imperial succession. In the remodeling of the Roman military system by Constantine the prætorian guard was abolished.

Revised by G. L. HENDRICKSON.

Pragmatic Sanction: a diplomatic term which originated with the Byzantine court, and denoted the highest and most solemn state ordinances issued by the emperor. It was early introduced into France, and has become historical as applied to four important instruments—namely, (1) that by which Charles VII. and the States-General of France, assembled at Bourges in 1438, adopted those decrees of the Council of Basel which authorized the election of bishops by cathedral chapters, and which were condemned by the pope. (See GALLICAN CHURCH.) (2) That by which the same decrees were adopted by the German Diet, assembled at Mentz in 1439. (3) That by which Charles VI., Emperor of Germany, who had no male issue, settled the right of succession to his Austrian dominions on his daughter, Maria Theresa. It was accepted by the various peoples over which he ruled, consented to by the different members of his family, guaranteed by all the European states, but immediately after his death (Oct. 20, 1740) the war of the Austrian Succession (see SUCCESSION WARS) broke out. (4) That by which Charles III. of Spain in 1759 settled the right of succession to the kingdom of the Two Sicilies on his third son, Ferdinand.

Prague (Germ. *Prag*: Czech, *Praha*): the capital of Bohemia, Austria; in lat. 50° 5′ N., lon. 14° 25′ E.; on both sides of the Moldau, 217 miles by rail N. N. W. of Vienna (see map of Austria-Hungary, ref. 3–D). It presents a picturesque and imposing aspect on account of the diversity of the surface on which it stands and its numerous towers, spires, and domes. It was surrounded by a wall 12 miles in circumference, which, since 1866, has been to a great extent removed; outside this line extend the suburbs of Karolinenthal, Wyscherad, Weinberg, and Smichow. The city proper consists of five parts—the Altstadt, Neustadt, and Josephstadt on the right bank of the Moldau, and the Hradschin and Kleinseite on the left—connected with each other by several bridges, of which the most remarkable is the Karlsbrücke, built 1358–1503 of stone, 31½ feet broad, 1,572 feet long, resting on sixteen arches and adorned with statues. The Altstadt, consisting of narrow, crooked streets lined with tall, quaint old houses, the Neustadt, of a more modern and elegant appearance, and the Josephstadt, the Jewish city, form the business part of Prague; the Hradschin and Kleinseite consist almost exclusively of palaces and public buildings. Here is the imperial castle, one of the largest royal residences in Europe. The Hradschin Place, formed by the immense palaces of the primate, the ex-Emperor Ferdinand, and Prince Schwarzenberg, extends in front of the castle. On the terrace in the rear of the castle stands the cathedral of St. Vitus, a Gothic structure built 1343–85, and containing the tomb of St. Nepomuk, the patron saint of the country, with his monument of solid

silver weighing 30 ewt., and a mausoleum of Carrara marble erected by Rudolph II. over the Bohemian kings. Among the most prominent buildings of the Kleinseite are the so-called Sachsenhaus, built in the thirteenth century; the gorgeous Church of St. Nicolai, erected in 1628 by the Jesuits; the palaces of Waldstein with beautiful gardens, of Fürstenberg with a large library and a picture-gallery, of Nostitz with a collection of coins, a library, and an art gallery, etc. In the Altstadt is the church Am Teyn, the old Hussite church, founded in 1407, containing the monuments of the two Bohemian martyrs, Cyrillus and Methodius, and of the Danish astronomer Tycho Brahe. The university has a library containing 195,000 volumes and 3,800 MSS., a botanical garden, a laboratory, an observatory, and the faculties of theology, law, medicine, philosophy (which comprises also languages and history), and the exact sciences. It was founded in 1348 by Charles IV., and was frequented in the fifteenth century by about 10,000 students, but subsequently its importance decreased. It was reorganized in 1881 and now has two sides, one German and the other Czech. In 1892 the former had 152 teachers and 1,248 students, and the latter 152 teachers and 2,354 students. There is also a technical high school of engineering and chemistry with (1892) 117 teachers and 569 students. The suburb of Karolinenthal, which is of modern growth, has numerous fine buildings, public gardens, and manufacturing establishments; farther N. there are public walks on the Moldau and a great botanical garden. The commerce and industry of the city are considerable. Leather, glass, liqueurs, beer, spirits, chemicals, woolens, linens, metal ware, and machinery are manufactured. Prague was founded in the eighth century, and has ever since formed the leading center of the Czech community. After the connection with Austria, Bohemia was often dragged into wars entirely foreign to its interests, and Prague, as its capital and a strong fortress, has several times suffered severely from sieges and bombardments. In 1866 it was occupied by the Prussians without bloodshed, and a treaty was concluded here. About four-fifths of the inhabitants are Czech. Pop. (1890) of the town proper, 184,-109; with the suburbs (1893) 327,953.

Revised by R. A. Roberts.

Prairie [= Fr. < Late Lat. *prata'ria*, an extensive meadow, deriv. of *pra'tum*, meadow > Fr. *pré*, meadow]: a word applied by the early explorers of North America to the fertile, grassy plains of the Mississippi basin. Prairies are level or gently rolling, and free from trees. The origin of their even surface has been described under Plain (*q. v.*) as sheets of fine glacial drift, or beds of former lakes, or swamps, or deeply weathered plains of denudation. The absence of trees has been much discussed. It can not be ascribed to deficiency of rainfall, as is the case on the treeless Western plains, for over the prairies the rainfall is sufficient and well distributed through the year. It can not be ascribed to excess of heat or cold, for trees grow abundantly in forests farther S. and N., as well as along watercourses and on hilly interruptions of the prairies. Moreover, trees will flourish on prairies if they are artificially planted and cared for. The absence of trees is more plausibly ascribed to the prevailingly fine and close texture of the prairie soil, this explanation being particularly applicable to those smaller prairies formed by the gradual filling of swampy lakes with peaty growth and fine silt, and to those broader prairies that represent the bottom of glacial lakes. There is reason to think that the former prevalence of prairie fires, while the country was occupied by Indians, may have had much to do with retarding the invasion of trees into districts where they would naturally spread; for trees are invading certain prairies, now that the settlement of the region prevents the frequent recurrence of fires.

The prairie region of the upper Mississippi valley is of extraordinary richness agriculturally, and has tempted rapid settlement by emigration from Europe and from the older Eastern States; it is in this respect strongly contrasted with the semi-arid, treeless plains farther W.

The prairies need no clearing of trees or rocks, and they yield abundant crops. Their disadvantages are insufficient local supply of timber for building and fuel, scarcity of building stone and road metal, and generally a want of sufficient slope for good drainage. W. M. Davis.

Prairie-dog: any rodent of the genus *Cynomys*, which forms a part of the great squirrel family, whose members are closely related to the ground or prairie squirrels (*Spermophilus*). Why they were called *dogs* it is difficult to see, for they neither look, act, nor bark like those animals. They are considerably larger than the squirrels, being generally about a foot in length, exclusive of the tail, which is short and from about 2 to nearly 5 inches in length, according to the species. They inhabit the prairies of Western North America, congregate in large numbers, and form communities designated as "villages." They burrow to a considerable distance in the ground, throwing up around the mouths of the burrows hillocks on which they are wont to mount and from thence survey the doings of the community. Horses are sometimes thrown by stumbling into such burrows. Four species of *Cynomys* are recognized, the best known being *C. ludovicianus*, abundant on the plains from Kansas to the Rocky Mountains, and from Western Texas to 49° N. The fable still clings to this species that it lives in harmony with the burrowing owl (*Speotyto*) and rattlesnake, but when any two of the above-named animals are found together it is either due to accident or bodes ill to the young "dogs" or owls. *Cynomys mexicanus* is a more southern species, while *C. gunnisoni* and *leucurus* inhabit uplands.

Revised by F. A. Lucas.

Prairie du Chien, prā'rĕe-doo-sheen': city; capital of Crawford co., Wis.; on the Mississippi river, 3 miles from its junction with the Wisconsin, and the Burlington Route and the Chi., Mil. and St. P. railways; 70 miles N. by W. of Dubuque, Ia., 194 miles W. of Milwaukee (for location, see map of Wisconsin, ref. 7–C). It has a large river trade, numerous artesian mineral wells, several mills, machine-shops, and other manufactories, St. Mary's Institute, St. John's College, a State bank, and two weekly newspapers. Pop. (1880) 2,777; (1890) 3,131; (1900) 3,232.

Prairie-hen, or **Pinnated Grouse**: a peculiar form of the grouse family, the *Tympanuchus americanus*, restricted to the U. S. and found chiefly on comparatively open plains and prairies. The species is at once recognizable by the extension of feathers to the lower end of the tarsus, the air-bladders, and the long and lanceolate feathers of the sides of the neck, and the short, subtruncate tail; the former generic name (*Cupidonia*) alludes to the long neck-feathers, which have recalled to the imagination of some the wings of the fabled Cupid; beneath these feathers on each side is a bare and distensible air-sac developed in the male, and connected with the organs of voice. During the love season the male inflates the bladders, which then resemble small oranges, lowers his head to the ground, and opening his bill gives utterance to a single sound, produced partly by means of the air contained in these bladders, which are alternately filled and emptied as he makes his booming noise. If these sacs are punctured they are no longer resonant. The prairie-hen feeds chiefly upon berries of various plants, as well as upon the buds, and in some places encroaches considerably upon the domains of the farmer. This species ranges from Illinois westward to the foot-hills of the Rocky Mountains, and formerly abounded, but has been decimated by market gunners. It is replaced in the Southwest by *T. pallidicincta*. A very closely related species, *Tympanuchus cupido*, formerly inhabited portions of the eastern parts of the U. S., and in comparatively recent times was common on Long Island, but has now been almost exterminated, only a few individuals being left on Martha's Vineyard and Naushon. This bird was for a long time confounded with the Western species, and much confusion of names has arisen in consequence.

Revised by F. A. Lucas.

Prairie-squirrel: any member of the genus *Spermophilus*, of the family *Sciuridæ*, found in various parts of the U. S. These are simply squirrels frequenting the ground rather than the trees, and having a shorter tail than the tree-squirrels, and also provided with cheek-pouches. They live on the prairie-lands of the Western States and Territories, make burrows, and generally associate in considerable communities. Eleven species are now recognized as inhabitants of various parts of the U. S.; the best known are the *Spermophilus 13-lineatus* (striped gopher and prairie-squirrel of Illinois, Iowa, and adjacent States), and the *Spermophilus franklini* (great gopher of Illinois and corresponding latitudes upward to the Saskatchewan region). See also Sciuridæ.

Prairie-wolf: See Wolf.

Prâkrit Languages [*Prâkrit* is from Sanskr. *Prākṛta*, liter., natural, common, vulgar, vernacular, deriv. of *prakṛti*, origin]: in Hindu usage, all languages derived from San-

skrit as their common source (*prakṛti*); Sanskritists and linguists, however, restrict the connotation of this term to the languages immediately derived from Sanskrit, while they call those more remotely connected with it *bhâshâ*, vernaculars, or modern Prâkrits. This article refers to the Prâkrit dialects in the narrower signification of the word.

The source of the Prâkrit languages is not the literary Sanskrit which has been cultivated by the Brahmans as their sacred language, but popular idioms of perhaps equal antiquity, which may be regarded as constituting, together with literary Sanskrit, the Aryan dialects of ancient India. The Prâkrits are lineal descendants from them. There have been brought forward some very interesting speculations on the distribution of these old Indian dialects (see Hoernle's *Comparative Grammar of the Gaudian Languages*, London, 1880, p. xxxi. ff.), but no certainty is yet attainable.

Though the root of the Prâkrits is fixed in the ancient Indian dialects, they developed under the continued influence of the Sanskrit. Their constant dependence on it is more visible in the literary Prâkrits than it would have been in the popular language, but of the latter we know little or nothing. The development of the Prâkrits differs considerably from that of languages which were entirely left to themselves. Nearly all crude forms of Sanskrit words could at all times be borrowed by Prâkrit writers, provided that they were made to agree with the phonetic laws of the dialect; such words are called *tatsamas* when they are identical with their Sanskrit prototypes, and *tadbhavas* when their difference from them is caused by a phonetic change only. On their account all Prâkrits look more archaic than their long separation in time from their parent language would lead us to expect. This appearance, however, is deceptive, for many words of common use, as some verbs (called *thâtvâdeças*), numerals, pronouns, etc., which could not be borrowed from the sacred language, present forms which can not be brought under the well-known phonetic laws of Prâkrit. The same remark applies to the so-called *deçîs*—i. e. words used in the Prâkrits, which can not be derived from Sanskrit, or have a meaning different from their meaning in Sanskrit. The *Deçînâmamâlâ* of Hemachandra (ed. by Prof. Pischel in the Bombay Sanskrit Series, 1880) contains about 3,000 *deçî* words, most of which are, as would seem at present, without corresponding originals in Sanskrit. They are probably derived from such Sanskrit prototypes as belonged to the vocabulary of the common people, and were therefore beyond the remodeling influence of learned authors.

The oldest Prâkrits are the Pâli, the nearly cognate idioms of the inscriptions, ranging from about 250 B. C. to 200 A. D. The Prâkrits proper, which represent a more advanced phase in the development of the language, come next in time. Among them Paiçâcî seems to have preserved the most archaic character. In this language was composed the *Brhatkathâ* by Guṇâdhya, probably in the first century A. D. It has not yet been recovered, and we have but scant materials to form an idea of its language. Younger than it from a linguistic point of view, but older from a literary one, is the Jaina Prâkrit, or the language in which the canonical books of the Jains were written; but as these works were brought into their present shape many centuries after their composition, their language may have undergone alterations. As it is, it resembles the Mâhârâshṭrî dialect in most points, but it has many forms which may be older or be derived from other sources. The writer believes that the Jaina Prâkrit represents faithfully, on the whole, an old literary Prâkrit, and that the Mâhârâshṭrî is but a more modern and refined variety of it, which assumed its present form in order to be suitable for songs. The oldest work extant, written in Mâhârâshṭrî, is the *Saptaçatakam*, or collection of 700 stanzas by various older poets, edited by Prof. A. Weber (Leipzig, 1881), and in the *Kâvyamâlâ* (Bombay, 1889). Its reputed collector is King Sâtavâhana or Hâla, who lived probably about the second century A. D. Mâhârâshṭrî is considered by the Prâkrit grammarians as the standard Prâkrit; in it are composed all Prâkrit poems such as the *Sétubandha*, *Gaüḍavaha*, etc., and it has been used by Jaina writers in many non-canonical works in verse and prose. There is, indeed, a large literature extant in Mâhârâshṭrî. The other dialects are chiefly used in dramas in which nearly all women and some men, not of the highest rank, speak various Prâkrit dialects. The one most frequently employed is the Çaurasênî, but its use is almost entirely restricted to prose, while the same persons use Mâhârâshṭrî in their songs or verses. The remaining dialects, among which Mâgadhî, Ardhamâgadhî, Paiçâcî, Âvantikî are the most conspicuous, are reserved for persons of the lowest social, moral, or intellectual status, or to denote their local extraction. Most of these dialects are named after countries, probably after those where they were spoken. A third group of Prâkrit dialects which has undergone the greatest changes is collectively called Apabhraṃça, and is said to have been the language of *abhîras* or cowherds. These idioms seem to have been the forerunners of the modern vernaculars of India, and to have gradually merged into them. Yet they are apparently as old as the other Prâkrits, since they are used in one of Kâlidâsa's plays, and some Apabhraṃça peculiarities occur in metrical works of the Jaina canon.

All Prâkrits, Pâli included, differ from Sanskrit in the following points: (1) They have lost (*a*) the Sanskrit vowels *ṛ*; *ḷ*; *ai*; *au*, replacing them by *a*, *i*, *u*, *ri*; *ili*; *é* or *aï*; *ô* or *aü*; (*b*) the Visarga. (2) They have but one sibilant (rarely two), usually *s*, instead of the three sibilants in Sanskrit. (3) They do not admit groups of more than two consonants, which, besides, must never be dissimilar. (4) They shorten long vowels before two consonants (few exceptions in Pâli), and occasionally lengthen a short vowel when an original group has been reduced to one consonant. (5) At the end of words they allow only vowels and the *anusvâra*. (6) They have lost the dual number. Besides these special changes, the inflection, especially that of the verb, has been gradually simplified till in the most modern Prâkrits only few original forms are left.

In Prâkrit proper single consonants between vowels, which are generally retained in Pâli, are variously modified. In Mâhârâshṭrî the following consonants are dropped between vowels: *k*, *g*, *c*, *j*, *t*, *d*, *y*; they either disappear entirely or with the Jainas are replaced by a scarcely audible *y*. The aspirates *kh*, *gh*, *th*, *dh*, *ph*, *bh* become *h*. The cerebral surds become soft, *ḍ* becomes *l*; *ç* and *sh*, *s*; *p* and *b*, *v*; *n*, *ṇ*. The same changes occur in Çaurasênî except that the soft consonants, which are dropped or replaced by *h* in Mâhârâshṭrî, remain unchanged, and the surds become soft. This also applies to Mâgadhî which, besides, changes *r* to *l*, and the sibilants to *ç*. Paiçâcî as taught by the grammarians totally differs in this respect from Mâhârâshṭrî and the other dialects, as it retains all single consonants between vowels, and only changes *d* to *t*, *ṇ* to *n*. Except these two changes Paiçâcî scarcely differs from the Prâkrit of the inscriptions; its difference from Pâli consists in the grammatical structure of the language which is more like that of Prâkrit proper. In the subdialect Cûlikapaiçacî every soft consonant is changed to the corresponding surd. Jaina Prâkrit has an intermediate position between Paiçâcî and the standard Prâkrit, at least as regards single consonants; for it optionally retains them. It may be mentioned that it admits the dental *n* when it is initial or doubled or joined with *h*.

Initial single consonants undergo no change except *y*, which in Mâhârâshṭrî and Çaurasênî becomes *j*, while in Mâgadhî it retains its sound and even *j* is changed to *y*.

Conjunct consonants are treated in very much the same way as in Pâli (see the article on PÂLI); even those conjunct consonants which are admitted in Pâli, as *jv*, *lv*, *vy*, *yh*, *vh*, *tr*, *br*, *tv*, *sv*, *kv*, *sm*, are assimilated in Prâkrit to *jj*, *ll*, *vv*, *jjh*, *bbh*, *tt*, *bb*, *tt*, *ss*, *kk*, *mh*. In some points the dialects differ from one another. Thus Çaurasênî admits *yy* for *ry*, which in Mâhârâshṭrî is changed into *jj*, and Mâgadhî always has *yy* for the *jj* of the common Prâkrit. Mâgadhî retains *s* before other consonants and substitutes *st* for *tt* and *shṭh*, *st* for *sth* and *rth*, *çch* for *chchh*, the *jihvâmûlîya* and *k* for *ksh*; it shares with the Paiçâcî and the older Prâkrits the change of *ny*, *ṇy*, *jñ*, *ñj* to *ññ*, which corresponds to *nn* in the other dialects.

As regards the inflection of nouns and adjectives, stems ending in consonants generally drop the consonant or add a vowel, so that they practically become stems ending in vowels; but some stems in *n* and *r* have retained a few original inflected forms. Thus we have only three declensions: (1) stems in *a*; (2) stems in *i* or *u*; (3) the feminine stems in *â*, *î*, *û*. Following are the paradigms of the masculine in *a* and the feminines in *â*: Singular nom. *dêvô*; voc. *dêva*; acc. *dêvaṃ*; instr. *dêvêṇa(ṃ)*; dat. *dêvâê* (very rare); abl. *dêvâô*, *dêvâ*: gen. *dêvassa*; loc. *dêvê*, *devammi*. Plural nom. voc. *dêvâ*; acc. *dêvê*; instr. *dêvêhi(ṃ)*; gen. *dêvâṇa(ṃ)*; loc. *dêvêsu*; abl. *dêvêhiṃto*, *dêvêsuṃto* (not frequent). Sing. nom. *mahilâ*; voc. *mahilê*; acc. *mahilaṃ*; abl. *mahilâo*; instr. gen. loc. *mahilâe*. Plural nom. voc.

acc. *mahilâo*, etc. Nom. acc. plural of neuters *vaṇâiṃ* or *vaṇâṇi*. In Çaurasênî the abl. is *dêvâdô*; loc. only *dêvê*; acc. plur. *dêvâ*. The pronouns differ only in the gen. plur., which may be *têsiṃ*, *tâsiṃ*, or *tâṇaṃ*. The personal pronouns have developed many new forms, most of which can be accounted for by the principle of analogy.

Prâkrit has suffered the greatest loss of forms in the conjugation of verbs. Of original tenses it possesses but the present with its modes (indicative, optative, and imperative) and the future. The present or, more usually, the past passive participle is substituted for the original past tenses—the imperfect, perfect, and aorist. The Âtmanêpadam is lost, except the third person singular and plural, which are occasionally met with. There is but one set of endings: *mi*, *si*, *i*; *mo*, *ha*, *nti* (in Çaurasênî, *mi*, *si*, *di*; *mha*, *dha*, *nti*). The imperative has peculiar endings in the second person singular: *hi*, *su* (Çaurasênî, *ssa*); third sing. *u* (Çaurasênî, *du*); third plural *ntu*.

The original variety of stems has given way to great simplicity: all stems of the present end in *a* or *ê*, few in *â* or *ô*. From this stem the modes and tenses are derived. Following are the Mâhârâshṭrî forms of the third person singular of a verb in *a*: Present, *bhaṇai*; imperative, *bhaṇau*; optative, *bhaṇejjâ*; future, *bhaṇissai* or *bhaṇihii*. The participle of the present is *bhaṇanta*, *bhaṇamâṇa*; of the future, *bhaṇissanta*, *bhaṇissamâṇa*; the infinitive is *bhaṇiuṃ*; the gerund, *bhaṇiuṃ*, *bhaṇiya*, *bhaṇittâ*; the future pass. part., *bhaṇiyavva*, *bhaṇaṇijja*; the perfect pass. part., *bhaṇiya*. There are, however, many irregular forms which in truth are generally the regular Sanskrit forms. Besides the active, Prâkrit has a regular passive verb, *bhaṇijjai*, or one directly derived from Sanskrit, *bhaṇṇai*, and a causative verb, *bhaṇâvei*. Both active and causative may be conjugated in all tenses and modes.

For details of Prakrit grammar, the student is referred to the following works: Chr. Lassen, *Institutiones linguæ Pracriticæ* (Bonn, 1837); H. Jacobi, *Ausgewählte Erzählungen in Mâhârâshṭrî* (Leipzig, 1886); E. Müller, *Beiträge zur Grammatik des Jaina Prâkrit* (Leipzig, 1876); and to the native grammarians: Vararuchi, *Prâkrita Prakâśa*, ed. E. B. Cowell (London, 1868); Hemachandra, *Grammatik der Prâkrit Sprachen*, ed. R. Pischel (Halle, 1877–80); Chaṇḍa, *Prâkrita Lakshaṇa*, ed. R. Hoernle (Calcutta, 1880).

HERMANN JACOBI.

Pram. KRISTEN HENRIKSEN: Danish poet and critic; b. in Norway of Danish parents, 1756. He was the author of a vast number of poems and plays of slight value, the best of the former being *Emilies Kilde* (Emilia's Spring). As one of the founders and editors of the critical journal *Minerva*, he exerted great and beneficial influence on public taste in the north. D. at St. Thomas, 1821. His works were edited by K. L. Rahbek (6 vols., Copenhagen, 1824–29). D. K. D.

Prase: See QUARTZ.

Pratinas (Gr. Πρατίνας) of Phlius in the Peloponnesus: Greek poet; flourished toward the end of the sixth century B. C., and is said to have introduced the satyr drama into Athens. Interesting fragments of his lyrics are given in Bergk, *Poetæ Lyrici Græci*, vol. iii., 557 foll. (4th ed.).

Prato (sometimes called *Prato in Toscana*): town; in the province of Florence, Italy; on the right bank of the Bisenzio; 11 miles N. W. of Florence (see map of Italy, ref. 4–D). It is situated in a plain surrounded by hills; has a citadel and a cathedral with frescoes by Filippo Lippi, and manufactures of cloth, paper, and straw hats; the water of the Bisenzio is largely used to work machinery. The chief domestic industry is straw-plaiting. Pop. 15,510.

Pratt, CHARLES: See CAMDEN, CHARLES PRATT, EARL OF.

Pratt, ORSON: Mormon apostle and author; b. at Hartford, Washington co., N. Y., Sept. 19, 1811; was educated in common schools in Columbia County; became a member of the Mormon Church, in which he was one of the "twelve apostles"; traveled extensively as a preacher; was also Professor of Mathematics in Deseret University, and Church historian, and was for several sessions Speaker of the Utah House of Representatives; author of *Divine Authenticity of the Book of Mormon*; *Cubic and Bi-Quadratic Equations* (London, 1866); *The Great First Cause*; *The Absurdities of Immaterialism*; and many religious pamphlets; had in MS. *Lectures on Astronomy* and *Differential Calculus*, and was engaged in the preparation of a work to be entitled *A New System of the Universe*. D. at Salt Lake City, Oct. 3, 1881.

Pratt, PARLEY PARKER: Mormon apostle; b. at Burlington, N. Y., Apr. 12, 1807; joined the Mormon Church in 1830, and was a member in 1835 of the first quorum of the twelve apostles; traveled widely in the U. S. in his efforts to make converts; visited England in 1840, where he established and edited at Manchester *The Millennial Star*; revisited England in 1846; explored parts of what is now Utah in 1847 and 1849; made a proselyting tour to the Pacific coast in 1851 and 1854; on a similar tour eastward was assassinated near Van Buren, Ark., May 13, 1857. He was the author of numerous pamphlets, and of the works *Voice of Warning and Instruction to all People* (New York, 1837); *History of the Persecutions in Missouri* (Detroit, 1839); and *Key to the Science of Theology* (Liverpool, 1854).

Pratt, ZADOCK: manufacturer; b. at Stephentown, Rensselaer co., N. Y., Oct. 30, 1790; began business 1811 as a saddler and harness-maker; located a tannery in 1824 among the Catskill Mountains on Schoharie Kill, Greene County, which became the nucleus of the town of Prattsville; was elected to Congress 1836, and again 1842; became noted for his advocacy of cheap postage; procured the establishment of the National Bureau of Statistics, and prepared the plans for the new post-office building at Washington; became colonel of militia 1823, State Senator 1830, presidential elector 1836 and 1852; was an active Democratic politician, a delegate to the Baltimore convention of 1852 and president of many industrial and benevolent institutions. D. at Bergen, N. J., Apr. 6, 1871.

Pratt Institute: an educational institution in Brooklyn, N. Y.; founded in 1887, and endowed by Charles Pratt (1830–1891), and administered by his sons, who constitute a board of trustees. Its work is on four general lines: (1) Educational, pure and simple, aiming to develop the faculties harmoniously, as in the high-school department, where art and manual training play a large part in fitting youth for life; (2) normal—the preparation of teachers; (3) technical—special training for skill in handicraft, applied science, household science, domestic art, library economy, etc.; (4) philanthropic and social—designed to exert a pronounced influence on the community for industry, thrift, self-culture, good-citizenship, etc.; illustrated in free lecture courses on social science and on art, in a savings-bank, a free library, and a "neighborship association," for Pratt Institute extension.

The departments, each administered by a director, are high school, with classes in language, history, politics, mathematics, science, drawing and manual training, and music; department of fine art, including freehand drawing and drawing from life, painting, designing, modeling, normal training, wood-carving, art needlework; of domestic art, including sewing, dressmaking, study of textiles, millinery, physical culture; of domestic science, including household economy, cookery, laundry-work, hygiene, and home nursing; of science and technology, including mechanical drawing, machine design, mathematics, mechanism, strength of materials, theory of steam-engine, trade-school work; of commerce, including phonography, typewriting, bookkeeping, and commercial arithmetic; of kindergarten, including theory and practice; of libraries, including library economy and management, a circulating department of 45,000 volumes, large reading and reference rooms, with branches; the thrift, including investments, deposits, loans; of museums, including art and industrial collections. There are classes for morning, afternoon, and evening. The average number of students is about 3,000. C. M. PRATT.

Pratz, LE PAGE, du: colonizer and explorer; b. in Holland about 1690; entered the French army in early youth; was engaged in campaigns in Germany; became a member of a French Western Land Company, which obtained the grant of a tract of land near New Orleans, La.; conducted an expedition thither 1718; made fruitless efforts at colonization; ascended the Mississippi 1720, and settled among the Natchez; explored Missouri and Arkansas rivers; was for several years treasurer of the land company at New Orleans; returned to France 1734; published a valuable *History of Louisiana* (3 vols., 1758). D. in 1775.

Prawn [M. Eng. *prane*, probably from a deriv. of Lat *perna*, mussel]: a name applied to many of the smaller long-tailed decapod crustaceans, chiefly to those of the *Palæmonidæ* and *Peneidæ*. In Europe and in the tropics they are used as food, but in the U. S., except in the Southern States, they are little used. Some of the species which inhabit the seas of warm climates reach a large size.

Praxit'eles: a Greek sculptor; head of the Attic school; b., it is thought, at Athens about 392 B. C. Of his life nothing is known; of his works we have an idea through tradition, descriptions, images on coins, copies, and fragments. His favorite material was marble, though he wrought also in bronze. The *Cnidian Venus*, celebrated in antiquity, which travelers went to Cnidus expressly to see, which King Nicomedes is said to have offered in vain to buy at the price of the whole debt of the island, we know by copies, one of the most famous being in the Vatican Museum, partly concealed by metal drapery. Another famous Venus was at Cos. The *Cupid* of the Vatican, the *Satyr* in the Capitol, the *Apollo Sauroktonos* in Florence and the Louvre, the *Narcissus* in Naples, familiar to visitors at the galleries and to lovers of art, are thought to be reproductions, replicas, or copies of works of his. One statue only is known which is certainly his own work, the famous *Hermes* at Olympia in Greece. Praxiteles has been called the sculptor of the beautiful, as Phidias was of the sublime.

Pray, Isaac Clark: journalist and actor; b. in Boston, Mass., May 15, 1813; graduated at Amherst College 1833; became a journalist at Boston and New York, and subsequently a successful theatrical manager and actor, and both in the U. S. and in England aided in the professional training of several theatrical celebrities, including Charlotte Cushman; published *Prose and Verse* (1835), *Poems* (1837), *Book of the Drama* (1851), *Memoirs of James G. Bennett* (1855); was author of several burlesques and other plays, including a tragedy, *Virginius*; edited several magazines and other periodicals, and conducted the Philadelphia *Inquirer* 1859–60. D. in New York, Nov. 28, 1869.

Revised by B. B. Vallentine.

Prayer [from O. Fr. *preiere* (> Fr. *prière*) < Lat. *preca'rius*, pertaining to prayer, deriv. of *preca'ri*, entreat, pray > O. Fr. *preier*, whence Eng. *pray*]: the communion of the soul with God. It is the necessary result of the recognition of the dependent relation of the creature to the Creator. It may be exceedingly various in form, "uttered or unexpressed," but in its most perfect form it is the expression of thought, feeling, or purpose to God in language. Such prayer will consist in adoration, thanksgiving, confession, petition, and intercession. Adoration expresses a sense of the excellence, glory, majesty, and holiness of God, and delight in his works of providence and redemption. It is the natural utterance of every heart in which there is a true love for him, which must delight in his excellences. The prayers of the Bible, specially the Psalms, are full of it. Thanksgiving recognizes with gratitude the special goodness of God, as it has been manifested in particular benefits conferred. Confession recognizes sinfulness, general or explicit, with the expression of penitence, the promise of reformation, and the request for pardon and for grace. Its language is: "Forgive us our debts as we forgive our debtors." All approach to God partakes of that original repentance by which man gives himself to God in conversion, and all prayer is the repetition of the cry of the publican (Luke xviii. 13), especially when sins have long been persisted in, and when prayer is the resumption of long neglected duty (Ezra ix. 6–15, x. 11). Petition may properly embrace our daily physical wants, "our daily bread," the general course of our life, its great affairs, our work and career, success in our efforts to perform all the ordinary and extraordinary duties of our lot and station (Romans i. 10), our special necessities also, whether in times of crisis, in sickness, and want, or in more common times (Isaiah xxxviii. 3; Matt. xxvi. 36 ff.; Heb. v. 7; Psalms xxxv., xxxviii., xl., etc.); but particularly it should include spiritual gifts of every sort, which constitute the burden of the biblical prayers (Eph. i. 16, iii. 14–19; John xvii.), and prayer for which is never denied since it is "according to the will of God" (1 John v. 14; Luke xi. 13); and it reaches its culmination in the great petition, embodying substantially all others: "Thy kingdom come, thy will be done on earth as it is in heaven." Intercession is both recommended by the example of our Lord, who completes therein his sacerdotal office (Heb. vii. 25, ix. 23–28), and commanded by the apostle (1 Tim. ii. 1), and should embrace every person and every cause with which the suppliant has a natural connection, even his enemies (Matt. v. 44).

Prayer is founded upon the belief that it constitutes a real transaction between the soul and God, leading to real and definite consequences. Its effects may be subjective, preparing the soul to receive the gifts of God, exerting a soothing, purifying, and elevating influence upon it; or objective, in the consequent communication to the soul of gifts of grace or the conferment of outward benefits. It has its *conditions*, however. The suppliant must come in the spirit of true submission and reconciliation to God, else there is no communion (Psalms lxvi. 18). Every prayer must contain implicitly or explicitly the petition "Thy will be done" (Matt. vi. 10, xxvi. 42). Hence it can not be dictation; nor the substitution in the intent of the petitioner of the will of man for that of God, which would make prayer, if it were thus answered, a calamity to the universe; nor the substitution of the wisdom of man for that of God; but it is the petition of a child, and must have the childlike spirit of a subject, and must have the loyal spirit of one who recognizes both limitations and shortcomings. Faith is also a condition (Heb. xi. 6). It lays hold of God with confidence in him, and it may at times rise into the realm of moral certainty, as was the case in the faith that wrought miracles (Matt. xxi. 22), or as when perfect obedience has brought perfect union with Christ (John xv. 7), when perfect sympathy with God brings the knowledge that petitions are in accord with his will (1 John v. 14, 15), and when the spirit inspireth the petition (Romans viii. 26). Prayer must also be offered in the name of Christ (John xiv. 13, 14, xvi. 23, 24, 26), that is, upon the ground of his person and work, and by a believer in him, pleading his intercession.

The *objections* to the possibility or the reality of prayer are mostly evacuated by the true understanding of its nature. If it be said that God is too great to answer prayer, the reply is that he may, and as it seems actually does, call man into a co-operation with him in his greatest works through prayer. The existence of general laws in the universe which, it is said, do not permit of exceptions in answer to prayers, may be so viewed as to imply that there is back of these laws no conscious Spirit, in which case the reply is the whole argument of theism. Or these laws may be viewed merely as an observed fact, so invariable as to leave no place for the supposition of their continual interruption. But if there is a personal God, the laws of the universe are modes of his operation, and not forces superior to him which he can not administer. Nor does the answer of prayer necessarily involve the suspension of laws, except in the sense that one suspends the law of gravitation when he lifts a stone. So far as man can say, every ordinary answer to prayer may be in the strictest accord with natural law. Certainly no law is violated when a widow prays for bread, and when the thought is suggested to the mind of some prosperous friend to send her just then an abundance of food. It is the "just then" which shows the hand of God; but law is not violated. Neither does the divine predetermination destroy the reality of prayer. Let all things be foreknown and foredetermined, including both my prayer and its answer; still I have a free will, and can pray or decline to pray, and hence my prayer is a real act; and the answer is just as real as if it never entered into the thought of God till I had already prayed. The whole difficulty about prayer being answered or not answered resolves itself into one of the manner in which the divine and human agencies co-operate. The objection that as a fact many prayers are not answered is met by the consideration that, if an answer is not given in the precise form in which it was put, it is because of the higher wisdom of the Giver, which was invoked in and with the petition, and by the affirmation that no true petitioner ever fails to find some form of answer to his request.

The *forms of prayer* have been quite various. The ancient Greeks offered prayers and vows together. The worshiper raised his eyes and hands toward heaven or toward the images of the gods. He stood, or if in deeper earnest he and at times all the assembly knelt. Suppliants wore garlands on their heads or necks, and carried boughs of olive or laurel twined with wool, with which they touched the knees or cheeks of the images. Libations of wine, water, or oil were poured out. The Romans covered their heads, bowed to the ground, moved completely round from right to left, as if to meet the god from whatever direction he might approach; then, with the right hand on the mouth, looked toward the east or toward the altars or images. In higher devotion they knelt or were prostrate, and laid hold on the altar. Public prayers were offered by the priest or magistrate. The Mosaic law took prayer for granted; the temple was "the house of prayer" where public prayer accompanied the sacrifices and where private prayer was offered. Those who were absent from the temple prayed toward it. The chief

hours for the duty were 9 A. M., 12 M., and 3 P. M. To these were added the beginning and end of night and the time of eating. According to the degree of his fervor, the Jew stood, bowed, knelt, or prostrated himself. Free prayers were constantly offered, though forms were used with tithe-offerings and certain blessings, but Solomon's prayer at the dedication of the temple seems to have been the beginning of a litnrgy, which at the time of Christ had developed into a set service before, during, and after the sacrifice. A similar liturgy was used in the synagogue, from which the petitions of the Lord's Prayer were probably drawn. Prayer was accompanied by almsgiving and fasting, and was made in conspicuous places, with many vain repetitions, by formalists who loved display. Among the early Christians prayer was the chief service, and was counted the main bond of unity. In their methods they followed Jewish customs largely. The pastor led the congregation, using both free prayer and forms. A strong liturgical tendency appears early in both the East and the West. Worship was first simple, then intricate, then regulated, then liturgical. Liturgies were made first by the bishops, then by the metropolitans. Early Christians knelt in ordinary prayer, but stood on the Lord's Day and from Easter to Whitsunday, in honor of Christ's resurrection. Prayer at all times and in all places was commended, though the temple and other places of meeting, the Lord's Days, occasional appointed days, morning and night, times of eating, times of success or distress, and crises of every kind were deemed peculiarly appropriate.

FRANK HUGH FOSTER.

Prayer-book: See LITURGICS and EPISCOPAL CHURCH, THE PROTESTANT.

Preaching Friars: See DOMINICANS.

Pre-Adamites: men living before the time of Adam. This term has been adopted by various writers to designate the tribes or nations which they believe existed on the earth before the date assigned by the usual scriptural chronology to the appearance of Adam and Eve. Before the investigations of geologists and archæologists in the nineteenth century there was no positive reason for imputing a greater antiquity to the human race than that given in the book of Genesis. This itself was not definitely fixed, as the chronological data of the Pentateuch differ widely in the three authoritative ancient versions known as the Masoretic Hebrew text, the Septuagint (which is the early Greek translation), and the Samaritan Pentateuch. The usual date for the creation of Adam given in English works is that derived by Archbishop Usher (about 1660) from the Hebrew text, and places it 4,004 years before the birth of Christ. The calculations of William Hales (about 1810) founded upon the Septuagint assigned the creation of Adam to 5411 B. C. Still wider variations have been advanced by other competent orthodox scholars, so that it is stated in a publication by the University of Oxford (*Chronological Tables*, 1835) that "not less than 300 different dates have been assigned as the era of the creation, varying in the extremes no less than 3,000 years." The decided tendency among the ripest scholars of all Christian denominations is to regard the account of the Pentateuch, in respect to time, as symbolical, indicative of the relation of the primitive human race to their Creator, and not as an historical narration. The same is true in regard to the location of Adam's creation. It was long supposed to have been somewhere in the valley of the river Euphrates, and many attempts have been made to discover the precise spot once occupied there by the Garden of Eden; but a closer examination of the text shows that Eden lay eastward from the scene of Adam's first existence as described, and that the river Nile (Gihon) was its western boundary. From these exegetical considerations, the term "pre-Adamites" means simply those members of the human race who lived previous to the beginning of the chronological records in the book of Genesis. That there were such, and in considerable numbers, is distinctly implied by that book itself, for there would have been no necessity for placing a mark on Cain to prevent him being killed if there had been no one living but members of his own family; nor could he have built a city if there had been none to live in it. It is entirely consistent, therefore, with faith in the scriptural narrative to recognize an antiquity of the human race indefinitely greater than that attributed to it in the chronology of Archbishop Usher. The necessity of so doing became apparent when geologists and archæologists discovered in undisturbed deposits of vast antiquity the fragments of human bones and the relics of human industry. These have been exhumed in every continent, showing that at a very remote epoch man was not only living upon the earth, but had already wandered widely over its surface. The scene of his first home can only approximately be defined, and the term of his existence as a species can not from such data be established with accuracy; but in the opinion of most competent observers it must be estimated by tens of thousands of years. Furthermore, investigations on the sites of the oldest known cities of the valleys of the Nile and the Euphrates prove beyond question that several of them were founded and were the scenes of a developed civilization long antecedent to the remotest date above mentioned as that of the creation of Adam. Prof. Norman Lockyer has demonstrated from astronomic data that some of the temples of Philæ in Egypt were constructed not later than 6400 B. C.; and the explorations of Niffir in Babylonia show it to have been a city already old in age at Usher's alleged date of the creation of the world. Even in America, usually considered to have been the latest of the continents to have received its human population, relics have been found, both in the northern and southern continents, which indicate that its extensive area was at least sparsely inhabited by tribes of low culture when many animals were living which are now extinct, and when the climate and the distribution of land and water were widely different from those now prevailing. This means a lapse of many thousand years since the earliest men reached its shores.

It may be said in conclusion that the term "pre-Adamites" is no longer regarded as sufficiently accurate for the language of science. It is better to employ the phrase "prehistoric men," meaning those who lived before the recorded dates of any authentic historical narratives. This avoids the impossible effort to frame a correspondence between the scriptural account of creation, which was certainly not intended to be a treatise on geology, and the results of modern scientific research, which, upon this subject, have by no means reached harmonious conclusions among themselves.

D. G. BRINTON.

Preble, preb'l, EDWARD: naval officer; b. at Falmouth (now Portland), Me., Aug. 15, 1761; in 1777 embarked in a privateer, and in 1779 entered as midshipman in the provincial navy; was taken prisoner in New York harbor, and upon his release served as first lieutenant on board the sloop of war Winthrop, with which he remained until 1782, greatly distinguishing himself by boarding with four men an armed British brig off Castine, Me., and capturing her under fire. In 1799 he was appointed to the command of the Essex, and in 1803 he commanded the squadron sent against Tripoli. Arriving at Tangier, he concluded peaceful negotiations with the Sultan of Morocco, after which he proceeded to blockade Tripoli, which he subjected to repeated vigorous bombardments, interrupted by several sharp engagements with the Tripolitan gunboats. In Sept., 1804, having been relieved by Com. Barron, he returned home, and received the thanks of Congress and a gold medal. D. at Portland, Aug. 21, 1807.

Preble, GEORGE HENRY: naval officer; b. at Portland, Me., Feb. 25, 1816; entered the navy as a midshipman Oct. 10, 1835. Served in Florida against the Seminoles, and in the Mexican war participated in the capture of Alvarado and Tampico; was in several actions with Chinese pirates in 1854–55; commanded the Katahdin at the taking of New Orleans in 1862, and the fleet brigade in the battles of Honey Hill and De Vaux's Neck in 1864. He was promoted to the rank of rear admiral Sept. 30, 1876; retired Feb. 25, 1878. D. in Boston, Mass., Mar. 1, 1885. He was the author of *History of the American Flag* (Albany, 1872); *History of Steam Navigation* (Philadelphia, 1883); and other historical works. Revised by C. BELKNAP.

Preble, WILLIAM PITT, LL. D.: jurist; b. at York, Me., Nov. 27, 1783; graduated at Harvard College 1806; was tutor in mathematics there 1809–11; became a lawyer and a leader of the Democratic party; was U. S. district attorney 1813; settled at Portland 1818; was a leading member of the convention which formed the State constitution of Maine 1819; on the inauguration of the new State government was appointed a judge of the State Supreme Court 1820; was minister to the Netherlands 1829; held many other public offices; was the first president of the Atlantic and St. Lawrence Railroad 1847. D. at Portland, Me., Oct. 11, 1857.

Precambrian Flora: See PLANTS, FOSSIL.

Prec'edents [from Lat. *præce'dens*, pres. partic. of *præce'dere*, go before, precede; *præ*, before + *ce'dere*, go]: (1) forms of procedure, of conveyancing, and the like, which have been approved by usage or judicial authority, and therefore may be followed safely; (2) decisions of the courts which declare a rule of law susceptible of application to other cases.

Legal precedents have a place in every system of jurisprudence, but English law is peculiar in the limits and the value which it puts upon them. It confines them to the judicial decisions of actually litigated cases. The opinions of distinguished lawyers and text-writers are not precedents, and British judges frequently condemn the practice of citing such opinions even upon the argument of a cause. (*Union Bank* vs. *Munster*, 37 Chancery Division 51.) In the U. S., however, such practice is not discouraged by the courts, but the opinion of a text-writer is never treated as a precedent.

The value of a judicial precedent varies with the questions involved and with the rank of the court from which it emanates. If the question is one of procedure, and especially if it is decided without serious contest, the court will not consider itself bound by its prior decision. (*Cross* vs. *Burke*, 146 U. S. 82.) The declaration of a rule of substantive law by a court of last resort is binding on all inferior tribunals within that jurisdiction, and will not be overruled by the same court unless it is convinced that the principle laid down is erroneous and works serious hardship. The strongest argument in favor of this practice is that of convenience. It has been stated in the following terms by Chancellor Kent: "It would therefore be extremely inconvenient to the public if precedents were not duly regarded and implicitly followed. It is by the notoriety and stability of such rules that professional men can give safe advice to those who consult them, and people in general can venture with confidence to buy and trust, and to deal with each other. If judicial decisions were to be lightly disregarded, we should disturb and unsettle the great landmarks of property." This "sort of consecration," to use Sir Henry Maine's expression, which English law gives to judicial precedents, exercises a most conservative influence in legal development. At times it has conserved error and barred legal progress. This is especially notable in international law, where the rules evolved by the courts based on early precedents are frequently less enlightened and benignant than those formulated by military commanders, who are not bound by the precedents of an earlier and less humane age.

After a decision of the court of last resort has been overruled it is treated not as having been bad law, but as not having been law at all. It still concludes the parties to the case in which it was rendered, but it does not affect the rights of other parties depending on the question erroneously decided.

In the U. S. the decisions of State courts are binding precedents upon the Federal tribunals when they decide questions dependent upon local statutes or local usages of a fixed and permanent operation, such as the rights and titles to immovables, but not when they decide questions of general commercial law. *Baltimore Railway* vs. *Baugh*, 149 U. S. 368. FRANCIS M. BURDICK.

Precession of the Equinoxes [*precession* is from Lat. *præce'dere*, go before or ahead; *præ*, before + *ce'dere*, go]: a slow change in the position of the equinox among the stars, of such a nature that the pole of the equator moves around the pole of the ecliptic in a period of about 25,000 years. It was first discovered through a difference in the length of the year as determined by the passage of the sun through the equinox, and by its angular distance from a bright star. The distance of the sun from the star Spica or α Virginis was determined from time to time by Hipparchus and other ancient astronomers by measuring the distance between the sun and the moon shortly before sunset, and between the moon and star after sunset. This double measure was necessary, because the star and the sun could never be seen at the same time. At the end of a year, when the earth had made a revolution around the sun, the same distance could again be measured. By repeating the measures at an interval of one or two centuries the true time of the revolution of the earth, or the sidereal year, could thus be determined. In this way it was found by Hipparchus and Ptolemy that the length of the sidereal year was a few minutes more than 365¼ days; but the interval between two passages of the sun over the equator was found to be a few minutes less than 365¼ days. This showed the point at which the sun crossed the equator. This point was called the equinox, and was subject to a continual motion from E. toward W. among the stars. According to the ancient astronomers the motion was a degree in a hundred years, so that a complete revolution would have required 36,000 years. Modern astronomy, however, shows it to be greater, about 50·25″ in a year, and therefore a degree in about seventy-one years; but the amount varies with the obliquity of the ecliptic, and will increase for several centuries to come.

When the motion of the earth around the sun was understood, it was seen that precession meant simply a gradual change in the direction of the earth's axis. Newton showed that this change was due to the action of the sun and moon upon the slight protuberance of the earth around the equator. The effect of the moon is about twice that of the sun. Were the earth perfectly spherical, there never could be any change in the direction of its axis; but owing to the centrifugal force generated by its rotation on its axis, the equatorial parts are slightly expanded, and the figure is changed into that of a spheroid, flattened at the poles, and bulging at the equator. In consequence of this bulging, there is a certain excess of attraction upon those parts of the equator nearest the sun or moon, and a deficiency in those parts farthest from it. This slight effect causes the unceasing change which has been described. The action is somewhat analogous to that which makes a top in rapid rotation perform a slow motion round and round, so as to describe the surface of a cone. If the sun and moon were always in the plane of the earth's equator—that is, if there were no obliquity of the ecliptic—the attraction of these bodies upon the northern and southern hemispheres would be symmetrical, and there would be no such motion as has been described, and therefore no precession. The latter arises from and varies with the sun's declination. At the time of the equinoxes the sun is on the earth's equator, and farthest from it at the solstices. The result is that the force which produces precession is not a uniform one, but takes place in a series of small cycloids, two in each year. This inequality of motion is called *nutation*.

Nutation, as here described, is produced not only by the action of the sun, but also by that of the moon; but in the case of the latter action there is also another inequality due to the fact that, owing to the revolution of the moon's nodes in a period of eighteen and a half years, the action of the moon in producing precession is more powerful at some epochs than it is at others. Again the result is an inequality, having a period equal to that of the revolution of the moon's nodes. This is called *lunar nutation*. The semi-annual term produced by the sun is called *solar nutation*. In addition to these principal inequalities there are a number of minuter ones, depending on the eccentricity of the sun's orbit, and on the inclination of the lunar orbit to the ecliptic. The formulas for these terms are given in astronomical ephemerides, to which reference may be made. S. NEWCOMB.

Précieuses, prā'si-öz': name given in France in the seventeenth century to a group of women who cultivated an extreme refinement in speech and manners. They carried to excess the concern for propriety and elegance of expression and of the forms of social intercourse which, centering in the Hôtel de Rambouillet, was doing much to refine French language and society. With the *précieuses* this elegance became affectation. Such common words as mirror or chair were held vulgar; they were to be replaced by "counselor of the graces" and "convenience of conversation." For a moment the *précieuses* were conspicuous in the salons that imitated the Hôtel de Rambouillet, and even invaded that salon itself, and threatened to impose their jargon on the French language; but good sense, aided materially by the pungent satire of Molière's *Précieuses ridicules*, turned them into ridicule. Cf. Livet, *Précieux et Précieuses* (Paris, 1859); V. Cousin, *La Société française au XVII^e siècle* (2 vols., Paris, 1858). A. G. CANFIELD.

Precious Stones: mineral substances possessing such beauty and brilliancy of color, hardness, and rarity, as to fit them for use in jewelry or for ornamental purposes. Strictly speaking, the only precious stones are the diamond, ruby, sapphire, and emerald, though the term is often extended to the opal, notwithstanding its lack of hardness, and to the pearl, which is strictly an animal product.

There are other minerals hard enough to scratch quartz,

without metallic luster, but generally brilliant and beautiful, such as the chrysoberyl, alexandrite, tourmaline, spinel, zircon, andalusite, aquamarine, and topaz, which are known as semi-precious or "fancy" stones (called *pierres de fantaisie* by the French). Minerals of both these classes, especially when cut and polished, are popularly called gems, but mineralogically only the semi-precious stones are so called, while archæologically the term gem is restricted to engraved stones, such as intaglios and cameos. See GEM.

The diamond, although the hardest and the most brilliant of the precious stones, does not command the highest price unless it be of a fine red, blue, or green color, all of exceptional rarity. Fine rubies command from five to ten times the price of fine white diamonds. Emeralds rank next in value, and frequently sell for as much as or more than fine diamonds; sapphires for somewhat less; fine cat's-eyes and the alexandrite variety frequently sell for as much as sapphires. The finest Hungarian opals frequently command one-half the value of diamonds, but little increase in price with size. The New South Wales, Queensland, and Washington opals sell for less. Ruby spinels of deep ruby-like color frequently command a price nearly as great as that of the diamond. The diamond is 10 in hardness; sapphire, 8·9; chrysoberyl or cat's-eye, 8·5; spinel, 8; topaz and aquamarine, 8; emerald and zircon, 7·8; tourmaline, 7·5; garnet, agate-chalcedony, and bloodstone, 7·3; rock-crystal, smoky cairngorm, smoky quartz, amethyst, 7; turquoise and opal, 6. The beauty of the precious stones is brought out by cutting and polishing, or the correct form of cutting and the angle of the various facets. To produce the greatest brilliancy the brilliant form of cutting is the best. The most perfect brilliant cut has fifty-eight facets. To heighten the color in a stone the step, degree, or trap cutting is the best.

The terms "artificial" and "imitation" must not be confounded in speaking of gems or precious stones, the former being of the true material, but produced by art, while the latter are imitations in other materials. Nearly all gems, with the exception of the diamond, have been artificially produced, but, with the exception of the ruby, only in small examples. Rubies have been made, but the chamber of commerce of precious stones of Paris has decreed that all gems of this kind shall be sold as artificial and not as precious stones. Imitation gems comprise (1) what are known as doublets, in which the upper part of the gem is made of garnet, quartz, or other hard stone, below which is cemented glass the color of the stone to be imitated; for instance, an imitation emerald may have its top of garnet or quartz, and the back a green glass. Other kinds are (2) those which are made by heating rock-crystal and plunging it in a solution the color of the gem to be imitated; and (3) those made entirely of glass, for which purpose a brilliant glass is employed containing oxide of lead, and known as *paste* or strass. This is colored by small amounts of metallic oxides, according to the tint desired—e. g. oxide of cobalt for blue, oxide of manganese for violet, etc.

Pearls are imitated by lining tiny hollow glass beads with the scale of the bleakfish, called *essence d'orient*, and then filling them with wax. Another imitation is made by silvering beads made of mother-of-pearl. GEORGE F. KUNZ.

Precocity [from Lat. *præ'cox*, *præ'cocis*, cooked or ripened too soon; *præ*, before + *co'quere*, cook]: a rapid and abnormally early development of the mental powers, sometimes associated with a correspondingly early ripening of the functions of the body. The popular belief that precocious infants are usually destined to early decay of mental and physical powers, resulting in speedy death, idiocy, or at the best in mediocrity, is well founded, as can be established by abundant proofs; but there are exceptions to the rule. No doubt precocity is often associated with diseases of the nervous system, with scrofulous symptoms, and with rickets, but not a few instances can be adduced of precocity associated with apparently good health. There is a double relationship between ill-health and precocity. The former by restraining a child leads to habits of reading and association with older people, and thus to precocity. The latter by causing a taste for reading and indoor life tends to engender ill-health or disease. Precocious children should be restrained from following their intellectual bent, and their physical culture encouraged. Revised by W. PEPPER.

Predestination [from Lat. *prædestina're*, predestine, foreordain; *præ*, before + *destina're*, establish, determine]: in theology, the doctrine according to which God has foreordained from eternity and unchangeably whatever takes place. It was first defined and debated during the controversy between Pelagius (see PELAGIANISM) and ST. AUGUSTINE (*q. v.*). In the Roman Catholic Church the Jansenists (see JANSENISM) became the champions of predestination. It was generally adopted by the earliest Reformers, but while in the Reformed Church it received a very strict and explicit development by Calvin (see CALVINISM), to which the Arminians (see ARMINIUS AND ARMINIANISM) opposed a milder explanation, it was for some time entirely given up by the Lutheran Church until Schleiermacher revived it in a mitigated and somewhat mystical form. The doctrine is distinct from various theories of the method by which events are governed; and it is in every form intended to be totally different from the idea of fate. All the chief points of the idea will be found expanded in Forbes's *Predestination* (Edinburgh, 1878). See also MOHAMMEDANISM.

Revised by F. H. FOSTER.

Predicate (in logic): the second term in a proposition; that which is asserted or predicated of the subject. See LOGIC.

Preece, WILLIAM HENRY: electrician; b. near Caernarvon, North Wales, Feb. 15, 1834; was educated at King's College, London; received practical training in the telegraph and cable service. In 1870 he entered the service of the Post-office as divisional engineer, was appointed electrician in 1877, and chief electrician in 1892. He is the author of many important papers in electro-technics, particularly in the fields of submarine telegraphy and telephony. He is also the author (with Sir James Sivewright) of a well-known *Text-book of Telegraphy*, and (in collaboration with Julius Maier) of a volume on the telephone. Mr. Preece is a fellow of the Royal Society and a member of numerous other learned scientific associations. E. L. NICHOLS.

Pre-emption [Lat. *præ*, before + *e'mere*, *emp'tum*, buy, obtain, (in compounds) take]: the act of one belligerent in seizing upon the sea, and taking at a price, certain kinds of neutral property not strictly contraband intended for importation within the territory of his foe; a forced purchase instead of confiscation. It was a relaxation of the harshness of the doctrine of *occasional contraband*. See CONTRABAND. T. S. W.

Prefect [from Lat. *præfec'tus*, prefect; *præ*, before + *fac'tus*, made]: the title of many officers and magistrates of ancient Rome. The *præfectus urbi* was the warden of the city, and was anciently an officer of great dignity and importance, but his duties varied much at different periods, and at times were almost nominal. The prætorian prefects commanded the imperial body-guard. The *præfectus annonæ* was an extraordinary magistrate of great importance who presided over the corn-market and the distribution of public charity. In modern France a prefect is an important official, the chief of police in each department, and a kind of justice of the peace.

Prefixes: significant particles joined to the beginning of words. In the Indo-European languages the prefixes are generally adverbial or prepositional in character, and their use with nouns appears to have been originally due to a connection with verbs either in meaning or by direct derivation; thus Eng. *belief* owes its existence to *believe*. In primitive Teutonic these prepositional prefixes were accented in the nouns but unaccented in the verbs. Traces of this appear in modern German—as *ant'wort*, but *entspre'chen*; *ur'theil*, but *erthei'len*; *urlaub*, but *erlau'ben*. In English the native Teutonic prefixes are relatively few—e. g. *a-* in *arise*, *be-* in *begin*, *for-* in *forget*, *mis-* in *misdeed*, *of-* in *offspring*, *un-* (Germ. *ant-*, *ent-*) in *untie*, *un-* (: Gr. ἀ-: Lat. *in-*) in *unwise*. The Latin prefixes are the most common; some of them come with Latin words directly from the Latin, as *ab-* in *abscond*, *ad-* in *adapt*, *amb-* in *ambition*, *ante-* in *antecedent*, *bi-* in *bisect*, *circum-* in *circumvent*, *con-* in *conduct*, *contra-* in *contradict*, *de-* in *delegate*, *dis-* in *dissolve*, *ex-* in *express*, *extra-* in *extravagant*, *in-* in *invade*, *in-* (: Gr. ἀ-: Germ. *un-*) in *insane*, *inter-* in *interference*, *intro-* in *introduce*, *ob-* in *obviate*, *per-* in *pervade*, *post-* in *postpone*, *præ-* in *precept*, *pro-* in *produce*, *retro-* in *retrograde*, *se-* in *seduce*, *semi-* in *semicolon*, *sub-* in *subscribe*, *super-* in *superimpose*, *trans-* in *transpose*; others come from Latin viâ the French, as *counter-* (< Lat. *contra-*) in *counterpart*, *es-* (< Lat. *ex-*) in *escape*, *en-* (< Lat. *in-*) in *enjoin*, *enter-* (< Lat. *inter-*) in *entertain*, *par-* (< Lat. *per-*) in *pardon*, *sur-* (< Lat. *super-*) in *surface*. The Greek has

also furnished a number of important prefixes, as *anti-* in *antithesis*, *apo-* in *apology*, *cata-* in *catalogue*, *di-* in *digraph*, *dia-* in *diameter*, *en-* in *energy*, *endo-* in *endogamous*, *epi-* in *epitaph*, *exo-* in *exogamous*, *hyper-* in *hypercritical*, *hypo-* in *hypodermic*, *meta-* in *metathesis*, *para-* in *parody*, *syn-* in *synthesis*. In the strictest sense, however, none of these alien prefixes can be regarded as having acquired a position as English prefixes, unless they have proven their vitality by contributing to the formation of new words. The Greek *en-* of *enthusiasm* is only from the Greek point of view a prefix. In English it is merely a syllable of a loan-word. It shows no vitality. Contrast *anti-* in *anti-fat*, *anti-snapper*. BENJ. IDE WHEELER.

Pregnancy: See OBSTETRICS.

Prejevalsky, Col. NICOLAI MICHAELOVITCH: See PRJEVALSKY.

Prel'ate [from Lat. *præla'tus*, preferred, or placed before; partic. of *præferre*, prefer]: a term applicable to all ecclesiastics of high rank, as well as some of the inferior dignitaries of the papal court. Prelates of the Great Mantle are the lowest in rank; those of the Small Mantle, of higher rank. In the Roman Catholic Church they have mostly the title of "monsignore."

Premise: See LOGIC.

Premium: See INSURANCE.

Premonstratensians [by analogy of Lat. *præmonstra're*, show beforehand, point out the way, from Fr. *Prémontré* < Lat. *pratum monstra'tum*, liter., shown meadow], or **Norbertines**: a religious order established at Prémontré, near Laon, in France, in 1120, by St. Norbert (1080–1134). Norbert was a relative of the Emperor Henry V., and held several rich benefices, when suddenly he was converted, and retired from the world to found a new monastic order, which followed the rule of St. Augustine and were in part canons regular. He became Archbishop of Magdeburg in 1127. The order (which had become very powerful and widespread) kept up the primitive vigor of the rule for about 120 years, but began to decline toward the end of the fifteenth century. It was divided about 1573 into two congregations, the Spanish abbeys having a stricter observance. In 1630 the whole order received the stricter rule. It is not very large, but has convents both of monks and nuns, especially in Austria, Belgium, and Holland. The habit is white. See *Hugonis Annales Ordinis P.* (Nancy, 1734); Winter, *Die Premonstratensen d. 12ten Jahrhunderts* (Berlin, 1865); and Currier, *History of Religious Orders* (New York, 1894). Revised by J. J. KEANE.

Prence, or **Prince**, THOMAS: governor of Plymouth, Mass.; b. in England in 1601: was one of the Leyden Pilgrims; arrived at Plymouth, Mass., in 1621; was one of the first settlers at Nansett or Eastham; was chosen governor in 1634, 1638, and continuously from 1657 to his death; was assistant 1635–37 and 1639–57; was distinguished for religious zeal and the promotion of education. D. at Plymouth, Mar. 29, 1673.

Prentice, GEORGE DENISON; journalist; b. at Preston, Conn., Dec. 18, 1802; graduated at Brown University 1823; was admitted to the bar in 1829; edited *The Weekly Review*, Hartford, Conn., 1828–30; from 1830 to his death was editor of the Louisville, Ky., *Journal*, which he made one of the leading Whig newspapers of the country; author of many fugitive poems and of a *Life* of Henry Clay (1831): *Prenticeana* (1859), a collection of his witticisms, has gone through several enlarged editions. D. at Louisville, Ky., Jan. 22, 1870. His *Life* has been written by G. W. Griffin, and a posthumous edition of his *Poems* was issued in 1876.
Revised by H. A. BEERS.

Prentiss, GEORGE LEWIS, D. D.: minister and professor; b. in Gorham, Me., May 12, 1816; was educated at Bowdoin College; studied theology in Halle and Berlin 1839–41; was pastor of the South Trinitarian church, New Bedford, Mass., 1845–51, of Mercer Street Presbyterian church, New York, 1851–58; traveled abroad 1858–60; in 1860 organized the Church of the Covenant in New York, of which he was pastor till 1873; since 1873 he has been Professor of Pastoral Theology, Church Polity, and Missionary Work in Union Seminary. Besides sermons, addresses, and contributions to periodicals, Dr. Prentiss has published *Memoir of Sergeant Smith Prentiss* (2 vols., New York, 1855; new edition 1879); *Discourse in Memory of Thomas Harvey Skinner, D D., LL. D.* (1871); *Our National Bane* (1877); *Life and Letters of Elizabeth Prentiss* (1882; new edition 1887); *The Union Theological Seminary* (1889); *The Agreement between Union Seminary and the General Assembly* (1891); and *The Problem of the Veto Power and How to Solve It* (1892). —His wife, ELIZABETH (*Payson*) PRENTISS (b. at Portland, Me., Oct. 26, 1818; d. at Dorset, Vt., Aug. 13, 1878), was married in 1845; published a number of very popular works, including *Little Susy's Six Birthdays* (1853); *The Flower of the Family* (1856); *Fred and Maria and Me* (1868); *Stepping Heavenward* (1869), translated into several foreign languages; *The Percys* (1870); *Aunt Jane's Hero* (1871); *Urbane and His Friends* (1874); *The Home at Greylock* (1876); and *Gentleman Jim* (1879). C. K. HOYT.

Prentiss, SEARGEANT SMITH: lawyer; b. in Portland, Me., Sept. 30, 1808; graduated at Bowdoin College 1826. He practiced law at Vicksburg, Miss., but losing much property by legal process, and partly also because he regarded that State as "disgraced and degraded" by its repudiation of its bonded debt, he removed to New Orleans in 1845, and died at Longwood, near Natchez, Miss., July 1, 1850. He was eminent as a lawyer, and still more so as an orator. In the opinion of such judges as Daniel Webster and Edward Everett he was a peer of the statesmen of the period so prolific in eloquent men. See his *Life*, by his brother, George Lewis Prentiss.

Prepositions [from Lat. *præpositio* (*præ*, before + *po'nere*, place), a translation of the Greek term *πρόθεσις*; *πρό*, before + *θεῖναι*, set, referring to the usual position of these words before the noun]: a class of words which serve the purpose of defining the relation of a noun-word to its governing word in the sentence. Thus in the sentences *he went to it*, *he went from it*, *he went for it*, the prepositions *to*, *from*, *for* set forth the relation existing between the act of *going* and the thing *it*; similarly in the case of relations between nouns or adjectives and nouns, as *the son of John*, *ready for use*. In the primitive Indo-European, which was a highly inflected language, these relations were expressed chiefly by the case-endings, and prepositions were used only where these relations were not clearly or definitely enough expressed by the case-endings. Such is also approximately the condition in the classical Greek and Latin. The group of words which afterward became prepositions were in Indo-European chiefly, and in their origin probably entirely used as preverbs—i. e. they were closely attached to the verb, and served to define more clearly the nature of the action; cf. Gr. *κατ' ἄρ' ἕζετο*, he sat down; Sanskr. *tíṣṭhā rátham ádhi tám*, step upon this car. In the last example the preverb *adhi*, upon, serves so directly to suggest the aspect of the action toward the governed object that it may be regarded as a preposition. It represents the transition from preverb to preposition. In the English, *to pass by the house*, *what were you thinking of*, it is also difficult to determine whether *by* and *of* are preverbs or prepositions—i. e. whether their connection is closer with verb or noun. The fact that *pass-by* and *think-of* can be inflected in the passive voice, *it can not be passed by*, *it must not be thought of*, points, however, to the conclusion that *pass-by* and *think-of* are compound verbs in nearly the same sense as Gr. *παραλείπειν*, or Lat. *deliberare*. BENJ. IDE WHEELER.

Preraphaelites, or **Præraphaelites**, or **Pre-Raphaelites**: a very small body of artists and lovers of fine art, called by themselves the Pre-Raphaelite Brotherhood, and formed in London in 1849; less properly, all those artists and others in England or elsewhere who executed or admired artistic work done in supposed sympathy with the aims of the brotherhood—that is, those who painted minutely and with attention to detail; those who sought an unaccustomed reality of gesture or pose in painting or sculpture; or those who took religious and mystical subjects and tried to give them new interpretations; thus the school of Cornelius was called the German Pre-Raphaelites. The name given in this way was often inappropriate and misplaced.

The Pre-Raphaelite Brotherhood, or P. R. B., consisted of Dante Gabriel Rossetti, William Michael Rossetti, William Holman Hunt, John Everett Millais, James Collinson, Frederick George Stephens, and Thomas Woolner. According to the latest writers on the subject and biographers of Rossetti, no other persons ever became members of the brotherhood. They were all very young men; Woolner and Hunt, apparently the oldest, were twenty-seven and twenty-five years of age, the Rossettis much younger. They saw in paintings of the fifteenth century a religious enthusiasm and a simplicity of artistic aim which they longed to re-

call, and they thought that Raphael's early work in Rome marked the change from that purer art to later and less single-minded designing. One of their first objects was to publish a journal, in which their ideas about fine art should be expressed in prose and verse, and embodied in etchings, and *The Germ* was begun in 1850, had its name changed to *Art and Poetry* after the second issue, and never appeared after the fourth number. This little magazine contains Thomas Woolner's poem, *My Beautiful Lady*, and several poems by Dante Rossetti and Christina Rossetti which are contained (often altered) in their collected works.

The avowed purposes of the brotherhood were the encouragement of perfect sincerity and a lofty purpose in the practice of art. Some of their rules or maxims seem now excessively strict, and even fettering, but the fine art of the day in England seemed to young and high-minded men extremely meaningless and feeble, and that of all Europe, so far as they knew it, devoid of any true purpose, and they stated their principles in a dogmatic form by way of protest and counter-action. Thus it was laid down as a principle that a figure should be painted from one and only one person serving as a model. It is evident from the pictures themselves that the painter allowed himself to impart as much of feeling to the expression of the face as he wished and could achieve. Probably, too, he felt at liberty to make stiff movements more easy, or else he did so unconsciously. The one man or woman in the costume desired, with the color and light actually seen in it, he painted just as it seemed to him. Even gesture was to be stiff and awkward if thereby it became natural and dramatic; thus in Millais's picture, taken from Keats's poem *Isabella, or the Pot of Basil*, a painting of *Isabella and Lorenzo* at the supper-table, where Isabella's brothers and their household are seated, one of the brothers reaches out his right leg with energetic kick at the hound whose head lies in Isabella's lap, and the other bites his nails and grins savagely at Lorenzo, who is speaking to Isabella tenderly and handing her fruit. There was also a disposition, like that of the recent impressionists, to paint effects of light and color, generally seen by artists only. There was also a very free use of suggestive and illustrative imagery, aiding the main purpose of the composition.

Artists not included in the original brotherhood, but who were considered Pre-Raphaelites among Englishmen of the years from 1850 and 1860, were Arthur Hughes, Ford Madox Brown, and Edward Burne-Jones. The architects most interested in the Gothic revival were also considered as more or less allied with the Pre-Raphaelites, especially Sir Thomas Woodward and William Burges, and perhaps Philip Webb. John Ruskin was looked upon as the most ardent and influential advocate of Pre-Raphaelite doctrines and practice.

Bibliography.—*The Fortnightly Review*, vol. xlix., contains Holman Hunt's paper on the brotherhood, and *The Portfolio*, new series, May, 1894, consists of a monograph on D. G. Rossetti by Frederick G. Stephens. Also see Esther Wood, *Dante Gabriel Rossetti and the Pre-Raphaelite Movement*; William Sharp, *Dante Gabriel Rossetti, a Record and a Study*; Harry Quilter, *Preferences in Art, Life, and Literature*; Ruskin's pamphlet, *Pre-Raphaelitism*, and passages in other works. The large-paper edition of the last-named work contains many photographic copies of pictures, and Mrs. Wood's book and Stephens's essay each give several illustrations. The Moxon *Tennyson's Poems* of 1856 contains several wood-cuts after designs by Rossetti, Hunt, and Millais. Russell Sturgis.

Presburg: See Pressburg.

Presbyter [= Lat. = Gr. πρεσβύτερος, elder, deriv. (liter., compar.) of πρέσβυς, old]: the title of an officer in the Christian Church, given at first on account of age, length of service, or dignity. It was a Jewish-Christian name, and came from the synagogue. In the New Testament the words "presbyter" and "bishop" are interchangeable. In each early church there was a board of presbyters. Their duties were to superintend the church order, discipline, and doctrine, to teach, preach, visit the sick, receive strangers, and preside at the meetings. They were appointed by the apostles or their representatives, or may have been elected or nominated by the people. They were ordained with prayer and the laying on of hands. See J. A. Hodge, *What is Presbyterian Law?* (Philadelphia, 1882); A. T. McGill, *Church Government* (Philadelphia, 1890). See Presbyterian Church.

Presbyterian Church [*Presbyterian* is from Gr. πρεσβύτερος, elder, and πρεσβυτέριον, a body of elders. See Presbyter]: a distinctive title descriptive of one division of the Church of God. I. *Name.*—The Greek word is used in both the Septuagint and the New Testament to designate a body of officers to whom was committed the government of the Church. In the Septuagint (e. g. Lev. iv. 14, 15) the term synagogue is used for the congregation of Israel, and "the elders (presbyters) of the synagogue" are the representatives of the whole people. In the New Testament the synagogue is a parish church, but the elders of the Jews are members of the Sanhedrin and representatives of the whole people, though possibly they are sometimes local, e. g. Luke vii. 3. In some later writings the elders are the officers of the local synagogue. The title and the duties it implies were retained under the new dispensation, as the Christian Church was the outgrowth of the Jewish. Hence the name is the key to the system.

II. *Constitution.*—The visible Church is held to be the aggregate of those who are known as the people of God. It exists in the form of organized associations. Every such association must have its official representatives; and, since an ecclesiastical organization is of necessity widespread, it must provide both for particular congregations and for the relations of these to each other. In the following description of the Presbyterian Church, as it now exists, the Presbyterian Church in the United States of America is taken as a type, though the features indicated are mainly those that are common to most Presbyterian churches. A particular congregation is generally organized by some recognized authority, but is complete in itself. It elects its own officers, who are—(1) a pastor, (2) a bench of elders, (3) a board of deacons. A pastor, once elected, is installed by the ecclesiastical body, called presbytery, with which the congregation is connected. In case no pastor is installed, an ordained minister may have charge of the congregation, subject to the oversight of the presbytery. The elders are elected by the people and "set apart" by the presiding minister or by the presbytery. To them is committed the spiritual oversight and government of the congregation. Their number is determined by the wishes of the people; it is seldom less than three or greater than twelve. The *office* is for life, but in some congregations the term of active service is limited by vote. The board of deacons is also elected by the congregation, and its members are "set apart" by solemn ceremony, as are the elders. Their duty is to care for the poor of the congregation and for such temporal interests as may be committed to them. They have no governmental control. In most parts of the U. S. there is a civil corporation, created by State law, technically differing from the ecclesiastical "congregation," though practically consisting of the same persons, which owns and manages the property, through trustees chosen for that purpose. In Scotland and in some parts of the U. S. the duties of trustees are discharged by the deacons.

Governmentally, there are in the Presbyterian body four "judicatures," styled in order the session, the presbytery, the synod, and the general assembly. The *session* consists of the bench of elders above described. Of this judicatory the pastor is *ex officio* a member and its moderator. The *presbytery* consists of all the ministers or "teaching elders" (as they are sometimes distinctively called) and one "ruling elder" from each congregation in a limited district. Each minister in that district is, if received by vote, a permanent member of the presbytery. The ruling elders act at particular meetings, being elected by the sessions for that purpose. The duties of this body are "to receive and issue appeals from church sessions, and references brought before them in an orderly manner; to examine and license candidates for the holy ministry; to ordain, install, remove, and judge ministers; to examine and approve or censure the records of church sessions; to resolve questions of doctrine or discipline seriously and reasonably proposed; to condemn erroneous opinions which injure the purity or peace of the Church; to visit particular churches for the purpose of inquiring into their state and redressing the evils that may have arisen in them; to unite or divide congregations at the request of the people, or to form or receive new congregations; and in general to order whatever pertains to the spiritual welfare of the churches under their care" (*Form of Government*). The *synod* originally consisted of all the ministers and one elder from each congregation within a larger district, which must embrace at least three presbyteries. At present, however, in some of the Presbyterian

churches, the synod is a body of delegates. It stands to the presbyteries within its bounds in the same relation in which each presbytery stands to its churches. It is empowered to receive and issue appeals from the presbyteries, to examine their records, to form or divide or unite these lower bodies, and generally to take proper oversight of presbyteries, sessions, and people under their care. The *general assembly* consists of an equal delegation of ministers and elders from each presbytery. For the proportion and the functions of this judicatory, see GENERAL ASSEMBLY.

III. *Essential Principles of Church Polity.*—Three things are essential in Presbyterian polity. First, there must be a presbyter ministry, that is, a body of ordained ministers, equal in order. In this Presbyterians agree with the other churches that hold to the parity of the ministry. They differ, on the one hand, with those who recognize other orders in the ministry (bishops or deacons, for instance), either above or below the order of elders; and, on the other hand, with those who do not set their ministers apart by ordination. Second, there must be ruling elders, distinct from ordained ministers, and co-ordinate with them in the government of the church. Properly speaking, the Presbyterian elder (presbyter) is not the ruling elder, but is the minister, though the opposite use of the term is very prevalent, leading to some confusion concerning the two offices. The setting apart of the ruling elder is often called ordination, like the setting apart of the minister, but the standards of the Presbyterian churches do not teach that the two are equivalent. Third, there is the principle of review and control by the higher judicatories. These are not, as among Congregationalists, merely advisory or arbitrating bodies, but have an actual right of jurisdiction. Connected with these three points are others of less importance. In particular the office of deacon, as above described, is quite different from the office of deacon in other churches.

IV. *Doctrines.*—A church with Presbyterian polity is Presbyterian irrespective of all questions of doctrine; but, as a matter of fact, the Presbyterian churches mainly hold to the type of theology that is called Calvinistic. Several different theological symbols are accepted among the different Presbyterian bodies. Probably those that come nearest to being typical are the Confession of Faith and the Catechisms adopted by the famous Westminster Assembly, and then by the Parliament of England and by the Church of Scotland, 1646–48. These plant themselves first of all upon the fundamental Protestant principle that the books of the Old and New Testaments were given by inspiration, and are the only infallible rule of faith and conduct. From the Scriptures they deduce a system of doctrine controlled at every point by the idea of the sovereignty of God. Human freedom and divine love are affirmed, and all deep ethical and spiritual truths and experiences are either affirmed or taken for granted, but the thing that is everywhere made conspicuous is that God controls beforehand all his creatures and all their actions. Among the principal doctrines held are: First, God in three persons, Father, Son, and Holy Ghost, these three "the same in substance, equal in power and glory." Second, man morally depraved by nature. Third, Jesus Christ an atoning Saviour. Fourth, justification by faith in the Redeemer. Fifth, regeneration and sanctification by the Holy Ghost. Sixth, eternal happiness in the other world for believers, and eternal punishment for the finally impenitent. To the articles of the "Confessions" of the different branches of the Church the officers are required to subscribe at their ordination; but the only usual requirements for membership are repentance from sin, faith in the Lord Jesus Christ, and an unreserved consecration to God. See CHRISTIANITY, CALVINISM, and the articles on the various specific religious doctrines.

V. *History.*—Presbyterians claim that their history begins even before the apostolic age; that the analogy between the constitution of the Presbyterian church and that of the Jewish church is evident, being much closer than that of flower to seed; that the synagogue had its rabbi, its bench of elders, its appeal to a higher ecclesiastical court at Jerusalem; that the Christian church, very naturally, adopted the principal ideas of that church order to which it succeeded. Further, according to their view, the congregations of the apostolic Church were organized associations of the people of God, now assuming the title of Christians. The officers of these congregations were ordained elders. Appeals went up from one body of ecclesiastical rulers to another. Ordinations to the ministry, as in the case of Timothy, were performed by the "laying on of the hands of the presbytery." The whole visible Church was regarded as one body, and the decrees of the assembled apostles and elders at Jerusalem were, when sent down to the congregations, received as authoritative. It is claimed but by few that the present order of the Presbyterian church is *precisely* that of the apostolic age; few claim a *jure divino* authority for the system; yet its principles are believed to have undergone little change. After the apostolic age presbyterian government in the Church gradually gave way to prelatical. It is claimed that there are traces of Presbyterianism in all the centuries, but, at best, they are not very distinct. Among the Culdees and other earliest Christians in different parts of Great Britain; among the Albigenses and, later, among the Vaudois or Waldenses, in France and Piedmont; among the Hussites in Bohemia and their successors the Taborites, the Bohemian Brethren, the older Moravian Brethren; among the English Lollards and other early Protestants from Wycliffe to Cranmer and Hooper, from the fourteenth century to the sixteenth—among these, and elsewhere, elements may be distinguished affiliated with Presbyterianism as it now exists, but also other elements not so affiliated. When, however, the Reformers of the sixteenth century broke with the Church of Rome, they found themselves in need of a polity by which to organize the churches of the Reformation. They looked into the New Testament for such a polity, with the pretty uniform result of finding there, each of them, some elements of what we now know as Presbyterianism; though, when it is said that "all the Reformed churches in France, Germany, Holland, Hungary, Geneva, and Scotland were thorough Presbyterians, not only in principle but also in practice," the statement is misleading if we understand by it that all these churches were at once organized into congregations, each choosing ruling elders for itself, with relations of appeal and review and control between each and a higher judicatory. The changes that actually occurred were affected by complications concerning church and state, by the retaining of ideas and usages that had prevailed under Roman supremacy, and, on the other hand, in some quarters by ideas of independency in church government that sprang up along with Presbyterian ideas. In some cases ruling elders were for a city or for a district, and not for a particular congregation. In John Calvin's church at Geneva the ruling elders were appointed not by the people, but by the civil authorities. A Presbyterian polity of some sort, however, came to be very prevalent among the churches of the Reformation. See REFORMATION, GENEVA, CALVIN, HUSS, HUSSITES, HUGUENOTS, etc.

These churches became classified as Lutheran and Reformed. Though the Lutheran churches have always retained certain elements of Presbyterianism in their polity, they are not regarded as Presbyterian churches. The distinctive symbols of the Reformed churches, on the other hand, are regarded as monuments of Presbyterian orthodoxy. This is especially true of the Gallican Confession, adopted by the first national synod of France in 1559; the Belgic Confession, written in 1561, and afterward adopted in Belgium and Holland; the Second Helvetic Confession, written by Bullinger in 1562, and afterward adopted in Switzerland, Scotland, Hungary, France, Poland, and other countries; the Heidelberg Catechism, prepared in 1562; the Canons of Dort, made for the Netherlands in 1619; and various symbols of the British churches.

At present, however, the established Reformed churches on the Continent are hardly to be counted as in sympathy with Presbyterianism. The Churches of Switzerland and of Hungary, of the Helvetic Confession, and the Church of the Netherlands come nearest to being exceptions to this rule. In different localities, more perhaps in France than elsewhere, the churches that now combine a genuine Presbyterian polity with an evangelical Calvinistic theology maintain some sort of continuity with the Reformed churches of the sixteenth century; but, in the main, these churches are relatively small, and are in an attitude of practical dissent from the established churches of the countries where they exist.

In Great Britain the case is somewhat different. The first Scottish General Assembly was organized by John Knox and others in 1560. A presbytery was formed at Wandsworth, England, in 1572, and such Englishmen as Thomas Cartwright (1535–1603) and Walter Travers advocated Presbyterian principles. In 1592 the Scottish church was formally established by act of Parliament. (See the article SCOTLAND, CHURCH OF.) Then followed the anti-Presbyterian policy of King James and King Charles and

the Covenant movements of 1638 and 1643. (See COVENANTERS and COVENANT, NATIONAL.) Meanwhile Puritanism, which at that stage was strongly Presbyterian, made great progress in England. In 1643 the Westminster Assembly of English divines, with four assessors from Scotland, was convened in London by act of Parliament. In 1647 and 1648 the various parts of the doctrinal standards framed by them were adopted by the English and Scottish Parliaments. Till the death of Cromwell the Presbyterianism thus defined was nominally (though not actually) the established religion of England. At the restoration of the Stuarts Episcopacy was re-established in both countries. On their overthrow the Presbyterian polity was restored in Scotland. In Ireland Presbyterianism appeared at the beginning of the seventeenth century, was firmly established there by the middle of the century, and has maintained itself with vicissitudes somewhat like those through which the Scottish churches have passed. On the history of Presbyterianism, in addition to articles already referred to, see HENDERSON, ALEXANDER; KNOX, JOHN; WESTMINSTER STANDARDS, etc.

VI. *Some of the existing Presbyterian Churches.*—Presbyterians in America are descended from those of every part of Europe, but in their organized churches only those of Germany, Holland, England, and Scotland are perpetuated. The Reformed Church in Germany is represented by the REFORMED CHURCH IN THE UNITED STATES (*q. v.*), popularly known as the German Reformed Church. Its standard is the Heidelberg Catechism. German immigration began as early as 1684. Churches were organized soon after, and a synod in 1747. Statistics of this and the other churches named are given at the end of this article.

The Reformed Church of the Netherlands took for its standards the Belgic Confession and the Heidelberg Catechism, and later the Canons of Dort; but, notwithstanding its abundant confessional bulwarks, it changed in doctrine and discipline, and in 1835, in protest against the alleged growing laxity, a number of ministers and people separated from it, and are now known as the Christian Reformed Church. In America the oldest church of the Presbyterian order is the daughter of the Reformed Church of Holland, the Reformed Church in America, popularly called the Dutch Reformed Church. It adopts the three standards of the Holland church, and in addition the Nicene and Athanasian creeds. Its earliest congregation was organized in New Amsterdam (now New York) in 1628. Negotiations were in progress for organic union between this church and the German Reformed Church, but the action taken in 1892 was adverse. In 1822 the Rev. Sol Froeligh and others separated from this church and formed the True Reformed Dutch Church. At one time this body had attained to some importance, but it dwindled to a few congregations, and in 1889 these were absorbed into the Christian Reformed Church of the United States. This is a branch of the church of the same name in Holland, and is a comparatively recent body. In 1882 it received a considerable accession from members of the Dutch Reformed synod of Chicago, who were dissatisfied with the refusal of that church to make Freemasonry a subject of church discipline. It now exists in the form of one synod, with nine classes, and about 100 churches, about half of its strength being in Michigan.

The changes in the British Presbyterian churches and their American progeny are more complicated. The Presbyterian churches in Scotland are the Reformed Church of Scotland, the Reformed Presbyterian Church, the Synod of United Original Seceders, the Free Church of Scotland, and the United Presbyterian Church. The origin of the Church of Scotland has already been noticed. During the interval between 1660 and 1689, and especially during the last ten years of that time, many Scotchmen, among whom Richard Cameron was prominent, abjured the sovereignty of King Charles II. and King James II. on account of their tyranny, and especially their violation of the Solemn League and Covenant. These people formed societies, and were known as Cameronians and Covenanters. At the accession of William and Mary, Presbyterianism in Scotland was restored on the basis of the old establishment of 1592, and of the Westminster standards, the Covenant not being re-enacted. For this reason many members of the societies stood aloof from the established church. In 1706 Rev. John Macmillan joined them, and in 1743 the Rev. Mr. Nairn. They then constituted the "Reformed Presbytery." This was the beginning of the Reformed Presbyterian Church of Scotland, whose members are popularly known as Covenanters, or Cameronians. About 1863 a large majority in the Scotch synod of this Church held that it was consistent with their principles so far to countenance existing political institutions as to vote for a member of Parliament. A minority thought otherwise, and a disruption took place. In 1876 the larger body joined the Free Church of Scotland. The smaller still maintains its existence.

In 1718 Edward Fisher's book, *The Marrow of Modern Divinity*, was republished in Scotland. The General Assembly of 1720 condemned the book. Twelve ministers, of whom Ebenezer Erskine was one, sent to the Assembly a representation to the effect that some of the propositions they had condemned were identical with statements in the Scriptures and in the church standards. In 1722 the Assembly rebuked them for this. They are known as Marrow Men and Representers. In 1731 the Assembly approved the calling of ministers to a congregation by the patrons and elders, without the consent of the congregation. Erskine rebuked this in two sermons preached in 1733. Being admonished for so doing, he and three others protested. They were suspended. In December of that year they organized the Associate Presbytery. In 1745 the number of congregations had increased to forty-five, and the Associate Synod was formed. Two years later a controversy culminated respecting the oath taken by the burgesses of Edinburgh and other towns, which included a profession of "the true religion presently professed within this realm." The Antiburghers held that the swearing of this oath was a sin, to be punished by excommunication, and went through the form of deposing and excommunicating Erskine and the others who held the opposite view, and who were known as Burghers. Both Burghers and Antiburghers increased rapidly, and each claimed to be the Associate Synod; but in 1788 the Antiburghers divided into four provincial synods, and from that time were called the General Associate Synod.

Meanwhile, in 1752, Thomas Gillespie was deposed by the Church of Scotland for refusing to take part in the installation of a minister whom he regarded as thrust upon an unwilling congregation. In 1761 he, with two others, formed the Relief Presbytery. This grew in time into the Relief Church, with a synod and seven presbyteries.

For more than fifty years the Burgher and Antiburgher synods grew side by side, with no intercourse between them. Then controversies arose in each in regard to the power of the civil magistrate in matters of religion. In each the more liberal party was largely in the majority, and was called New Light, while the other party was called Old Light. In 1799 the Old Light Burghers seceded, taking the name Associate Presbytery, which became in 1805 the Associate Synod, or Original Burgher Synod. In 1804 McCrie and three others (Old Lights) withdrew from the Antiburgher Synod and formed the Constitutional Associate Presbytery.

Thus, in 1820, there were in existence in Scotland five little denominations of seceders from the national church. In that year 129 of the congregations of the New Light Antiburgher Synod united with the 154 congregations of the New Light Burgher Synod, forming the United Secession Church. The remaining eight of the Antiburgher congregations united in 1827 with the Old Light Antiburghers, forming the Associate Synod of Original Seceders. In 1839 a majority of the Old Light Burgher Synod joined the Church of Scotland. The remainder, in 1842, joined the Associate Synod of Original Seceders, taking the name of United Original Seceders. A small majority of these, twenty-seven ministers in all, joined the Free Church in 1852. The remainder constitute the present synod of this name. In 1841 James Morrison, minister of the United Secession Church, was deposed for holding, *inter alia*, that the spirit strives with all the unregenerate, and that the atonement is universal; and he and others formed the EVANGELICAL UNION (*q. v.*). In 1847 the United Secession Church joined with the Relief Church, forming the United Presbyterian Church of Scotland, which thus became a large and important body.

In 1843 the FREE CHURCH OF SCOTLAND (*q. v.*) came out from the established church. The question at stake was measurably the same as in the times of Erskine, namely, the right of a congregation to choose its pastor. In 1852 and 1876 it absorbed majorities of the Original Seceders and of the Reformed Presbyterians. Negotiations for a union between the United Presbyterian and the Free churches were brought to a successful conclusion in October, 1900, when the resultant body was constituted as the United Free Church of Scotland. A small minority of the Free Church, however, deny the validity of the union, and claim that their organization is the lawful Free Church.

In England the Presbyterianism established in 1647–48 failed to take permanent root. Many of the Puritans emigrated and others conformed to the established church. Some of the Presbyterian churches lapsed from orthodoxy, but during the second half of the nineteenth century a new Presbyterianism has grown up in England. Previous to 1876 there was in England a branch of the Scottish United Presbyterian Church and an English Presbyterian church. In that year the two united, taking the name of the English body, the Presbyterian Church of England. There is also in England a synod connected with the Church of Scotland. There is a strong Welsh Church, sometimes called the Presbyterian Church in Wales, but oftener the Welsh Calvinistic Methodist Church. (See METHODISTS.) In Ireland are the Presbyterian Church in Ireland, the Reformed Presbyterian Church of Ireland, the Eastern Reformed Presbyterian Church of Ireland, and the Secession Church of Ireland. The second and fourth of these are in connection with the Scottish churches of the same names.

We have already noticed the German and Dutch Presbyterian bodies in America. Had the early Dutch ascendency been maintained, the Dutch type of Presbyterianism would perhaps have remained dominant. As affairs turned out, the mould of the principal type of Presbyterianism in the U. S. was formed by the fusion of English Puritans with people from the churches of Scotland and Ireland. Into this mould Presbyterians of other types became assimilated, among these very prominently the French Huguenots. Into this main body were absorbed a large proportion even of the German and Dutch Presbyterians, and, probably, a majority of the immigrants who belonged to the Reformed Presbyterian and the Secession churches of Scotland. Many of these last, however, adhered to their old-country preferences and organized churches of their own, and we will briefly follow their history before taking up that of the larger bodies.

The Seceders (Antiburghers mainly) organized the Associate Presbytery of Pennsylvania about 1753 and that of New York in 1776. The Covenanters organized a Reformed Presbytery in 1774. In 1782 the three presbyteries united, forming the Associate Reformed Synod of North America; but some members of each body refused to go into the union, and before 1800 an additional body had been organized, so that the century opened with four of these organizations—an Associate Presbytery or Presbyteries, a Reformed Presbytery, an Associate Reformed Synod, and the Reformed Dissenting Presbytery. Of the last there seems to be no further trace.

The Reformed Presbyterians organized a synod in 1809 and a general synod in 1823. In 1833 a division occurred similar to that which came thirty years later in Scotland, the New Light party holding that it was right to vote and hold office under the Government of the U. S., and the Old Light party holding the contrary. This caused a division. The New Light body has ever since been known as the Reformed Presbyterian Church in North America (General Synod). The other is the Reformed Presbyterian Church in the United States of America (Synod). In 1840 the Reformed Presbyterian Covenanted Church withdrew from the Synod on account of the alleged lack of strictness in that body. In 1883 the Reformed Presbyterian Church in the United States and Canada was formed by separation from the General Synod.

The Associate Presbyterians in 1801 organized the Associate Synod of North America, otherwise known as the Associate Church of North America. In 1858 the number of congregations had become nearly 300. It was then merged into the UNITED PRESBYTERIAN CHURCH OF NORTH AMERICA (*q. v.*), though a small minority continued their separate existence and perpetuate the name of the Associate Church.

The Associate Reformed Presbyterians in 1802 formed a general synod, including the synods of New York, Pennsylvania, Scioto, and the Carolinas. In 1820 the Synod of Scioto withdrew. About the same time an unsuccessful attempt was made to unite the Associate Reformed and Reformed Dutch churches under the name of the Reformed Protestant Church of North America. In 1821 the Synod of the Carolinas became an independent body, which still exists as the Associate Reformed Synod of the South. The same year a union was made illegally between the Associate Reformed body and the General Assembly of the Presbyterian Church. In this attempt the Pennsylvania Synod was practically merged into the General Assembly. The Scioto Synod grew, became a general synod, and after several unsuccessful attempts united again with the New York Synod in 1855, forming a body of 367 congregations. This body three years later consolidated with the Associate Presbyterians into the United Presbyterian Church. There still remained, however, a separate body named the Associate Reformed Synod of New York. By 1894 all the congregations of this body save two were absorbed into other churches.

The first presbytery in the American colonies was that of Philadelphia, formed in 1705. In 1716 the Synod of Philadelphia was constituted. In 1729 it adopted the Westminster Confession of Faith. In 1745 the presbyteries of New Brunswick, New York, and a part of that of Newcastle withdrew and formed the independent Synod of New York. This was called the New Side Synod, and the old Synod of Philadelphia the Old Side. The Old Side stood aloof from Whitefield and revivals, and insisted on a full course of scholastic study for ministers; the New Side affiliated with Whitefield and judged of ministers by their qualifications and not by their scholastic studies only. The synod came together again in 1758 as the Synod of New York and Philadelphia. The Old Side ministers were in the majority at the disruption; at the reunion the New Side outnumbered them three to one.

Four ministers withdrew in 1779 and formed the Presbytery of Morris County. Three other affiliated presbyteries were formed within the next eighteen years. They were known as the Associated Presbyteries. In no very long time they were absorbed by other bodies.

In 1788 the Synod of New York and Philadelphia had increased to sixteen presbyteries. In 1789 these were distributed into four synods, and the General Assembly of the Presbyterian Church in the United States of America was organized. Very soon after, as the effect of a plan of united work with the Congregationalists of New England, the churches of the assembly multiplied greatly in the new settlements of New York and Ohio. In the first decade of the nineteenth century differences arose among the Scotch-Irish Presbyterians in the Cumberland valley, and these resulted in the formation of the CUMBERLAND PRESBYTERIAN CHURCH (*q. v.*). In the following decades arose the division into Old School and New School. The New School men were charged at the time with laxity in doctrine and discipline. This they denied, and they certainly made good their denial. As the Old School party was strong in the Southern States, the party was charged with proslavery sympathies; but it does not appear that this was true in such a sense as to affect their ecclesiastical conduct. The difference was partly a difference of race and temperament, English blood being relatively more prominent among the New School men, and Scotch-Irish blood among the Old School men. The Old School men magnified the prerogatives of church government and church office, were ambitious of power in the church courts, were very ready to bring men before church courts for trial, were impatient of any restrictions that should prevent a majority in a church court doing as it pleased. The New School men were not ambitious to distinguish themselves as ecclesiastical leaders, insisted on constitutional restrictions as limiting the power of majorities in church courts, preferred to deal with innovations rather by study and argument than by prosecution. In 1837 the Old School men, finding themselves in a majority in the General Assembly, passed a vote exscinding several of the synods in which the New School men were most numerous. The New School men denied the constitutionality of this, but accepted the situation under protest, and were soon in good working order as a church by themselves. In 1858 the Southern presbyteries of the New School church withdrew and formed the United Synod of the Presbyterian Church. In 1862 the Southern constituency of the Old School church withdrew and formed the General Assembly of the Confederate States of America, a name which at the close of the civil war was changed to the Presbyterian Church in the United States. The following year this body formed an organic union with the United Synod of the south, and a few years later incorporated the synods of Missouri and Kentucky, which had been practically exscinded by the Old School General Assembly in 1866. In 1869 the Old School and New School General Assemblies after thirty-two years of separation were reunited.

With the addition of the Welsh Calvinistic Methodist Church in the U. S. the list is substantially complete.

In Canada, Presbyterianism was planted in nearly as many different forms as in the U. S., and passed through somewhat similar stages. The several movements for union culminated in 1875, when practically all the Canadian Pres-

byterian churches were consolidated into one church bearing the name The Presbyterian Church in Canada. In Australia, New Zealand, and other British dependencies, and in South Africa, are vigorous Presbyterian bodies.

A federative assembly of the Presbyterian churches in Australia was formed in 1896; and the necessary legal steps to their union were completed in 1901, when the first United General Assembly was to meet at Sydney July 24.

VII. *Church Institutions.*—The Presbyterian churches commonly manage their missionary work, domestic and foreign, and other special forms of church work, through permanent boards or permanent committees. For example, the Presbyterian Church in the United States of America has the following organizations of this sort: The trustees of the assembly, the boards of home missions, of foreign missions, of education, of publication and Sabbath-school work, of church erection, of ministerial relief, of freedmen, of aid for colleges and academies, and the permanent committee on temperance. The other Presbyterian churches have similar arrangements. In addition, many particular synods and presbyteries are incorporated, having boards of trustees of their own, authorized to hold and use property for church purposes. The Presbyterian churches also have a large number of educational institutions. (See COLLEGE, and the names of particular institutions.) Further, they have hospitals and asylums in many parts of the earth, and also historical societies, houses of publication, clubs, family papers, reviews, etc. The Young Men's Christian Association and the Young People's Society of Christian Endeavor have been especially fruitful in their work among Presbyterians.

VIII. *Present Condition of Presbyterianism.*—The various evangelical Presbyterian churches number about 4,852,500 communicants, representing a population of about five times that number—nearly one-fifth of the Protestant population of the world. In order to give an account of the different Presbyterian bodies by name it has been necessary to describe the series of disruptions and reunions that have characterized Presbyterian history. It should be remembered that this phase has never had more than a small relative importance as compared with the Christian work done in these churches, which have always been distinguished for the number and character of their educational institutions, for the extent of their foreign missionary operations, for their liberal contributions for religious and educational purposes, and for thoughtful preaching.

As the result of a movement begun in the U. S. in 1812 to bring the Presbyterian churches into closer union, a council was held in London in July, 1815, at which a constitution for a federation to be called "The Alliance of the Reformed Churches holding the Presbyterian System" was agreed upon. The first general council of the confederation was held at Edinburgh July, 1877; and six others have been held—viz.: at Philadelphia, Sept., 1880; Belfast, June, 1884; London, July, 1888; Toronto, Sept., 1892; Glasgow, June, 1896; and Washington, Sept., 1899. The union is popularly known as the Pan-Presbyterian Council.

In the different branches of the Presbyterian church there is more or less of movement toward creed revision. Several of the British churches have adopted changes in the Westminster standards, or explanatory declarations, or both. In the largest American Presbyterian church a special committee was appointed in 1901 to consider the subject. The formulation of a creed which shall express the consensus of doctrine in all the churches of the alliance is also proposed.

IX. *Statistics.*—The following general summary of the Presbyterian and Reformed churches of the world, and the statistics for Great Britain, taken from the volume of the Washington Council of 1899, with fuller statistics for North America, will show the present condition of these bodies:

GENERAL SUMMARY.

COUNTRIES.	Congregations.	Ministers.	Communicants.
European continent	5,164	5,467	926,184
United Kingdom	5,375	5,186	1,474,225
Asia	189	255	50,726
Africa	328	214	195,028
North America	17,935	14,522	2,110,431
South America	93	61	12,986
West Indies	33	30	11,133
Australia	457	460	42,965
New Zealand	172	201	25,338
Melonesia	.....	25	3,050
Total	29,746	26,421	4,852,066

FULLER STATISTICS FOR GREAT BRITAIN AND NORTH AMERICA.

CHURCHES.	Classes or presbyteries.	Congregations.	Ministers.	Communicants.
Presbyterian Church in England	12	311	337	73,249
Church of Scotland in England	3	14	14	3,520
Presbyterian Church in Ireland	37	569	655	106,602
Reformed Presbyterian Church of Ireland	4	36	28	4,040
Eastern Reformed Presb. Church of Ireland	2	6	..	700
Secession Church of Ireland	2	10	7	1,230
Church of Scotland	84	1,624	1,560	641,803
Free Church of Scotland	75	1,047	1,149	290,789
United Presbyterian Church of Scotland	24	583	620	195,631
Reformed Presb. Church of Scotland	2	9	8	1,040
United Original Secession Church	4	29	24	3,769
Welsh Calvinistic Methodist Church	24	1,137	780	151,882
Presbyterian Church in Canada	54	976	1,071	205,992
Presbyterian Church in the U. S. of A.*	233	7,779	7,532	1,025,388
Presbyterian Church in the U. S.*	79	2,991	1,985	227,991
Cumberland Presbyterian Church*	122	2,963	1,586	182,449
Cumberland Presb. Church (colored)	22	400	450	39,000
United Presbyterian Church in N. A.*	68	995	1,017	116,934
Associate Reformed Synod of the South	9	131	104	11,344
Reformed Presb. Church in N. A., Gen. Syn.	7	36	33	5,000
Reformed Presb. Church in N. A., Synod*	12	112	125	9,733
Reformed Presb. Church, Covenanted	..	1	1	37
Welsh Calvinistic Methodist Church	18	158	89	12,152
Ref. Presb. Church in the U. S. and Canada	..	1	1	608
Reformed Church in America*	35	651	723	110,898
Reformed Church in the U. S.	57	1,677	1,077	239,930
Christian Reformed Church in America	9	144	98	15,584

*General Assembly or General Synod reports of 1901.

A summary of Presbyterian and Reformed foreign missions, reported at the meeting of the Council of the Alliance in 1899, gave the following numbers: of European agents of all kinds, 2,098; of native agents, 4,574; of communicants, 147,135; of pupils in the schools, 158,648.

X. LITERATURE.—The literature of Presbyterianism is extensive. First. It has its place in many general historical works, particularly those that treat of religious and missionary movements in the Reformation and post-Reformation period. A valuable bibliography of this period is contained in Fisher's *History of the Reformation.* Second. Presbyterian statistics and other information are to be found in the census reports and other archives of the U. S. and other nations. Such material in compendious form is given in such works as *The Census of the Churches* (1894) and *The Religious Forces of the United States*, vol. i. in the American Church History Series (1893), by H. K. Carroll; *Our Country* (revised edition 1891), by Josiah Strong; *Problem of Religious Progress* (1881), by Daniel Dorchester; and *The Churches and Churchless of Scotland*, by Robert Howie. Third. Sessions, presbyteries, synods, general assemblies, and the Alliance are record-keeping bodies, and their records and archives, either in manuscript or published, are the true sources of information. The prominent churches publish their minutes annually, and some publish an additional volume of reports and documents. Collections of these are accessible in libraries. Among the publications of this kind that have an interdenominational value may be mentioned the *Scottish Church and University Almanac*, Nevin's *Presbyterian Year-book*, and the quadrennial volumes of the Alliance of the Reformed Churches. For the earliest period, see *Introduction to the Records of the General Assembly, 1646–47*, *Minutes of the General Assembly, 1644–49* (Edinburgh, 1874), and *The Westminster Assembly, its History and Standards* (London, 1883), by A. F. Mitchell; *History of the Westminster Assembly of Divines* (4th ed., revised, Edinburgh, 1878), by W. M. Hetherington; and *Documentary History of the Westminster Assembly* (*Presbyterian Review*, Jan., 1880), by C. A. Briggs. Fourth. A unique work, of importance to those interested in the creed-revision movements of 1887–92, is the scrap-book entitled *Confessional Revision*, made by Winthrop S. Gilman, of which complete copies exist in the libraries of Union, Auburn, and Princeton Theological Seminaries. Fifth. The doctrinal position of the Presbyterians is defined in the published standards of each Church. The well-known *Confession of Faith* of the Scottish and American churches is the most prominent example. A good account may be found in *Creeds of Christendom*, by Philip Schaff (5th ed. 1890). Of Presbyterian theological works the following are a few among many: *History of Christian Doctrines* (1889) and *Dogmatic Theology* (2d ed. 1889), by W. G. T. Shedd; *Christian Dogmatics* (1887), by J. J. Van Oosterzee; *Systematic Theology* (1873), by C. Hodge; *Outlines of Theology* (1862, and later editions), by A. A. Hodge; *Sys-*

tem of Christian Theology (4th ed. 1890), by H. B. Smith; *Present Day Theology* (1893), by L. F. Stearns; *Systematic Theology* (Nashville, 1870), by R. Beard; *The Doctrine of the Covenants in Reformed Theology* (1891), by G. Vos; and *The Institutes of the Christian Religion* (1891–95), by E. V. Gerhart. Sixth. Works on Church polity: *The Books of Discipline* of the several churches; *The Law of Creeds in Scotland* (1867), by A. T. Innes; MacPherson's *Presbyterianism* (Scottish); Levi's *Digest of the Presbyterian Church of England*; *Digest of Deliverances in the United Presbyterian Church*, by A. G. Wallace; *Assembly Digest*, by S. J. Baird (1856, rev. ed. 1858); *The Presbyterian Digest of 1886*, by W. E. Moore; *Digest of the Presbyterian Church (South) to 1887*, by W. A. Alexander; *Manual of Church Polity* (1878), by S. M. Hopkins; *What is Presbyterian Law?* (1884), by J. A. Hodge; *Relations of Civil Law to Church Polity* (1875), by Justice William Strong; and *Manual of Law and Usage* (1888), by B. F. Bittinger. Eighth. Works on the history of Presbyterianism: Knox's *History of the Reformation in Scotland*; Burton's *History of Scotland*; McCrie's *Vindication of the Scottish Covenanters*; *History of the Puritans*, by Stowell, Hetherington, and Neal; Plumley's *The Presbyterian Church throughout the World* (1875); Stoughton's *History of Religions in England* (1884); and Blaekie's *History of Presbyterianism in New England* (1881). Church of Scotland: The histories of Calderwood, Spotiswood, Row, and Woodrow, among the older authorities; those of Hetherington (1853), Stanley (1872), Walker (1882), Moffat (1884), P. M. Muir (1893); and *St. Giles Lectures*, first series (1881). Reformed Church in the U. S.: *Tercentenary Monument, Chambersburg* (1863); *History of the Reformed Church*, by L. Mayer (1851), by E. V. Gerhart (1863), by J. H. Dubbs, in American Church History Series, vol. vii. (1895), and *Historic Manual* (1885), by J. H. Dubbs. Reformed Church in America: *Manual* (3d ed. 1879), *Centennial Discourses* (1876), *Centennial Volume of the New Brunswick Seminary* (1884), and *The Reformed Church in America* in the American Church History Series, vol. vii. (1895), by E. T. Corwin; *History of Rutgers College* (1879), by T. S. Doolittle; *The Huguenots on the Hackensack* (1886) and *The Reformed Church in America* (1856; 3d ed. 1889), by D. D. Demarest. Reformed Presbyterian Church of Scotland: Naismith's *Historical Sketch* (1887). United Presbyterian Church of Scotland: M'Kerrow's *History of the United Secession Church* (1841); Struther's *History of the Relief Church* (1843); and Mackelvie's *Annals and Statutes of the United Presbyterian Church* (1873). Free Church of Scotland: Hanna's *Life of Dr. Chalmers*; Rainy's *Life of William Cunningham*; Walker's *Life of Buchanan*; Buchanan's *Ten Years' Conflict* (1849); Bryce's *Ten Years of the Church of Scotland* (1859); *Our Church Heritage* (1874), *Religious History of Scotland* (1882), and *Scottish Church History* (1880), by N. L. Walker; *The Free Church of Scotland* (1893), by Peter Bayne; and (in one volume) *Scotland's Free Church*, by G. B. Ryley, with the *Summary of Free Church Progress*, by J. M. McCandlish (1893). Presbyterian Church of England: T. McCrie's *Annals of the English Presbytery from the Earliest Period to the Present Time* (1872); Skeats's *History of Free Churches in England, A. D. 1688–1851* (1869); Drysdale's *The Presbyterians in England* (1889); Black's *Presbyterianism in England in the Eighteenth and Nineteenth Centuries*; and D. Fraser's *Presbyterian Church in England* (1892). Welsh Calvinistic Church: *Encyclopædia Cambrensis* (10 vols., in Welsh, Denbigh, 1882). Presbyterian Church in Ireland: *Ecclesiastical History of Ireland* (1875), by W. D. Killen; *The Presbyterian Church in Ireland*, by P. Adair (1866), by J. S. Reid (1867), and by W. Cleland (1892). Reformed Presbyterian: Glasgow's *History of the Reformed Presbyterian Church*; *Reformation Principles as Testimony*. United Presbyterian Church: *United Presbyterianism* (2d ed. 1883), by W. J. Reid; *The United Presbyterian Church*, by A. G. Wallace, in Hay's *Presbyterians* (1892), and by J. B. Scouller, in vol. ii. of the American Church History Series (1894). Cumberland Presbyterian Church: *The Presbyterian Church in Kentucky* (1847), by R. Davidson; *The Cumberland Presbyterian Church*, by B. W. McDonnold (1888), and by R. V. Foster in vol. ii. of the American Church History Series (1894). Presbyterian Church in the United States of America: Hotchkin's *History of Western New York* (1848); *The Presbyterian Church in America* (1857), by R. Webster; *Sketch of Presbyterianism in Central New York* (1877), by P. H. Fowler; *History of the Division in the Presbyterian Church* (1852), by G. N. Judd; Brown's *Historical Vindication of the Abrogation of the Plan of Union* (1855); *History of the New School* (1868), by S. J. Baird; *Presbyterian Reunion* (1870); *Centennial Historical Discourses* 1876); *Historical Almanac* (10 vols., 1858–68), by T. M. Wilson; *Constitutional History of the Presbyterian Church* (1840), by C. Hodge; *The Presbyterian Church* (revised ed. 1873), by E. H. Gillett; *Presbyterians* (1892), by G. P. Hays; *American Presbyterianism* (1885), by C. A. Briggs; and *Presbyterians*, by R. E. Thompson, in the American Church History Series, vol. vi. (1895). Presbyterian Church in the U. S.: Howe's *Presbyterian Church in South Carolina* (vol. i., 1870; vol. ii., 1883); *James H. Thornwell's Collected Writings* (Richmond, 1881–86), his *Life and Letters* (1875), by B. M. Palmer; and *The Southern Presbyterian Church*, by T. C. Johnson, in vol. ii. of the American Church History Series (1894). Welsh Calvinistic Methodist: *Welsh Methodism* (in Welsh, 3 vols., Wrexham, Wales, 1850-56), by J. Hughes; *The Welsh Calvinistic Methodists* (Rome, N. Y., 1854), by W. Roland; *Welsh Calvinistic Methodism* (London, 1872), by W. Williams; and *The Welsh in America* (in Welsh, 1872), by R. D. Thomas. The Presbyterian Church in Canada: *History of the Presbyterian Church in Canada*, by G. Bryce (1875), by W. Cleland (1890), by W. Gregg (1890); and *Short History of the Presbyterian Church in Canada from the Earliest to the Present Times* (1892), by W. Gregg.

Revised by W. J. Beecher and William H. Larrabee.

Prescott, William: soldier; b. at Groton, Mass., Feb. 20, 1726; served in the expeditions against Cape Breton (1754) and Acadia (1756), attaining the rank of captain; became a farmer in the town of Pepperell, where he inherited a considerable landed estate; commanded a regiment of minutemen 1775; took part in the battle of Lexington, and commanded in that of Bunker Hill (according to the usual account); resigned from the army 1777, but took part as a volunteer in the campaign against Burgoyne in the same year; and sat in the Massachusetts Legislature for several years. D. Oct. 13, 1795.

Prescott, William Hickling: historian; b. at Salem, Mass., May 4, 1796. He entered Harvard College as a sophomore in 1811. Not long after he received injuries which eventually resulted in total blindness in one eye and partial loss of sight in the other. Owing to this misfortune he was forced to employ a reader for his historical investigations, and in writing he used an ingeniously contrived frame, the "noctograph." He graduated at Harvard in 1814 with high honors in classics and literature; traveled in the Azores, England, France, and Italy 1815–17, and settled in Boston, where he was married in 1820. He chose as his special field of literary work modern Spain and the Spanish conquests in America. In the course of his researches he procured from Spain copies of a large number of valuable manuscripts. His first book, *History of the Reign of Ferdinand and Isabella* (3 vols., Boston, 1837), was the result of ten years of labor. It was recognized in Europe as the most meritorious historical work which had yet appeared in America, and was translated into French, Spanish, Italian, German, and Dutch; yet it is stated that Prescott himself, with characteristic modesty, refused to give it to the world until urged to do so by his friends. In 1843 appeared his most brilliant work, *History of the Conquest of Mexico*; it was followed by *Biographical and Critical Miscellanies* (1845); *Conquest of Peru* (1847); and *History of the Reign of Philip the Second* (3 vols., 1857–58, incomplete). In 1858 he edited Robertson's *Charles the Fifth*, with a supplement on the life of the emperor after his abdication, and he was the author of historical and critical articles in *The North American Review* and other periodicals. His relations with Irving, Motley, and Ticknor were particularly cordial, and their mutual confessions honored them all. Irving, who had begun a work on the conquest of Mexico, resigned the field to Prescott as soon as he heard that the latter had taken it up, and Prescott aided and encouraged Motley to write his *Dutch Republic*, though the subject was partly covered by his own *Philip the Second*. Prescott, like Irving, was a brilliant writer and a painstaking investigator, but his tendency to hero-worship and to picturesque coloring often produces a false impression. He himself was aware of this, and tried to counterbalance it by occasional rigid condemnation of such men as Cortés and Pizarro, but his evident sympathy and his gorgeous descriptions blind us to the cruelty and injustice of the conquer-

ors. His works are among the American classics and have had numerous editions. D. in Boston, Jan. 28, 1859. See Ticknor, *Life of W. H. Prescott* (1864), and for critical estimates Allibone's *Dictionary of Authors* and Bancroft's *Mexico*, vol. i., pp. 7, 17, 701–702. HERBERT H. SMITH.

Prescription [from Lat. *præscrip'tio*, liter., a writing before or in front of; in Roman procedure, a defense which, if proven, renders unnecessary the examination of the plaintiff's allegations, and which was therefore put at the top of the formula sent to the referee; deriv. of *præscri'bere*, write before; *præ*, before + *scribere*, write]: the conversion of an actual into a legal state of things by lapse of time. It is evident that prescription, in this sense, plays a very important part in public law. In the relations of state to state, and of class to class within the same state, power actually asserted is constantly transforming itself into right, and rights left unexercised are sooner or later lost.

In private relations, lapse of time seems to have had equally great and equally general results in early society. Originally, rights of all kinds appear to have been created by successful force and extinguished by the failure to exercise them. In civilized states, however, the law does not give prescription so wide an effect. Certain rights only are established by the exercise of the corresponding power, and certain rights only are lost by non-user. To the former category belong, regularly, rights over things. To the latter category belong certain rights *in re*, and nearly all rights of action, or claims, whether *in rem* or *in personam*. For the Roman and modern European law governing the prescriptive extinction of claims, see LIMITATION OF ACTIONS; what remains to be noted is the law governing the prescriptive establishment and extinction of rights over things.

1. *The Roman law* started with the rule that all corporeal objects capable of private ownership passed, in relatively short terms, into the ownership of the possessor; movables in one year, immovables in two years. This method of acquiring property right was called "taking by use" (*usucapio*). In the provinces, where usucaption, as an institution of the civil law, was held to be inapplicable, an analogous protection was given to the possessor of realty by the "prescription of long time." The rules of usucaption and of prescription were subjected, partly by legislation and partly by interpretation, to certain qualifications, and the two institutions were fused into one by Justinian. According to the rules laid down by him, the possessor of movables acquired ownership in three years; the possessor of immovables in ten years *inter præsentes* (i. e. when both the prior and the present possessor resided in the same province), and in twenty years *inter absentes*. In order to ripen into ownership the possession had to be "juristic" and must have been acquired *bona fide*, which regularly implied color of title. In calculating the term of possession the possessor was permitted to reckon the possession of him from whom he obtained possession (*accessio possessionis*), provided the latter also had acquired *bona fide*. Things incapable of ownership (*res extra commercium*) were, of course, incapable of prescription; also, by the rule of the Twelve Tables, things which had been stolen, and by a later enactment things of which the possession had been acquired originally by force.

This "ordinary" prescription was supplemented in the codification of Justinian by a much more sweeping *præscriptio longissimi temporis*. By virtue of this so-called "extraordinary" prescription, possession, if acquired *bona fide*, was converted into ownership whenever the previous owner's actions were lost by limitation. The period in this case was thirty or forty years.

Lesser rights over things, e. g., the servitudes or easements upon realty, were capable of being acquired by prescription in ten or twenty years.

As to the loss of rights over things by non-user, distinctions were drawn. Ownership was not lost by non-user, but only in consequence of the creation of a new adverse ownership. Real or "prædial" servitudes were extinguished by non-user whenever the exercise of the right involved positive acts on the part of its holder (as, for example, in the case of a right of way). When the servitude merely imposed upon the owner of the servient estate the duty of not doing certain things (which was regularly the case with the so-called "town servitudes") the servitude was extinguished only by "usucaption of liberty," i. e. the owner of the servient estate must do that which he was forbidden to do and must maintain this attitude of opposition for the legal period (ten or twenty years). The so-called "personal" servitudes were not extinguished by non-user.

All the shorter prescriptions of the Roman law were suspended during the minority of the true owner, and in certain other cases where he was unable to press his claim. No such suspension was recognized in the case of the prescriptions of thirty or forty years.

2. *Mediæval Developments.*—Teutonic custom recognized, as regarded immovables, no acquisition of ownership by lapse of time, but only a strengthened claim of the possessor to legal protection. This protection was given through the rules of procedure and particularly of evidence. He who had possessed for a "year and day," however vicious his original possession, had at least the advantage of the defensive position; and if his possession was based on a colorable title, like inheritance or conveyance in folk-moot, he might either ignore opposing claims or defend himself by proving, with the aid of compurgators, his possession, and by his "sole oath" the manner in which he acquired possession. This protection was obviously based rather on the extinction of opposing claims than on the acquisition of prescriptive right.

As regarded movables, Teutonic custom treated possession as ownership except in the case of things lost or stolen; but here again the protection of the possessor was based, originally, on the fact that the owner of movables who had parted with possession of his free will was allowed no action of recovery against other persons than his bailee.

The Church accepted the Roman rules of prescription, but with one important modification. The Roman law required that possession should be obtained *bona fide*, but did not demand the continuance of *bona fides*. In other words, the fact that the possessor discovered, after prescriptive possession had been established, that his title was bad, did not interfere with the completion of the prescription. The Church made such a discovery fatal to the completion of prescription (*mala fides superveniens nocet*). This rule was generally recognized and enforced by the secular courts.

3. *Modern legislations* generally recognize, in some form and to some extent, the Roman theories of prescription (Fr. *prescription*, Germ. *Ersitzung*). According to the analogy of the Roman extraordinary prescription, the European codes generally treat the extinction of the previous owner's action of recovery as establishing the ownership of the honest possessor. The Code Napoléon goes further and discards the Roman requirement of *bona fides*. The rules of ordinary prescription are substantially Roman, but in some legislations the character of the title on which prescription can be based has been modified. The Roman law permitted prescription when the possessor erroneously imagined that he had color of title; so, for example, when he acquired possession through a representative or agent and erroneously supposed that the agent had acquired by some legal method of transfer (so-called "putative" title). The Roman law, again, permitted the heir to prescribe, although his ancestor had held possession for another as bailee or lessee, etc., provided the heir was ignorant of this fact (title *pro herede*). In the latter case prescription is excluded by the French law; in the former case it is excluded by the Austrian law, which admits prescription only when the possessor has at least a color of title.

The whole doctrine, however, has lost or is losing much of its importance in modern European law, by reason of changes in the law concerning acquisition of ownership. As regards movables, the tendency is to give further protection to the honest possessor than was given as Roman law. In a large number of cases honest possession carries with it a perfect title, exception being made only in the case of lost and stolen property. The Code Napoléon, which goes furthest in the protection of the honest possessor, lays down no rules at all concerning the prescriptive acquisition of movables. The matter is regulated by treating honest possession as equivalent to ownership, except in the case of things lost or stolen, and by limiting the action for the recovery of lost or stolen things to three years.

In the German law there is a tendency to exclude prescription of realty. This tendency is due to the development of the "land-book" system (see RECORDING) and to the *publica fides* which entries in the land-book enjoy. In Prussia and in a large number of minor German states prescription is absolutely excluded as against a registered title; and in some of these states, in which registration is made

essential to title, preseription of unregistered land gives only a right to demand registration. The German draft code excludes real property from preseription.

The Austrian code, whieh does not go so far in the protection of the registered title, makes the entry in the land-book a basis for a peeuliar preseription of perfeet title without aetual possession. The person registered as owner obtains "full right" against all the world in three years.

4. *Theory.*—Preseriptive aequisition is defended on the same grounds whieh are held to justify the LIMITATION OF ACTIONS (*q. v.*). Statutes of preseription are also "statutes of rest." The wrong apparently done to him who loses his right in eonsequenee of the establishment of an adverse right disappears when it is eonsidered that he has only himself to blame, that he is the vietim of his own negligenee. An independent reason for reeognizing preseriptive aequisition is found in the faet that it not merely transforms imperfeet into perfeet titles, but that it also transforms derivative into original titles, and frees owners from the neeessity of proving the titles of their predeeessors. The former result of preseription is oeeasional, the latter is constant. This eonstant eonversion of derivative into original titles is really the most important funetion diseharged by laws of preseription; and it is beeause the same end is gained, as regards realty, by the German registration laws, and as regards movables, by the proteetion given to the honest possessor as sueh, that preseription is losing its importanee in modern European law.

IMMEMORIAL PRESCRIPTION.—Ordinary preseription and the so-ealled extraordinary preseription of thirty or forty years ereate and extinguish only eertain kinds of property rights. It is commonly asserted by European jurists that by virtue of the so-ealled "immemorial preseription" any sort of status may beeome a legal status; and that, in particular, private rights whieh ean not be established by any other sort of prescription (e. g. obligations) may be established by the faet that they have been exercised "time out of mind." Aeeording to one theory, immemorial preseription absolutely ereates rights; aeeording to another, it creates a presumption that the powers actually exercised are rightful —a presumption that can be overturned only by showing that their origin was unlawful. The doctrine is not based wholly upon the Roman law, which reeognized immemorial preseription only in a very limited class of eases (viz., rights of way, water rights, etc., *quorum memoria non extat*), but upon certain provisions of the canon law and the rules of old German eustom. The canon law, however, recognized immemorial preseription only as establishing rights of eeclesiastieal supervision, rights to tithes, and rights to eertain tolls and tributes, all of which are properly publie, not private rights; and while old German custom upheld as presumably rightful a state of things which had existed for at least two generations, provided the older members of the community had neither known nor heard of a contrary state of things, the rights thus established were either quasi-publie rights or rights capable of what the Romans called quasi-possession. Those who, nevertheless, affirm the general recognition of immemorial prescription in old German law not infrequently confuse the establishment of legal rules by immemorial eustom with the establishment of rights by preseription. The doctrine of immemorial prescription seems to have no place in modern private law. It is ignored by all the European eodes.

MUNROE SMITH.

Prescription: *English and U. S. Law.*—In the eommon-law system the term *prescription*, though borrowed from the civil law and embodying the same legal eoneeption, is used in a much narrower sense. Here it describes the aequisition by lapse of time only of those rights over the land of others whieh the Roman law described as *servitudes*—sueh as easements and profits (see EASEMENT and HEREDITAMENTS, *Incorporeal*)—and it has no referenee to the aequisition of title to lands or goods by long occupation. The theory of the eommon law as to the title to lands by *adverse possession* was that the property in the land was at once transferred by the disseisin and oeeupancy to the wrongful taker, and that the lapse of time operated not to confer any additional right upon the latter, but only to make him more seeure by depriving the former owner of his remedies against the wrongful transfer of title. (See LIMITATION OF ACTIONS, *Real Property.*) The theory of *prescription*, on the other hand, is that long and uninterrupted enjoyment of a use or profit in another's land is of itself conclusive evidence of a *right* lawfully aequired at some remote period in the past.

It is in the highest degree probable that many of these preseriptive rights go back to a time when the land over whieh they are asserted was common land, and when the use in question was merely the exercise of a eommon right, and that the private ownership of the land affeeted was imposed upon these original rights of enjoyment and was exercised in subordination to them. This is espeeially true of that extensive elass of rights known as "rights of eommon" (see HEREDITAMENTS, *Incorporeal*), as well as of those eustomary rights whieh are hereinafter deseribed. This historical view of the origin of preseriptive rights, however true in faet, eould not long withstand the feudalization of the eommon law of property. In a system under whieh all lands were held, direetly or indirectly, of the king, as lord paramount, there was no room for any theory of original ownership of lands in eommon. (See ESTATES, FEUDAL SYSTEM, and PROPERTY.) Aeeordingly a support for these preseriptive rights was found in the doetrine of a "lost grant." This doetrine was expressed in terms of a legal presumption, that uninterrupted, notorious, and adverse enjoyment of the right asserted, from time immemorial (i. e. for so long a time "that the memory of man ran not to the eontrary"), was evidenee of a grant of sueh right in the remote past by the then owner of the "servient tenement" to the aneestor or predeeessor (as the ease might be) of the person now elaiming the right. This theory of a lost grant was, of eourse, a fietion, pure and simple, and was invented in order to give a eolor of legality to the preseriptive elaim, there being in English law no eountenanee for the doetrine of the eivil law that mere persistenee for any length of time in a wrongful state of affairs converts it into a right and lawful state of affairs. Originally, however, the fietion was taken very seriously by the judges, and the question as to whether there had in faet been sueh a grant as was alleged was submitted to the jury for their determination. At a later period the doctrine took its plaee as a true presumption of law (see PRESUMPTIONS), the existenee of the grant being arbitrarily assumed by the law from the fact of use and enjoyment for the required term and under the proper conditions. It was still possible, however, to rebut this presumption by showing that such a grant as the one alleged eould in faet never have been made. This appears to be the state of the law in England at present in eases not covered by the statute hereinafter referred to. (See 3 *Harv. Law Rev.* 183.) In the U. S., however, the fictitious character of the doctrine of a lost grant has, as a general thing, been fully reeognized and evidence is not admitted to rebut the allegation. This result is commonly expressed by saying that the presumption of a grant has beeome "conclusive," but the true view of the matter would seem to be that the law no longer indulges in any presumption regarding the origin of the right in question, but arbitrarily holds that due and proper enjoyment thereof shall be eonclusive evidenee of the existenee of the right.

The length of time requisite to answer the description of "immemorial" enjoyment has varied greatly from time to time, the period of limitation of real actions (see *Real Property*, under LIMITATION OF ACTIONS) having usually been adopted by the eourts as the measure of the prescriptive term. This rule formerly required the tenant to show that his possession or enjoyment dated back to the aceession of Riehard I. (A. D. 1189), but, when the lapse of centuries rendered this an inconvenient measure of the right claimed, it was shortened by statute (32 Hen. VIII., c. 2, A. D. 1540) to sixty years, and finally to twenty years, at which it now stands in England and most of the U. S. The eourts having taken over this period of limitation as the measure of the preseriptive term, it follows that a right in the nature of an easement or profit over the land of another may now generally be aequired by enjoyment of the right for twenty years, though different periods, varying from fifteen to thirty years, have been adopted in a few of the States. A disability existing at the time the prescriptive period began to run will be allowed in computing the latter, as in the case of the limitation of aetions for the reeovery of real estate. In England the whole subject is now for the most part regulated and the length of the preseriptive term fixed by a Prescription Aet (2 and 3 Wm. IV., ch. 71, A. D. 1832), but in the U. S. the doctrine eontinues to be governed by the eommon law as above set forth.

Not all easements or rights in the nature of easements may be aequired by preseription. The use or enjoyment relied upon as the foundation of the right must be of sueh a character that it is a visible and notorious infringement

upon another's property rights. It is wholly immaterial whether the person against whom the right is claimed has actual knowledge of the infringement or not, but the acts relied upon must be of such a character that he might or should have known of them. In all cases of *positive* easement—such as rights of way, of drainage, and the like—and in all profits, the notoriety of the enjoyment is conclusively presumed; but where the easement is of the kind described as *negative*—such as lateral support, light, etc.—and where the user is unobtrusive and of such a nature that it can not be conveniently interrupted, the courts have been loath to recognize a right founded upon mere prescriptive enjoyment. As applied to the easement of light the principle has long been established in England under the name of "ancient lights," and the English courts have lately applied it to an easement of the support of one house by another (*Angus* vs. *Dalton*, 3 Q. B. D. 85; 4 Q. B. D. 162; 6 App. Cas. 740), but they have refused to extend it so as to include a right to the flow of air to a windmill or to legalize a nuisance arising from the vibration of a wall in consequence of the operation of a pestle and mortar. In the U. S. the courts have generally refused to recognize the validity of prescriptive claims to negative easements on the ground of the unsuitability of the doctrine to the conditions of life and property in a new country.

Prescriptive rights as here described should be carefully distinguished from similar rights existing by local or special custom, with which they are often confounded. In England (though not, it would seem, in the U. S.; see *Ackerman* vs. *Shelp*, 3 Halsted [N. J.] 125) all persons residing in a certain community or belonging to a certain calling may have common rights, in the nature of easements, over the land of an individual by virtue of a local custom of great antiquity. What distinguishes these customary rights from prescriptive rights proper is the fact that they attach to the persons belonging to the group in question by virtue merely of their domicile or calling, as the case may be, and that a person who has newly become a member of the community or guild in question is entitled to the right equally with all other members thereof, whereas in the case of prescription proper the person asserting the right must show that it has descended to him from his ancestors or predecessors in title, as the case may be, or at least that it has been enjoyed by himself for the prescriptive period.

In addition to the authorities cited in the course of this article, see Gale on *Easements* and Washburne on *Easements and Servitudes*. GEORGE W. KIRCHWEY.

Prescription: in international law, a founding of good title to territory which without a treaty of cession or any well-defined right has for a considerable length of time been held in possession by a state. The objections to it are (1) its indefiniteness, since no fixed limit of time exists to constitute prescriptive possession; (2) the false resemblance to the common law doctrine, inasmuch as a dispossessed state can not be bound to declare war in order to prevent prescription from running against it; (3) its frequent violation at the dictate of national policy.

In spite of such arguments, the principle of a prescriptive title to territory has obtained in international law to quiet an originally doubtful title and to remove the uncertainty which would result if ownership of territory, though wrongfully acquired, after years of uninterrupted enjoyment could be called in question. Thus Wheaton believes this doctrine to be founded upon the general consent of mankind and man's sense of its mutual utility, and that it tends to promote the general welfare.

Phillimore asserts that "the peace of the world, the highest and best interests of humanity, the fulfillment of the ends for which states exist, require that this doctrine be firmly incorporated in the code of international law."

Hall declares that "the object of prescription as between states is mainly to assist in creating a stability of international order, which is of more practical advantage than the bare possibility of an ultimate victory of right," at the same time pointing out the defects of the theory. These opinions are shared by nearly all publicists. In accordance with this principle, Poland, divided between three states under no pretext of legality, has now lost its identity, and legally belongs to them. Among the proofs of prescriptive possession may be mentioned publicity, long continued (though not necessarily immemorial) occupancy, absence of interruption, and the use of the state's resources upon the land. THEODORE S. WOOLSEY.

Prescription: a written formula for the compounding and dispensing of medicines. Previous to the nineteenth century physicians dispensed their remedies, and the prescription was chiefly a record for the guidance of an assistant, who performed the manual work, and for the preservation of valuable or standard curative combinations; but with the separation of the vocations of physician and apothecary the prescription has become the medium of communication between them, the written instructions of the former to the latter. The ingredients of a prescription are commonly designated in Latin; the nomenclature of botany and of chemistry determines the names of vegetable and mineral remedies, and their technical names are the only ones by which they can be definitely known and correctly prepared. The enumeration of the several articles is preceded by the symbol ℞, an abbreviation of Lat. *recipe* (take). This symbol has also been regarded as a modification of the sign ♃, the symbol of Jupiter, with which the ancients prefaced their prescriptions to propitiate the gods and insure a favorable action of their drugs. The several component parts of a prescription should be enumerated in the order—(1) of their chemical relation and pharmaceutical combination; (2) with reference to the object sought by each. The chief therapeutic or remedial agent should be prominent; co-operating remedies and those producing other and secondary effects, termed *adjuvantia*, receive the second position; articles intended to modify or correct the action of the preceding, termed *corrigentia*, come next; and, lastly, substances, liquid or solid, intended to secure definite quantity or consistency, to insure solubility and uniform subdivision of doses, and variously known as the *vehicle*, *excipient*, or *menstruum*. The latter term arose from the superstition of ancient chemists and alchemists that dissolvents acted best at the time of the lunar changes. The quantities of the components are expressed by symbols. The prescription terminates with the abbreviation M. of Lat. *misce* (mix). Appended to the prescription the physician usually adds instructions of the dose and time and method of taking. These are usually in Latin, which the apothecary translates and transcribes on the label of the dispensed medicine; but the custom is growing of restricting the use of Latin to the prescription proper, and stating the direction for use plainly in English.

Revised by H. A. HARE.

Presentment: in criminal law, strictly, the act of a grand jury which of its own motion and from its own knowledge, or from evidence placed before it, and without a bill of indictment, makes a written accusation charging some person or persons with the commission of some public offense. At the common law, before criminal proceeding can be instituted against the accused upon this accusation, an INDICTMENT (*q. v.*) must be framed, but in some of the U. S. this rule is modified, and a trial may be had upon the presentment. Sometimes in the U. S. grand juries make general charges of public evils or offenses for the purpose of calling the attention of the public or the proper officers to them, without intending that they shall be a basis for an indictment or information. See GRAND JURY. F. S. ALLEN.

Preservation of Food: the art of treating articles of food so as to prevent their deterioration and loss through lapse of time. Although applicable to all perishable foods, it is of especial importance in relation to fruit. The value of fruits in the diet of human beings can hardly be overestimated. Their juices regulate the biliary secretions and the action of the digestive organs, and purify the blood. Grapes, peaches, strawberries, blackberries, and, pre-eminently, apples, if partaken of freely when at their ripest and best, go far toward obviating the need of cathartics and astringents.

Desiccation.—Even a partial appreciation of the nutritive, alterative, and curative properties of fruits, roots, and other vegetable edibles at an early age begot the desire to preserve them during the seasons when fresh supplies were not procurable. Succulence made them valuable, yet for a long time desiccation was the only method of preventing them from decaying into worthlessness. Dried dates, packed in bags, under powerful pressure, were as essential to the Arab in his desert wanderings as jerked buffalo, dried in the sun or smoked over the fire, was to the North American Indian. Delicious juices during this process became granulated sugar, and much of sweetness and distinctive flavor were lost. The antiseptic effect of desiccation upon flesh and fish was aided by salt, and certain fruits and green cereals were packed down in this, the saline taste being ex-

tracted by soaking in several waters before eating. Peaches, figs, apricots, limes, prunes, cherries, and grapes boiled in sirup and then desiccated were known as candied sweetmeats. They are popular still under the name of crystallized fruits. Ginger and other medicinal roots are sometimes preserved by mere desiccation, natural or artificial, or are cooked in sirup and then dried. Fruits, vegetables, meat, and fish are now dried in kilns far more rapidly and effectually than by the heat of the sun, the waste by shrinkage being reduced to a minimum, and the very form of the juice-cells remaining almost unchanged.

Method of Canning.—In canning the chief agent is heat: the object is to retain as far as practicable the natural character of the article subjected to the process, and to arrest at a given point agencies which would, in the natural course of events, cause decay. To effect this air must be absolutely excluded. The minutest flaw in the can or in the rubber padding the tightly screwed top will admit bacteria, the presence of which means putrescence. It is requisite, also, that the substance to be preserved should be made hot through and through. The heart of the fruit or vegetable, or the center of the lump of flesh or fish to be canned, must be of the same high temperature with the outside, or the germs which cause decomposition will not be destroyed.

The larger fruits are prepared for canning by paring and removing hard portions that would resist the action of heat, and decayed parts that would mar the flavor and color. As the fruit is pared it is dropped into cold water, lest it should "rust," that is, darken with exposure to the air, with consequent injury to the flavor. When ready for heating the prepared peaches, pears, or apples are packed in a kettle of clean bell-metal, of agate ironware, or of iron lined with porcelain. Sugar, in the proportion of one tablespoonful to each pound of fruit, is scattered between the layers, and the whole is brought slowly to the boiling-point. This reached, the contents of the kettle are cooked gently three minutes, to insure a thorough and even temperature. There must be no diminution of heat throughout the operation. The glass jars or tin cans designed to receive the fruit must be made hot, filled to overflowing directly from the kettle, and sealed instantly. The fruit and liquor in cooling will leave a vacuum between the cover and the contents. Were space left while the fruit is hot it would be filled with germ-laden air, and the process be imperfect. Small fruits are canned in the same way, with the omission of the prefatory paring. Vegetables of every kind are put up in accordance with the leading principles of thorough heating and hermetical sealing. When the work is done skillfully the preserved fruit is good for two years, often for ten.

Meats of various sorts, and such fleshy fish as salmon and sturgeon, are cut into neat pieces, boiled for a longer time than fruits and vegetables, and sealed hot. Chicken and tongue are sometimes cooked tender, packed into glass or metal cases, and the interstices between the pieces filled with well-seasoned meat-jelly or "aspic." This is a hot liquid when the cans are sealed, but congeals in cooling and tends to preserve the meat, while adding much to the palatableness and elegance of the dish when served. Sardines, anchovies, and other small fish are cooked in oil, pressed into tin boxes or glass jars, covered with boiling oil, and sealed. *Pâtés* and potted meats are made of well-cooked meats highly seasoned, ground into a paste, and pressed hard into cases. The surface is covered with melted butter or lard, scalding hot, and the cover is air-tight.

Somewhat similar in principle to canning is the use of dry sand, sawdust, ground cork, and desiccated earth in packing grapes, apples, and pears for long keeping—the intent in each case being exclusion of the outer air. Whenever this can be accomplished the integrity of the article to be preserved is tolerably sure. Other approved agents are tin-foil and raw cotton.

Pickles.—Almost every variety of esculent known to man is prepared and stored for table use by means of spiced vinegar. Green vegetables, liable to spoil by reason of the succulence that is their chief recommendation, must first be made firm. This is done by steeping them in strong brine for a number of days. Several times during the process the pickling substances are taken out, cleansed, and picked over, all doubtful specimens being rejected and the sound returned to freshly made brine. When sufficiently hard they are transferred to a vessel containing pure, soft water, and left thus for twenty-four hours. A kettle is lined with green vine-leaves, the cucumbers, mangoes, green peppers, melon-rind, gherkins, or whatever other articles are on hand, are packed into it with alternate layers of vine-leaves, and covered thickly with the same. Powdered alum is sprinkled between the layers and over the topmost stratum, and cold water poured in until the kettle is full, after which the contents are slowly cooked, or steamed, for a couple of hours, or until the vegetables are of a fine green. They are then thrown into ice-cold water, and lie in it for an hour or more. Finally, they are packed in a jar and scalding vinegar, highly spiced, is poured over them. The vinegar is strained off, heated, and returned to the pickles every two or three days for a fortnight. The jars are then covered and set away in the cellar or other cool place for the pickles to ripen. Thus prepared they keep good for years.

Meats and every variety of fish, oysters, clams, lobsters, shrimps, etc., are pickled by being partially cooked in clear water, and while lukewarm treated with boiling vinegar seasoned with whole spices, red pepper, and a little salt. These must be sealed boiling hot. Pickled oysters and clams, if put up in glass vessels, should be kept in a dark place, as the light darkens, and even has a tendency to decompose them.

Raw meats and fish are preserved from decomposition by plunging them into and keeping them below the surface of a solution of salt and water strong enough to float an egg. This process is technically known as corning. While it prevents decay, it hardens fiber and grain and renders the food more undigestible than when fresh. Beef and the legs and shoulders of pork are often treated with a mixture of saltpeter, sugar, and salt, rubbed well into them before they are covered with brine—treatment repeated at stated intervals for two or three weeks, until the corning or pickling is complete.

Olives, young limes, and anchovies are preserved by scalding them in salt and water, then filling the bottles in which they are packed with the same. Cucumbers, mangoes, and the like can be kept in simple brine for months, but deteriorate in tenderness and flavor.

Curing is done by suspending flesh or fish that has already undergone pickling in the smoke of smoldering wood, usually hickory or oak, and leaving it thus for an indefinite time, seldom for less than a month. A blackish crust, that tastes and smells of the creosote which is the antiseptic agent here, while it supplements the work of the brine and saltpeter, is not always proof against the invading host of bacteria and other invisible enemies. Unless hams, shoulders, and rounds are further defended by stout linen cases, which, in turn, are fortified by whitewash or paint, they can not be reckoned upon with safety. Some housewives envelop bacon in thick paper and bury it in sifted ashes. Buffalo-meat and salted fish hang all winter from the ceiling of wigwam and hut; the flitch of bacon of "ye olden time" hung in the cotter's wide-mouthed chimney. The Greenlanders and Lapps dry and then smoke reindeer venison and seal-meat. In Labrador and other regions where herring abound tens of thousands of barrels of these fish are salted, smoked, and pickled annually for the home and foreign market. The Yarmouth bloaters of England hold a high place in this class of staple provisions.

Eggs may be preserved good for two months by washing them all over with a solution of gum tragacanth and water, letting them dry in the shade, and packing them, the small ends downward, in bran, meal, flour, or salt. Another way is to arrange them, small ends downward, in a crock and cover them with lime-water. This is made by mixing a pound of lime, 2 oz. of salt, and half an ounce of saltpeter in a gallon of boiling water, stirring it until all are dissolved, and letting it get perfectly cold before it is added to the eggs. Still another more expensive method of keeping eggs is to pack them as above directed and pour over them half-congealed lard as cool as it can be and yet flow, and letting it harden about the eggs. Some housewives grease eggs with lard or oil and pack them in bran or salt.

Charcoal is a potent antiseptic. Butter may be kept sweet for a long time by fitting into the bottom of crock or firkin a linen bag of powdered charcoal. A bag of coarse charcoal is often kept in the barrel of pickled meat, and bits, wrapped in thin cloths, introduced into the inside of fish and fowl after they are cleaned, will ward off decomposition for a day or two.

Preserves.—This term is popularly applied to fruits cooked in sirup in the proportion of a pound of sugar to one of fruit. Our great-grandmothers called them "conserves," and gave them honorable place among their stored delicacies. Under the head of preserves come jams and marma-

lades, the only difference between these and the conserve proper being that less sugar is needed for jams, and that they and marmalades are stewed down to a smooth paste. In the regular preserve care is taken to retain, as far as may be, the form of the fruit. Clearness of sirup and agreeable color in the conserve are much esteemed by housewives. The process is delicate and tedious, and for some years the quicker and more economical method of canning threatened to supersede it entirely.

Fruit jellies are made by pressing and straining the juice from the pulp, boiling it clear, and adding a pound of sugar for each pint of scalding liquid, stirring the mixture over the fire until the sugar is dissolved, and filling heated glasses or china jars with it. When the jelly is cold and firm the surface is covered with tissue-paper, saturated with spirits, before metal or paper tops are fitted upon the glasses.

Alcoholic liquors are efficient agents in the preservation of fruits. A rich sirup is made in which the fruit, pared or with the skins on, is gently stewed until tender and clear; the liquor is added an instant before the kettle leaves the fire. When this preliminary stage is neglected the substance immersed in the spirits becomes tough and acrid.

Condensed Milk.—See MILK.

Extreme cold, by suspending natural processes which would induce decay, has long been recognized as a valuable accessory in preserving food. Food of every description, including the most delicate fruits, is transported from one side of the continent to the other in refrigerator-cars. Summer hotels have immense store-rooms, constructed upon the refrigerator principle, in which fish, poultry, and what is sold as "butcher's meat" may be kept for long periods. The beef killed upon the Texas plantation finds a market in New York and Boston. Adirondack trout and salmon from the Kennebec river set forth tables in New Orleans and San Francisco.

MARION HARLAND.

Preservation of Timber: the act or process of rendering timber more durable. Methods which accomplish this end are important as positive aids in arresting the progress of the exhaustion of the timber-supply. The extent to which the various practical methods of preserving timber are used depends upon the cost of timber, the nature of the structure, etc.

Decay of wood proceeds from agencies both internal and external. *Cellulose*, which constitutes the great bulk of woody tissue, is by itself an exceedingly imperishable substance, but appears, when in contact with fermenting or putrefying nitrogenous matters, to be capable of entering into decomposition like its isomers and congeners sugar and starch, forming humus-like substances, devoid of coherence. Fermentation or putrefaction can not take place in the absence of moisture, and hence perfect seasoning of the wood is a powerful preservative. This process, however, is exceedingly consumptive of time and expensive; being nugatory, moreover, in case the wood is to be exposed to moisture. It has been thought that this internal destructive agency is best antagonized by the use of chemical agents. Other internal destructive agencies arise from the eggs of insects deposited in the wood or under the bark. This may be sometimes, though not always, remedied by stripping off the bark; impregnation with agents poisonous to the developing larvæ is surer. External destroying agencies are many, and are most powerful when the wood is exposed to simultaneous action of air and moisture, which engender and foster a number of destructive processes. Under seawater, and between high and low tide, the teredo is another destructive agent. In tropical countries ants are enemies of timber structures. Contact with iron also destroys cellulose rapidly, through a slow combustion set up between the carbon of the cellulose and the oxygen of ferric oxide. A species of disintegration called DRY ROT (*q. v.*) is also caused by the action of some fungi. See also ROT.

The following are a few of the more prominent methods of treatment for rendering wood durable that have been practiced and have met with approval.

The Method of Kyan.—Impregnation with a solution of *corrosive sublimate*, bichloride of mercury. This was the first method experimented with in the U. S., and great expectations were entertained regarding it. It is founded on the known property of corrosive sublimate to form insoluble compounds with albuminoid bodies.

The Methods of Boucherie.—Impregnation with *sulphate of copper*, also with *chloride of calcium*. Sulphate of copper has much preservative power, and is cheaper and far less dangerous to handle than corrosive sublimate. It is, however, removed gradually from the wood by moisture. Chloride of calcium renders the wood fire-proof, adding also great strength and toughness. The latter substance has never been sufficiently or fairly experimented with, considering its cheapness and the enormous advantages it holds out. Dr. Boucherie was also the inventor of a method of making the preservative liquids penetrate the tree while still standing. Notches are cut in the trunk near the roots, and caoutchouc bags holding the solutions bound on. The tree sucks up the liquid through the evaporation from the leaves above.

The Method of Burnett.—A solution of *chloride of zinc*. This agent, like *corrosive sublimate*, operates by combining with the fermentable albuminoids, but is much cheaper and not noxious. For many uses burnettized timber is no doubt very valuable.

The Method of Bethell.—The impregnation of the wood with heavy oils of coal-tar, called in Great Britain "creosote oil"—in the U. S. "dead oil." This method has been largely used in Europe, and apparently with much success, even against the salt-water teredo, which other methods do not resist. The oil was forced into the pores of the timber in a strong receiver by a pressure of 13 or 14 atmospheres.

The Method of Seeley.—This is an improvement on that of Bethell. The wood is immersed in the oil—a crude carbolic acid being used, which is believed to be much more efficient than the common dead oil—in a closed tank, and the temperature raised to 300° F. The air and moisture are thus expelled from the timber, which is then suddenly introduced into a bath of *cold* carbolic acid. By this ingenious process an absolute impregnation is accomplished.

Revised by IRA REMSEN.

Preserves: See PRESERVATION OF FOOD.

President: in the U. S., the chief magistrate of the nation, chosen by a college of electors elected by the voters of the several States. The term of office is four years, after which the President may be a candidate for re-election, but custom and precedent are against electing him for a third term. The office, which was established by the Constitution of 1787, imposes upon the incumbent the obligation to see that the laws are faithfully executed, authorizes him to grant pardons and reprieves, to conclude treaties with the concurrence of the Senate, to veto unwise legislative measures, which can then be passed only by a vote of two-thirds of each house of Congress, and to appoint officers to administer the laws. He is commander-in-chief of the army and navy of the U. S., and of the militia of the several States, when called into the service of the U. S. Upon the death, removal, or resignation of the President, the Vice-President succeeds him in office. If, for any reason, both the President and the Vice-President are unable to serve, a member of the cabinet, in the following order, acts as President until the disability is removed or a President is elected: the Secretary of State, Secretary of the Treasury, Secretary of War, Attorney-General, Postmaster-General, Secretary of the Navy, Secretary of the Interior, and Secretary of Agriculture.

Presidential Electoral Commission: a board appointed during the second session of the Forty-fourth Congress of the U. S. to determine questions arising out of the presentation of two or more discordant certificates of the votes of the electoral colleges of certain States in which the election of presidential electors had been contested. The result of the election depended on the voice of three States, Florida, Louisiana, and South Carolina, in which both parties claimed the victory; and of a fourth, Oregon, in which one elector was claimed to have been elected by a minority, in consequence of a constitutional disqualification affecting one of the candidates of the majority. From Louisiana, Oregon, and South Carolina, the certificates presented were in each case twofold, and from Florida threefold. The electoral congress was so divided between the opposing parties that the choice of the Democratic electors in any one of the contested States would have given the majority to the Democrats, while the choice of the Republicans in all would give that party a majority of one. An angry controversy arose as to the constitutional mode of deciding between these competing certificates. The dispute assumed proportions which even threatened the peace of the republic. For the purpose of averting the impending danger a joint committee of fourteen members from the two houses was appointed early in Jan., 1877, to devise, if possible, some

means satisfactory to all of ascertaining the legal result of the election. The bill reported by this committee on Jan. 18 and passed by both houses in the following week provided for the creation of a tribunal to be composed of five Senators, five Representatives, and five associate justices of the Supreme Court of the U. S., four of the latter being designated by their districts in the bill itself, the fifth to be subsequently chosen by these four; to which tribunal should be referred the conflicting certificates, with the authority to ascertain the legal vote of each State in which the election was contested. The bill further provided that the decisions of such tribunal in every case should stand, unless rejected by the concurrent vote of both houses.

On Jan. 31 the commission was elected, three Republicans and two Democrats being taken by agreement from the Senate, and three Democrats and two Republicans from the House. The four justices having chosen a Republican, the relative strength of the two parties in the commission was eight Republicans to seven Democrats. When the subject had been argued by the ablest legal counsel that could be engaged on both sides, the vote in favor of the respective certificates was eight Republicans against seven Democrats, the eight Republicans voting in favor of the Republican electors in each of the contested States, thus giving to their party the majority of 185 to 184 in the electoral congress. The decision was communicated to the joint convention of the houses of Congress on Thursday, Mar. 1, and on Mar. 2 the president of the convention announced that Rutherford B. Hayes, of Ohio, had been duly elected President of the U. S. Revised by C. K. Adams.

Presidio of San Francisco: a military post in the northwest suburbs of San Francisco, Cal. It takes its name from the Spanish *presidio*, a garrison or fortress, the Spanish garrison defending San Francisco having been located near this site. The post is arranged for the accommodation of sixteen companies, but usually the garrison is much smaller. It is distant 4½ miles from the railway station in San Francisco, with which it is connected by a city railway. The reservation is large—1,540 acres—affording sites for gun and mortar batteries for harbor defense. J. M.

Presque Isle, presk'eel': town; Aroostook co., Me.; on the Aroostook river, and the Canadian Pacific Railway; 42 miles N. by W. of Houlton, the county-seat (for location, see map of Maine, ref. 3–F). The river affords abundant power for manufacturing, in which the town has large interest. There are a number of saw and grist mills, starch-factories, and machine-shops, a national bank with capital of $50,000, a trust and banking-house with capital of $50,000. Pop. (1890) 3,046; (1900) 3,804; village, 1,256.

Press: See Printing-presses.

Pressburg (Hun. *Pozsony*; Lat. *Posonium*): town; one of the finest of Hungary; on the north bank of the Danube, near the frontier of Lower Austria (see map of Austria-Hungary, ref. 5–F). It was the Hungarian capital from 1541 till 1784, when Joseph II. restored that dignity to its former possessor—Buda. It has a stately cathedral and a city-hall, begun in 1090 and 1288 respectively, an academy, museums of antiquity and natural history, and numerous other excellent educational and philanthropic institutions. Ruins of its magnificent royal castle, destroyed by fire in 1811, crown the neighboring hill 277 feet above the river. It manufactures chemicals, leather, and gold and silver ware, and carries on a large trade in grain and wine. Pop. (1890) 52,411, of whom less than a fourth are Hungarians, the majority being Germans. E. A. Grosvenor.

Pressensé, prā'sāañ'sā', Edmond (Dehault), dc, D. D.: clergyman and author; b. in Paris, Jan. 24, 1824; was educated in Paris, Lausanne, Halle, and Berlin; was pastor of the Chapelle Taitbout, Paris (Evangelical or Independent Protestant), 1847–70; received the degree of D. D. from Breslau 1869, from Montauban 1876, and from Edinburgh 1884; an eloquent and earnest preacher, his whole energies were devoted to the maintenance of the freedom of the Church from state interference and from dependence upon state aid, and to the presentation of Christianity as the means of solving the important moral and social questions of the day. After the proclamation of the republic he was elected a member of the French Assembly, and a life senator Nov. 13, 1883. Among his principal works are *Conférences sur le Christianisme dans son Application aux Questions sociales* (Paris, 1849); *Histoire des trois premiers siècles de l'Église Chrétienne* (1858–77, 6 vols.; 2d ed. 1889, *seq.*; Eng. trans. 1869–77; introduction to new edition separately trans. under title *Ancient World and Christianity*, Eng. trans. 1888); *L'Église et la Révolution française* (1864; 2d ed. 1867; Eng. trans. *The Church and the French Revolution*, London, 1869); *Jésus-Christ, son Temps, sa Vie, etc.* (1866; 7th ed. 1884; trans. into English by Annie Harwood, London, 1866; 4th ed. 1871); *Le Concile du Vatican* (1872); *Études contemporaines* (1880; Eng. trans. *Contemporary Portraits*, 1880); *Les Origines* (1882; Eng. trans. *Study of Origins*, 1883). D. in Paris, Apr. 8, 1891.
Revised by S. M. Jackson.

Pressing to Death: See Peine Forte et Dure.

Pressure-sense: the apparatus in the skin, muscles, etc., and its nervous connections, which gives sensations of weight or pressure. Such a sense, apart from touch and muscular-movement sensation, is claimed by expert investigators, and very delicate determinations have been made upon the minimum perceptible pressure, the pressure giving pain, the smallest perceptible difference of pressures, etc. See Psycho-physics and Sensation. J. M. B.

Prester John (*Priest John*): a semi-mythical character who figured largely in the geographical romances of the Middle Ages, whose true country and period are difficult to be fixed with certainty. According to general belief, there was somewhere in the interior of Asia or Africa a kingdom which had been converted from Islam to Christianity, governed by a priest-king named John, who was exceedingly anxious to open friendly intercourse with the Church of Rome. During two centuries numerous embassies were sent to Central Asia, and even to Abyssinia (1481–95), in search of the lost Christian nation, but the search proved fruitless. The origin of the legend appears to date from the Nestorian missions which in the eleventh and twelfth centuries penetrated to Karakorum in Turkestan, and converted the khan of that district, named Ung, who was overthrown and killed by Genghis Khan in 1202. He appears to have authorized the Nestorians to make in his name certain requests of the pope, and to their glowing narratives, sent to the Greek emperor and to the Kings of France and Portugal, Europe was indebted for a favorite cycle of legends which may be read in Assemani's *Bibliotheca Orientalis*. Father Rubruquis, sent by St. Louis, King of France (1253), in search of Prester John, penetrated to Karakorum. (See his interesting narrative in Purchas's *Pilgrims*.) There are extant letters from Prester John to the Greek emperor Manuel (1165) and one to him by Pope Alexander III. (1177). See G. Oppert, *Der Presbyter Johannes in Sage und Geschichte* (Berlin, 1864; 2d ed. 1870); F. Zamke, *Der Priester Johannes* (Leipzig, 1876–79, 2 parts); and note in Col. Yule's edition of the *Travels of Marco Polo* (London, 1871; 2d ed. 1875).
Revised by S. M. Jackson.

Preston: town; in Lancashire, England; on the Ribble, at the head of its estuary; 28 miles N. N. E. of Liverpool (see map of England, ref. 7–F). It is substantially built, principally of brick, at a height of about 120 feet above the river. The town-hall, designed by Sir Gilbert Scott, is a French Gothic structure with a spire. The Roman Catholic church, St. Walburge's, has the highest spire (306 feet) built in England since the Reformation. Three public parks were laid out in 1867. Preston was constituted a port in 1843, and since 1885 the channel has been deepened and a dock of 40 acres constructed. It is one of the chief seats of the Lancashire cotton industry. (See Lancashire, *Industries*). There are also iron and brass foundries, tanneries, rope-walks, glass-works, ship-building yards, engineering and machine shops, breweries, and distilleries. As capital of a district which was granted to the cathedral church of York, the place came to be known as Priests' town, afterward Preston. Near Preston, Aug. 17, 1648, Cromwell totally routed the royalists. Preston returns two members to Parliament. Pop. (1901) 120,860.

Preston, Harriet Waters: author; b. at Danvers, Mass., about 1843. She has spent much time abroad, and is known especially as a translator from French and Provençal. In 1873 she published a translation of the *Mireio* of the Provençal poet Mistral, and in 1881 a spirited rendering of Vergil's *Georgics*. She is also the author of *Aspendale* (1872); *Love in the Nineteenth Century* (1874); *Troubadours and Trouvères* (1876); *A Year in Eden* (1886); and other works. H. A. Beers.

Preston, Margaret Junkin: author; b. in Philadelphia about 1835; daughter of Rev. George Junkin, who became

in 1848, president of Washington and Lee University, and wife (1857) of Col. J. T. L. Preston, professor in the Virginia Military Institute; author of *Silver Wood, a Book of Memories* (1856); *Beechenbrook, a Rhyme of the War* (1866); *The Young Ruler's Question* (1869); *Old Songs and New* (1870); *Cartoons* (1875); *Colonial Ballads* (1887); and other writings in prose and verse, chiefly upon topics connected with the civil war. Her translation of the *Dies Iræ*, which appeared in 1855, has been highly commended. D. in Baltimore, Md., Mar. 28, 1897. Revised by H. A. Beers.

Preston, Right Rev. Thomas Scott, V. G.: prelate; b. at Hartford, Conn., July 23, 1824; graduated at Trinity College, Hartford, 1843; entered the Protestant Episcopal ministry 1846; assistant rector Church of the Ascension, New York, and later of St. Luke's; became a Roman Catholic 1849; studied at St. Joseph's Theological Seminary, Fordham, N. Y.; ordained a priest 1850; assistant at the cathedral, New York; subsequently pastor St. Mary's, Yonkers, N. Y.; appointed parish priest of St. Ann's, New York, 1861; appointed chancellor of the diocese of New York 1853, and vicar-general 1873; appointed domestic prelate in the pope's household, with title of monsignore, 1881; promoted prothonotary apostolic 1888; author of *Ark of the Covenant* (1860); *Life of St. Mary Magdalene* (1861); *Sermons for the Seasons* (1864); *Life of St. Vincent de Paul* (1866); *Christian Unity* (1866); *Purgatorian Manual* (1867); *Reason and Revelation* (1868); *Christ and the Church*, etc. D. in New York, Nov. 4, 1891. Revised by J. J. Keane.

Prestwich, Joseph, F. R. S.: geologist; b. at Clapham, London, England, Mar. 12, 1812; educated at University College, London; received medals from the Geological Society 1849, the Royal Society 1865, and the Institute of Civil Engineers for his contributions to science; has been repeatedly appointed by the Government on scientific commissions; Professor of Geology at Oxford University 1874–88; president of the Geological Society of London 1870–72; vice-president of the Royal Society 1870–71; and president of the international congress of geologists in London 1888. Prestwich's more important researches relate to Pleistocene submergences of the land and the evidences of prehistoric man. In 1886–88 he published a manual of geology in two volumes. D. at Darent Hulme, Shoreham, Kent, June 23, 1896. Revised by G. K. Gilbert.

Presum'ptions [from Lat. *præsump'tio*, a taking beforehand, a supposing beforehand, presumption: *præ*, before + *su'mere*, take]: assumptions of fact made by the law and embodied in legal rules (*presumptions of law*). The term has been involved in much ambiguity, owing, on the one hand, to its familiar use to describe mere inferences of fact (*presumptions of fact*), as well as to its employment, on the other hand, to cover a class of legal fictions whereby new rules of substantive law are introduced under the guise of assumptions of fact (*conclusive presumptions of law*).

All presumptions are originally presumptions of fact of varying weight according to the strength of the inference in a given case. The law, for its own purposes, selects certain of the strongest of these presumptions of fact, and adopts them, gives them a weight beyond that which logic and reason attach to them, and arbitrarily *assumes* that the inference is the correct one unless and until evidence is produced to prove that it is not. Here, then, we have the "presumption" proper, the "presumption of law."

Every fact which tends, however slightly, to support the fact sought to be established by evidence raises a "presumption of fact." Suppose it be required to prove that X is dead. It is proven that he has been missing for a year; that he was last seen embarking on a long voyage; that the vessel in which he embarked has never been heard from. Each of these facts, as a matter of logic and reason, suggests more or less strongly the probable fate of X. They all "raise a presumption," i. e. suggest the inference that X has lost his life by drowning. But this presumption of fact has no legal sanction. Its appeal is to logic, to the reasoning faculty, and its force is no greater in a court of law than in the forum of logic and reason outside.

But the inference from the facts proven may in a given case be so obvious or so clearly demanded by the policy of the law that it would be mischievous to leave it to be drawn by the untrustworthy reason of a jury or even of a particular judge. Hence the law, distrustful of individual judgment, prescribes in advance what inferences shall be drawn from certain facts. Thus if a man has been absent from home for seven years, and unheard of during that time, the law will not in a particular case allow the court or jury to draw the inference that he is probably alive, but arbitrarily directs the inference that he is dead. Hence we have the familiar presumption of law that seven years' unexplained absence is presumptive evidence of death.

A presumption, then, is a rule which fixes the legal value of a fact or facts in evidence, and this legal value may be exactly the same as the logical value of the fact, but is more likely to be in excess of its logical value. As, for example, there may be cases where the absence of a person for seven years would not logically demand the conclusion that he is dead, but the law draws that conclusion in all cases, nevertheless. Of course this presumption may (like all true presumptions) be rebutted by showing that the man is actually alive. The presumption has in that case performed the usual office of presumptions of law in shifting the burden of proof from the party in whose favor the presumption was drawn to the party who seeks to rebut it.

It has already been intimated that what is known as a conclusive presumption of law is not properly speaking a presumption at all, but a rule of substantive law which has in the process of legal evolution lost its inferential or presumptive character, though continuing to be expressed in terms of presumption. It is obvious that whenever a presumption becomes conclusive it can only be by discarding as immaterial the fact which is assumed. In other words, the facts in evidence now have consequences attached to them which are entirely independent of the intermediate facts "presumed" to exist. This process is well illustrated in the development of the doctrine of a "lost grant," as the foundation of rights claimed by prescription. (See Prescription.) In the present state of that doctrine, as it obtains in the U. S., at least, twenty years' enjoyment under the proper conditions of the right claimed is said to raise a "conclusive presumption" that the right had a lawful origin. But this is only a more awkward and roundabout way of saying that twenty years' enjoyment of itself confers the right claimed. The law no longer indulges in any presumptions on the subject, but it continues to veil the new rule behind the legal fiction of a presumption.

The number of presumptions of law is very large, and is constantly being augmented by the process of judicial legislation above described, as well as by direct legislative act. They play an important part in the due and orderly administration of justice, and furnish the best existing means for the modification and amelioration of the law by the process of adjudication.

See Greenleaf on *Evidence*, Best on *Evidence* (Chamberlayne's edition), and Prof. J. B. Thayer's article, *Presumptions and the Law of Evidence*, 3 *Harv. Law Rev.* 141.

George W. Kirchwey.

Pretender: a name frequently applied to the Stuart claimant to the British throne after the death of the exiled James II. The Pretenders were the son and grandson of that monarch, the lineal heirs to the throne, which they respectively attempted to recover by means of the "Jacobite" insurrections in Scotland in 1715 and 1745. See the articles James Francis Edward Stuart and Charles Edward.

Pretoria: capital of the South African Republic (now Transvaal Colony); on the Apies, a head-stream of the Limpopo; 1,040 miles by rail N. E. of Cape Town. Railways connect Pretoria with Lourenço Marques on Delagoa Bay and with Durban and Cape Town. The town lies at an elevation of 4,500 feet in a plain surrounded by hills. New public buildings, including a parliament-house, have been constructed. It was captured by Lord Roberts June 5, 1900. (See Africa.) Pop. 12,000, of whom about three-fourths are whites.

Previous Question: in parliamentary law, the question whether the main issue shall now be voted on. In the U. S. the motion is made and seconded by supporters of the issue for the purpose of shutting off further debate; they therefore, of course, vote in the affirmative on the previous question itself. In the British Parliament the previous question is brought forward and seconded by opponents of the main issue, who vote against the motion when put for the purpose of preventing the putting of the main question. See Parliamentary Law and Cloture.

Previtale, prā-vē̆e-taa'lā, Andrea: painter; b. at Bergamo, Italy, in the latter part of the fifteenth century. He probably studied under Giovanni Bellini in Venice, as his earliest known work, an altar-piece at Borgo Sant' Antonio,

bears the inscription *Andreas Bergomensis dissipulus* (*sic*) *Jo Bellini*. The altar-piece of St. John the Baptist in Sto. Spirito at Bergamo is considered his finest work. D. of the plague at Bergamo in 1528. Many of his pictures are at Bergamo. The National Gallery in London possesses a *Madonna and Child* by him. W. J. STILLMAN.

Prévost d'Exiles, prā′vō′dāg′zeel′, Abbé ANTOINE FRANÇOIS: novelist; b. at Hesdin, Artois, France, Apr. 1, 1697. After a good education he vibrated for a time between the army and the order of the Jesuits. In 1719 he entered the order of Benedictine monks of Saint-Maur, and for several years gave himself to serious study. He left the order somewhat irregularly (1727 or 1728), fled to Holland, and devoted himself to letters. His first work, *Mémoires d'un homme de qualité* (8 vols., 1728–32), revealed his gifts as a story-teller, and was very successful. He went to England in 1733, and in 1734 was permitted to return to Paris. D. Nov. 23, 1763. Among his works are *L'Histoire de M. Cléveland* (8 vols., 1732–39); *Le Doyen de Killerine* (6 vols., 1735); translations of Richardson's *Pamela* and *Clarissa*; and above all the *Histoire du chevalier des Grieux et de Manon Lescaut* (1731), one of the masterpieces of the French novel of all times. It has often been republished. His *Œuvres choisies* were published in 1783 and in 1810–16. A. G. CANFIELD.

Prévost-Paradol′, -pāā′rāā′dōl′, LUCIEN ANATOLE: author; b. in Paris, France, Aug. 8, 1829; became Professor of French Literature in Aix in 1855; was a frequent contributor to Parisian journals, and wrote *Revue de l'Histoire universelle* (1854); *Du Rôle de la Famille dans l'Éducation* (1857); *Essais* (3 vols., 1859–63); *Quelques pages d'Histoire contemporaine* (4 vols., 1862–66); and *La France nouvelle* (1868). In 1870 he went as ambassador to Washington, D. C. He arrived in July, but on Aug. 11 committed suicide.

Preyer, THIERRY WILLIAM, M. D., Ph. D.: psychologist and physiologist; b. in Manchester, England, July 4, 1841; educated in Manchester, London, Duisburg, Bonn, and at the Universities of Bonn, Berlin, Heidelberg, Vienna, and Paris; became privat docent at Bonn in 1865, Professor of Physiology at Jena in 1869, and privat docent at Berlin in 1888. His principal works are *Die Grenzen des Empfindungsvermögens und des Wollens* (Bonn, 1868); *Ueber Empfindungen* (Berlin, 1867); *Elemente der reinen Empfindungslehre* (Jena, 1877); *Die Kataplexie und der thierische Hypnotismus* (Jena, 1878); *Die Entdeckung des Hypnotismus* (Berlin, 1881); *Ueber den Farben- und Temperatursinn* (Bonn, 1881); *Ueber die Grenzen der Tonwahrnehmung* (Jena, 1876); *Akustische Untersuchungen* (Jena, 1879); *Die Seele des Kindes* (Leipzig, 1881; 3d ed. 1890); *Specielle Physiologie des Embryo* (Leipzig, 1883–84); *Elemente der allgemeinen Physiologie* (Leipzig, 1883); *Die Erklärung des Gedankenlesens* (Leipzig, 1885); *Die Bewegungen der Seesterne* (Berlin, 1887); and *Der Hypnotismus* (Vienna, 1890). D. in Wiesbaden, July 15, 1897. J. MARK BALDWIN.

Priacanth'idæ [Mod. Lat., named from *Priacan'thus*, the typical genus; Gr. πρίων, saw + ἄκανθα, spine]: a family of fishes of the sub-order *Acanthopteri*, distinguished by their very large eyes and small rough scales, which extend on the snout and jaws. Over twenty species are known from different tropical seas, in all of which some species are found. They are generally of a reddish color.

Revised by F. A. LUCAS.

Pri'am (in Gr. Πρίαμος): son of Laomedon and Strymo, and the last King of Troy. His original name was Podarces, but he received the name of Priam because he was ransomed (πρίασθαι) by his sister Hesione from Heracles. He was the husband of Hecuba, the father of Hector, Paris, Polyxena, Cassandra, Deiphobus, Helenus, Troilus, and others. During his reign fell the Trojan war, which ended with the destruction of Troy and the extinction of his race. The matchless words of the *Iliad* of Homer narrate a small portion of the events of the Trojan war. J. R. S. STERRETT.

Pribilof or **Pribyloff Islands**: a group of small volcanic islands in Bering Sea; 192 miles N. of Unalaska, 200 miles S. of St. Matthew, and about the same distance W. of Cape Newenham, on the mainland. The climate is disagreeable; but the perfect isolation of these islands, and the mist and fog which prevail, cause the fur-seal to select these grounds for the purpose of breeding. The great seal-producing island is St. Paúl, with a shore-line of 42 miles, of which 16½ miles are frequented by the fur-seals. See SEAL-FISHERIES.

Revised by G. K. GILBERT.

Price: See POLITICAL ECONOMY.

Price: town; capital of Carbon co. (organized from the northern part of Emery County in 1894), Utah; on the Price river, and the Rio Grande Western Railway; 78 miles S. E. of Provo City, 122 miles S. E. of Salt Lake City (for location, see map of Utah, ref. 5–N). It is in an agricultural, stock-raising, and mining region, is the immediate starting-point for Fort Duchesne and the Uintah and Uncompahgre Indian reservations, and is the shipping-point for a mine of remarkably pure asphaltum. The town has a church, two public schools, and a weekly newspaper. Pop. (1900) 655.

Price, BONAMY: economist; b. in the island of Guernsey, May 22, 1807; graduated at Oxford, 1829; soon afterward became assistant master at Rugby School, where he remained as teacher till 1850, and Professor of Political Economy at Oxford University 1868. Prof. Price was a distinguished representative of free-trade doctrines, which he presented to the public of the U. S. in 1874 in a series of lectures. He was the author of *The Principles of Currency* (1869); *Of Currency and Banking* (1876); *Practical Political Economy* (1878); and of many articles in reviews and magazines. D. in London, Jan. 8, 1888.

Price, IRA MAURICE, B. D., Ph. D.: educator; b. near Newark, O., Apr. 29, 1856; graduated at Denison University 1879; Professor of Greek and Modern Languages, University of Des Moines (now Des Moines College), Iowa, 1879–80; instructor in French and German, Morgan Park Military Academy, 1880–83; instructor in correspondence, School of the American Institute of Hebrew, 1882–84; Ph. D., University of Leipzig, 1887; instructor in Hebrew and cognate languages, Baptist Union Theological Seminary, 1886–88; professor of same department 1888–92; Associate Professor of the Semitic Languages and Literatures in the Graduate School of the University of Chicago. He is author of *An Introduction into the Inscriptions discovered by Mons. E. de Sarzec* (Munich, 1887); *Syllabus of Old Testament History* (1891; 3d ed. 1892); associate editor of new edition of Gesenius's *Hebrew Grammar* (Boston, 1892); member editorial staff of the *Standard Dictionary of the English Language* (New York, 1893–95).

Price, RICHARD, D. D., LL. D., F. R. S.: philosopher; b. at Tynton, Glamorganshire, Wales, Feb. 22, 1723; educated at Talgarth and Coward's Academy in London; became a Presbyterian minister; was chaplain to a Mr. Streatfield at Stoke Newington 1743–56, and pastor of churches at Hackney and Newington Green for the remainder of his life. D. in London, Apr. 19, 1791. Author of many papers in the *Philosophical Transactions*, and of numerous theological, economical, and political publications, among which were *A Review of the Principal Questions and Difficulties in Morals* (1758); *Observations on Reversionary Payments, Annuities, etc.* (1769); *An Appeal to the Public on the Subject of the National Debt* (1771); *The Nature and Dignity of the Human Soul* (1776); *Observations on the Nature of Civil Liberty, Principles of Government, and the Justice and Policy of the War with America* (1776); *Additional Observations, etc.* (1777); *An Essay on the Present State of Population in England and Wales* (1779); and *Observations on the Importance of the American Revolution* (1784). The pamphlets on American affairs forcibly and eloquently advocated the claims of the colonists to an ample redress of grievances, and 60,000 copies of the first pamphlet on this subject were sold in a few months. Dr. Price's various writings on the doctrine of chances, annuities, and the duration of life entitle him to a high place among the founders of the science of vital statistics, and his financial publications give him similar rank in regard to political economy. In religious opinions he was a precursor of the Unitarian movement, agreeing in many things with his friend Dr. Priestley. See his *Memoirs*, by his nephew, William Morgan, F. R. S. (1815).

Price, STERLING: soldier; b. in Prince Edward co., Va., Sept. 11, 1809; settled in Charlton co., Mo., 1830; served in the Legislature; was member of Congress 1845–47; colonel of Missouri volunteers in the Mexican war; captured Taos, N. M.; commanded at the battle of Canada, N. M., Jan. 24, 1847; was made brigadier-general July 20, 1847, and appointed military governor of Chihuahua; gained the battle of Santa Cruz de Rosales Mar. 16, 1848. He was Governor of Missouri 1853–57; presided over the State convention of Feb., 1861; was appointed major-general of the State forces by Gov. Claiborne F. Jackson, and endeavored to pre-

cipitate the withdrawal of Missouri from the Union, but was foiled in his purpose by the promptness of F. P. Blair and Nathaniel Lyon in compelling the surrender of the State guard at St. Louis, and defeating the militia at Boonville. In the South, however, the Governor and Price reeruited an army of about 8,000 men, and, being joined by McCullough with 3,000 from Arkansas, defeated Lyon and Sigel at Springfield Aug. 7. Price quarreled with McCullough, who withdrew his forces; captured Lexington, with 3,000 prisoners, after a four days' siege, Sept. 20, for which he was thanked by the Confederate Congress; was soon forced to retreat into Arkansas; was appointed major-general in the Confederate service Mar., 1862; took part in the battles of Pea Ridge, Iuka, and Corinth; was in command of the department of Arkansas 1863–64, when he entered into a combination with Clement Vallandigham, of Ohio, and other Northern sympathizers with the Confederacy, founding the secret organization known as Knights of the Golden Circle, of which he was "grand commander," and which nearly 25,000 Missourians joined. He invaded Missouri Sept., 1864, advancing with nearly 20,000 men as far as Pilot Knob, but failed to rally the Knights to his standard on account of the measures taken by Gen. Rosecrans in the discovery and repression of the plot; presented himself before Jefferson City and pushed westward to the Kansas border, but being pursued by Pleasonton and Curtis, had to retreat to Arkansas, thereby terminating in disaster a movement which had been expected to result in the conquest of Illinois and other States. After the war Gen. Price went to Mexico and founded a colony of ex-Confederate officers near Córdova; but the downfall of Maximilian involved that of the colony, and he returned to Missouri early in 1867 in poverty and broken health. D. in St. Louis, Sept. 29, 1867.

Price, Thomas Randolph, A. M., LL. D.: professor of Greek and English; b. in Richmond, Va., Mar. 18, 1839; educated at University of Virginia (1856–59), Universities of Berlin and Kiel (1859–61); served in the Confederate army; Professor of Latin and Greek at Randolph College 1867–70, Greek and English 1870–76; Professor of Greek in the University of Virginia 1876–82; became Professor of English Language and Literature, Columbia College, 1882; author of *The Teaching of the Mother-Tongue* (1877); *Shakespeare's Verse Construction* (1889); editor of *Othello*, Bankside edition of Shakspeare (1890). C. H. Thurber.

Prich'ard, James Cowles, M. D.: ethnologist; b. at Ross, Herefordshire, England, Feb. 11, 1786; resided in youth at Bristol; studied medicine at Bristol, London, and Edinburgh; began practice as a physician at Bristol in 1810, and received medical appointments at the Clifton Dispensary, St. Peter's Hospital, and the Bristol Infirmary. In 1813 he published his chief work, *Researches into the Physical History of Mankind* (4th ed. 1841–51). Dr. Prichard then applied himself to philology, and produced his standard treatise on *The Eastern Origin of the Celtic Nations* (1831; 2d ed. 1857). In 1843 he issued his *Natural History of Man* (4th ed. 1855); became 1845 commissioner in lunacy; was for many years president of the Ethnological Society, and published several works on medical subjects. D. in London, Dec. 22, 1848.

Prickly-ash, or **Toothache-tree**: the *Xanthoxylum americanum*; a large prickly shrub, belonging to the *Rutaceæ*; found in most parts of the U. S. The leaves have the smell of lemons. The bark is aromatic and stimulant, and is used as a remedy for toothache, for rheumatism, and other diseases. *X. carolinianum*, the Southern prickly ash, has a more southern range. It becomes quite a large tree. Its bark is extremely pungent, and is armed with curious prickly warts. *X. floridanum* and *X. pterota* grow also in Florida. China, Japan, South America, and the West Indies abound in species of this genus, nearly or quite all aromatic, pungent, and medicinal.

Prickly Heat: a popular name for eruptive skin diseases, occurring in hot weather and characterized by itching and sensations of stinging. Disordered digestion, constipation, and abnormal perspiration are causes. The disease is known as "miliaria" in technical language. In India there is quite a formidable variety of lichen called by this name. A popular treatment is the use of saline cathartics, which doubtless are sometimes advantageous. Soothing lotions containing carbolic acid, camphor, and similar sedatives are useful, and the disease is often avoided by susceptible persons by frequent bathing and protection from the sun's rays. W. Pepper.

Prickly-pear: any cactus of the genus *Opuntia*, especially *O. vulgaris*, a native of many places in the U. S. from Massachusetts southward and westward. It is naturalized extensively in the Old World. Its fruit is smooth and eatable, but not so good as that of *O. ficus indicus*, which is prickly. Some of the numerous species are used for forage in Mexico. The erect kinds are serviceable hedge-plants. One species is the official emblem of Mexico. Some prickly-pears afford food to the cochineal insect.

Prideaux, prid'ō, Humphrey, D. D.: b. at Padstow, Cornwall, England, May 2, 1648; educated at Westminster School; educated at Christ Church, Oxford, and graduated 1672; published a Latin account of the Arundelian marbles, *Marmora Oxoniensia* (1676); became rector of St. Clement's, Oxford (1679); prebendary of Norwich 1681, archdeacon of Suffolk 1688, and dean of Norwich 1702. D. at Norwich, Nov. 1, 1724. Author of a *Life of Mahomet* (1697), once very popular, and of *The Connection of the History of the Old and New Testaments* (4 vols., 1715–18), which is frequently reprinted.

Pride's Purge: See Cromwell, Oliver.

Priess'nitz, Vincent: hydropathist; b. at Gräfenberg, Austrian Silesia, Oct. 5, 1799, of peasant parents; became the inventor of hydropathy, and in 1822, by special authority from the Austrian Government, the founder of the Gräfenberg water-cure, which he administered till his death Nov. 28, 1851. See Hydropathy.

Priest [O. Eng. *prēost*, like Germ. *priester*, an early loan-word from Lat. *pres'byter*, in a Vulg. Lat. form of **prebister*. In Rom. languages the word appears as Ital. *prete*: Fr. *prêtre*, Provenç. *preste-s*. Lat. *presbyter* = Gr. πρεσβύτερος, elder]: one authorized to perform certain public religious acts, particularly religious sacrifices; in hierarchical churches, one of the second order of the ministry. In all nations of antiquity among whom a system of worship received any considerable development there existed also a system of priesthood. The priest stood in a sort of mediatorial relation between God and man, and under the Hebrew legislation this was divinely recognized and received the emphatic sanction of divine appointment. In earliest times the functions of the priest appear to have been discharged by the head of the family, who, as the recognized superior of all its members, was the fittest person to appear for them before God. Hence came what is called the "patriarchal priesthood." As the family multiplied into the tribe the duties of its head became too numerous for the proper discharge of the priesthood, as well as often incongruous, and persons were specially selected to fill the office, as in the case of Jethro, "the priest of Midian." When the tribe became a nation a class of men was set aside for the same purpose, although the monarch often remained at the nominal head of the priesthood thus established, as was the case in Egypt. Among the most ancient nations, India, Egypt, and the Hebrews, the priesthood was hereditary, and in the two former constituted a class distinctly separated in their whole life from the rest of the nation, and in Egypt endowed with large landed estates and great wealth. Among the Hebrews, on the contrary, the priests were only allowed cities necessary for their residence, and were cut off from other inheritance in land among the tribes of Israel. They were only in so far a caste as was necessary for the discharge of their duties, and in all other respects were on the same footing as their fellow citizens, it being specially noteworthy that all were entirely equal before the law. Their support was provided for by a tithe from the Levites of the tithes received by them from the whole body of the people, and also by assigned portions of most of the sacrifices. As there was no provision in the Hebrew law for the enforcement of the payment of the tithes, their income was dependent upon the general fidelity of the people. The special function of the Aaronic priesthood was to come near to God—themselves of the people, yet specially sanctified on their behalf to approach God and obtain from him pardon and blessings for their brethren. Hence their chief characteristic must be holiness, which was set forth in the Levitical law in every possible symbolical way, as well as directly commanded. The first of all their duties was the offering of sacrifice, thus "making atonement for the people." No sacrifice could be offered or incense burned without their intervention. They had also, as naturally connected with this, the general care of the sanctuary and the multitudinous duties flowing from this; and, as being themselves specially trained in the

Law, to them was assigned the duty of teaching it to the people. They had, however, little or nothing of the *pastoral* relation toward the people; their duties were almost wholly official. Their qualifications were Aaronic descent, perfect physical formation, and, during their ministrations, freedom from legal uncleanness and abstinence from wine and intoxicating drinks. There was no limitation of age. In marriage they were only restricted to virgins or widows of one of the tribes of Israel. When largely multiplied, in the time of David and Solomon, they were divided into twenty-four courses, which were placed on duty each one week in turn. When on duty, like the Egyptian priests, they wore linen robes and were unshod. The whole order culminated in the high priest, whose office was also hereditary, and who by the magnificence of his official robes was marked as very much elevated above his brethren. He was peculiarly the appointed mediator as a type of the promised Redeemer to come, and alone once in every year entered the Holy of holies. He could marry only a virgin within the priestly family. Later there was a "second priest," or vice high priest. The whole Hebrew priesthood, having its main function in the "making of atonement," necessarily ceased with the coming of Christ. By Canon 34 of the Anglican Church one must be twenty-four years of age before he can be admitted to the priesthood; anciently thirty years was required. Still by dispensation for sufficient cause it may be, and has occasionally been, conferred at an earlier age. In the Protestant Episcopal Church the person priested must be twenty-four years old, and usually the interval of a year is required between ordination to the diaconate and admission to the priesthood. Consult Kalisch, *Preliminary Essay to Lev. viii.*; Küper, *Das Priesterthum des alten Bundes.*

Revised by W. S. Perry.

Catholic theology teaches that Christ, "a high priest according to the order of Melchisedech" (Heb. v. 10), instituted at the Last Supper not only a sacrament, but a sacrifice also, and by commanding the apostles to do what he had done for a commemoration of him (Luke xxii. 19), established the priesthood of the new Law. The offering of the eucharistic sacrifice in the Mass, the clean oblation identical with that of the cross, is the principal function of the Christian priest. Also by his ministration the faithful partake of the fruits of this sacrifice, chiefly in Holy Communion, and, according to their various needs, in the sacraments of baptism, penance, and extreme unction. Confirmation and holy orders are administered by the bishop, while in matrimony, as theologians generally hold, the contracting parties are the ministers and the priest or bishop is the official witness. The priest, moreover, is charged with the preaching of the Gospel, and with the religious instruction and spiritual direction of those committed to his care. The jurisdiction necessary for exercising sacerdotal functions is given by the bishop of the diocese in which the priest permanently or temporarily resides, and the priesthood itself is conferred by the bishop at ordination. It imparts to the worthy recipient those graces or supernatural helps which he needs for the faithful discharge of his duties, and imprints upon his soul a character which can never be effaced. Once ordained, the priest, though he may be deprived of the right to exercise his office, always retains the essential power of consecrating the body and blood of Christ. See Lambrecht, *De S^mo^ Missæ Sacrificio* (Louvain, 1875); Probst, *Sakramente und Sakramentalien* (Tübingen, 1872); Cardinal Manning, *The Eternal Priesthood* (1883).

J. J. Keane.

Priestley, Joseph: physicist and writer on theology; b. at Birstal-Fieldhead, near Leeds, England, Mar. 24, 1733 (N. S.); was son of a cloth-dresser; was placed at a free grammar school, and at a Presbyterian academy at Daventry; obtained by private study a knowledge of the classics and modern languages, to which he added Hebrew and the rudiments of Chaldaic, Syriac, and Arabic; rejected some points of the Calvinistic theology before entering college, but was ordained in 1755 assistant minister to an Independent congregation at Needham-Market, Suffolk; left that post in 1758 on account of having adopted Unitarian views; taught a private school at Nantwich, Cheshire, 1758–61, making there numerous experiments in physics, and writing his first published work, *The Scripture Doctrine of Remission* (1761); was teacher of languages and literature in an academy at Warrington 1761–67, during which period he made the acquaintance of Dr. Richard Price and of Dr. Franklin, and prepared, at the instance of the latter, his *History and Present State of Electricity, with Original Experiments* (1767), which procured him the degree of LL. D. from the University of Edinburgh and election as fellow of the Royal Society; was pastor of Mill Hill Chapel, Leeds, 1767–73; made there important researches in pneumatics and chemistry, which he gave to the world in his *Directions for Impregnating Water with Fixed Air* (1772), and *History and Present State of Discoveries relating to Vision, Light, and Colors* (2 vols. 4to, 1772); published his *Institutes of Natural and Revealed Religion* (3 vols., 1772–74), which he had begun eighteen years before; was from 1773 to 1780 librarian and literary companion to the Earl of Shelburne, whom he attended in 1774 in a tour on the Continent; made in that year the discovery of oxygen (called by him dephlogisticated air; see Chemistry), soon followed by that of other gases, besides contributions to theoretical chemistry set forth in his *Experiments and Observations on Different Kinds of Air* (3 vols., 1774–77); published (1774–78) *Disquisition relating to Matter and Spirit*, and other philosophical works which excited much controversy. In 1780 Priestley retired from the service of Lord Shelburne with a life-pension of £150, became minister to the principal Independent congregation at Birmingham, and addressed to an eminent Frenchman his *Letters to a Philosophical Unbeliever*, in which he contended strongly for the doctrines of a revelation and a resurrection. This was followed by his *History of the Corruptions of Christianity* (2 vols., 1782); *History of Early Opinions concerning Jesus Christ, compiled from Original Writers, proving that the Christian Church was at first Unitarian* (4 vols., 1786), and other works, including *Letters to Burke, occasioned by his Reflections on the Revolution in France* (1791). The last treatise procured him an honorary citizenship in the French republic, and was the cause of a riot at Birmingham (July 15, 1791), in which Priestley's house was pillaged and his library, manuscripts, and scientific apparatus scattered through the streets, he himself escaping personal violence by flight. For three years he resided at Hackney as the successor of Dr. Price, instituted a suit for compensation for his losses, in which he was successful after nine years' delay, and in 1794 removed to the U. S., where his sons already resided. He settled on his son's farm at Northumberland, Pa., where he passed the remainder of his life; wrote replies to Volney and Paine, and several other works of little comparative importance, the most elaborate being *Notes on all the Books of Scripture* (Northumberland, 4 vols., 1803). He declined a professorship in the University of Pennsylvania, but occasionally preached at Philadelphia, and delivered there two series of *Discourses relating to the Evidences of Revealed Religion* (1796–97). D. at Northumberland, Pa., Feb. 6, 1804. His autobiographical *Memoirs*, with a continuation by his son, appeared in 1806, and a collection of his *Theological and Miscellaneous Works* (26 vols., Hackney, 1817–32) was edited by John Towell Rutt, vols. i. and ii. being composed of his *Life and Correspondence.* A bibliography of Dr. Priestley's productions, prepared at Washington (1875), gives the titles of more than 300 separate publications.

Revised by R. A. Roberts.

Priestley, Sir William Overend, M. D., LL. D., F. R. C. P.: obstetrician; b. near Leeds, Yorkshire, June 24, 1829; grand-nephew of Joseph Priestley; educated at the University of Edinburgh and took the degree of M. D. in 1853; received the senate gold medal for original research at graduation; settled in London as a physician in 1856; became lecturer on midwifery at the Middlesex Hospital; Professor of Obstetric Medicine in King's College, London, and physician to King's College Hospital 1862; and later consulting physician to King's College Hospital. He is a fellow of several colleges, and member of various learned societies; has been examiner in the University of London, Royal College of Physicians, Royal College of Surgeons, University of Cambridge, and Victoria University; in 1875 and 1876 was president of the Obstetrical Society of London. He has published *On the Development of the Gravid Uterus*; *On the Pathology of Intrauterine Death*; and was joint editor of Sir J. Y. Simpson's *Obstetric Works.* He was knighted in 1893.

Prieto, prĕĕ-ā'tō, Joaquin: general and politician; b. at Concepcion, Chili, Aug. 20, 1786. After serving in the Spanish militia he joined the patriots in 1811; took part in all the revolutionary struggles, holding high military offices; was prominent in congress from 1823 as a leader of the conservative party; joined in the conservative revolt of

1829–30, deciding its success by his victory over Freire at Lircay Apr. 17, 1830, and on the death of Ovalle was made provisional president by congress Mar. 22, 1831. He was confirmed in the post by a regular election, holding it by re-election until Sept., 1841. With him began the prosperous though somewhat reactionary rule of the conservative party in Chili. A constitution (still in force, though somewhat amended) was adopted in May, 1833; there was an unsuccessful revolt in 1836, and Chili aided Peruvian malcontents to overthrow the Peru-Bolivian confederation 1837–38. After retiring from the presidency Gen. Prieto was councilor of state, senator, and commandant at Valparaiso, where he died Nov. 22, 1854. HERBERT H. SMITH.

Prim, JUAN: Count of Reus and Marquis of Castillejos; b. in Reus, Catalonia, Spain, Dec. 6, 1814; entered the Spanish army in boyhood; obtained rapid promotion during the first Carlist war; became colonel in 1837; was soon afterward elected to the Cortes, plotted against the government of Espartero, and in 1843 placed himself at the head of a revolt in Catalonia. He aided materially in effecting the return of Christina, but, falling under suspicion of treason, was tried and sentenced to death. He was pardoned, however, and appointed governor of Puerto Rico. He was commander of the reserve division in the war against Morocco 1859–60, gaining a great military reputation and the title of marquis. As commander of the Spanish contingent in the allied intervention in Mexico 1861, he was instrumental in bringing about the convention of Soledad, Feb. 19, 1862, in which assurance was given that the independence of the Mexican republic would not be disturbed. On his return to Spain he successfully defended his conduct in the Cortes, denouncing the ambitious plans of the French emperor; was banished from Madrid Aug., 1864; devoted himself thenceforth to the overthrow of Isabella, for which object he entered into various combinations and headed several unsuccessful insurrections, especially that of Jan., 1866, in Aragon and Catalonia, but ultimately succeeded in organizing the movement which in Sept., 1868, through the aid of Serrano and Topete, resulted in the flight of the queen to France; was welcomed with enthusiasm at Madrid; became Minister of War and head of the cabinet in the new provisional government; conducted several negotiations for founding a new dynasty in Spain; furnished the pretext for the Franco-German war of 1870–71 by his offer of the crown of Spain to Prince Leopold of Hohenzollern, and in the autumn of 1870 obtained from the Cortes the election of the Italian prince Amadeus, Duke of Aosta. On the day that the new king landed at Barcelona (Dec. 28) Prim was attacked by assassins in a street of Madrid, and received eight balls in his body, and died two days later (Dec. 30, 1870).
Revised by F. M. COLBY.

Primary Elections: in U. S. politics, a term usually applied to the preliminary meetings of the voters of any political party to nominate candidates for offices to be filled by the people at a subsequent election, or to choose delegates to a convention that will make such nominations. The word caucus is sometimes used with reference to a meeting of certain members of a legislature or other deliberative body to decide upon harmonious action with reference to pending business. (See CAUCUS.) It will be seen that the primary election is the source of all nominations, from that of the village constable or pathmaster (unless these officers are both nominated and elected in town meeting) to that of President, although this has not been true throughout the history of the country. From 1800 till 1824 the presidential candidates of one party at least, and often of both, were designated by the members of Congress in a congressional caucus, though in the later years some of the State Legislatures also made nominations. In 1828 the presidential candidates were nominated by the State Legislatures, and in 1832 the present system of nomination by convention founded upon the primaries was started.

In rural districts, or in smaller towns where the voters of each political party are personally known to one another, the ordinary primary election is not generally seriously abused. The local political leaders are likely to pack the meetings in the interest of their favorites; but this can be successfully done, with rare exceptions, only when there is apathy on the part of many voters. In the larger cities, owing to the lack of acquaintance among the voters, there are many opportunities for fraud, and many abuses. The necessity of some means of identifying voters has led in New York and other large cities to the formation of local political associations; and from these associations have come the worst abuses. A check list of names of voters is of course necessary, no person being allowed to vote whose name does not appear on the list. This machinery of registration, and the necessity of having some authority to call meetings, make the appointment of a committee imperative. These committees, often reappointed, soon know their districts so well that they can manage them better than any one else; hence they have much influence with higher party officials. In New York each assembly district has had its local association in the nature of a permanent club, and its committee, associated with a central committee, which has had the general direction of affairs in the city. The two leading parties have had, under somewhat different forms, practically the same method of working. The direction of affairs has been held, in the main, in the hands of the central committee; and as membership in the local associations has been limited by pledges of support of regular candidates selected by the committee, pledges that many men could not give, the control has been retained. This rigid control has at times permitted not more than one-sixth, or even not more than one-tenth, of the voters to take part in nominations, and even these were compelled to follow the dictates of the small central executive committee. In such circumstances nominations could be made by the "boss" at will.

Much thought has been given to finding remedies for these evils in making nominations, but none that have been suggested are entirely satisfactory. The system of proportional representation, as found in three cantons of Switzerland, by lessening the strength of parties and party feeling is said to have had a marked influence toward purifying nominations and elections. (See REPRESENTATION.) Under the present system of party government in the U. S., probably more has been accomplished than in any other way by what are called "Primary Election Laws" in several States. By these laws—found in more or less complete form in Ohio, Kentucky, Missouri, California, Illinois, Kansas, West Virginia, Wyoming, Wisconsin, Oregon, Washington, etc.—primary elections are no longer to be considered entirely as voluntary meetings. The most complete laws provide regulations for duly calling and publishing notices of meeting, for registration of voters, for inspectors, challenging, voting, etc., with severe penalties against fraud, as well as against bribery or undue influence of any kind. Late practice in some districts in New York shows that a good system of minority representation in the primary election itself has had excellent results. JEREMIAH W. JENKS.

Primary Schools: See COMMON SCHOOLS.

Primate [viâ O. Fr. from Lat. *pri'mas, prima'tis*, one of the first, chief, (in Mediæv. Lat.) a primate, deriv. of *primus*, first]: originally, in the ecclesiastical system of the Roman Catholic Church and the Church of England, the first in rank of the archbishops in a country. Thus in England the Archbishop of Canterbury was long primate, but at present the Archbishop of York is styled "Primate of England," while Canterbury takes the higher title of "Primate of all England." The Church of Ireland Archbishop of Dublin has the title "Primate of Ireland," and the Church of Ireland and Roman Catholic Archbishops of Armagh are each called "Primate of all Ireland." Five or six French prelates are called primates, but the Archbishop of Lyons is "Primate of primates." Again, the Archbishop of Braga is Primate of Portugal, although inferior in rank to the Patriarch of Lisbon. These facts indicate that the office of primate has to some extent and in certain cases become a titular one, or at least a mere indication of a comparatively unimportant precedence. Revised by W. S. PERRY.

Primates [Mod. Lat., from Lat. *pri'mas, prima'tis*, of the first, chief, excellent, deriv. of *pri'mus*, first]: an order of monodelph mammals including man, the monkeys, and the lemurs. These are all externally distinguished by the fore as well as hind limbs being completely or almost entirely exserted outside of the common integument, and thus distinguished from the ordinary quadrupeds, in which the proximal joints are inclosed therein; the members have also generally five digits, developed on the hands as well as feet; the innermost or first of the hand or fore foot being the thumb, which is, however, frequently suppressed, and the corresponding and innermost digit of the foot being thickened and generally opposable like the thumb to the other digits, only in man assuming parallelism with them; this great toe is always furnished with a depressed nail; the teeth are not distinctive, being modified according to

several types; they are, however, at least in one stage, incisors, canines, and molars; of the incisors there are in each jaw generally four, and never more, although they may be reduced to two, or all in the upper jaw may be suppressed; the clavicles are always completely developed and co-ordinated with the development of distinct shoulders and their distance from each other; the brain has a large cerebrum which completely overlaps the olfactory lobes in front, and behind more or less covers the cerebellum; on the interior surface of each hemisphere behind a peculiar sulcus (the so-called calcarine) exists, which is co-ordinated with the development of a raised portion (the hippocampus minor) within the posterior corner of the ventricle by which the posterior lobe of the cerebrum is traversed. The order as thus distinguished includes two sub-orders—(1) *Anthropoidea*, comprising the families *Hominidæ* (man), *Simiidæ* (the large tailless apes), *Cercopithecidæ* (the Old World monkeys, baboons, etc.), *Cebidæ* (the common New World monkeys), and *Midídæ* (the marmosets, etc.); and (2) *Prosimiæ*, with the families *Lemuridæ*, *Tarsidæ*, and *Daubentonidæ*. The order, as thus limited and defined, is the result of studies of recent zoölogists. Linnæus, who framed the name, embraced under it in addition to the forms above indicated, all the *Cheiroptera* and *Galeopithecus*. By Cuvier and his numerous followers the true *Primates* were differentiated into two orders—*Bimana* (including man) and *Quadrumana* (including the monkeys and lemurs). The naturalness of the association of man with the monkeys is now almost universally conceded, and the main question in dispute at the present time is whether those forms (the anthropoids) should be associated with the lemuroids in a single order, or the two distinguished as independent orders. The differences between them are certainly great, and the discovery by Alphonse Milne-Edwards of the peculiarities of the lemuroid placentas adds to the arguments in favor of their separation, and the question is a very evenly balanced one. See, further, the names of the sub-orders and families.

Revised by F. A. Lucas.

Primaticcio, prĕē-maă-tĕē'tchō, Francesco: painter; b. at Bologna, 1490, of a noble family. Innocenzio da Imola and Bagnacavallo were his first masters, but it was at Mantua, where he studied under Giulio Romano, that he learned the art of color and modeling in stucco as a means of decoration. He gave proof of his talents in this line by the two pieces in the Palazzo del Te. He painted also several subjects after Giulio Romano's designs, so that when Francis I. of France asked Duke Gonzaga to send him a painter capable of directing the decoration of Fontainebleau, Primaticcio was sent as the best of Romano's followers. After nine years, during which time his work gave much satisfaction, he became the superintendent of the king's buildings, succeeding in this post the Florentine Rosso, who had died, and of whom Primaticcio had always been extremely jealous. After the death of Francis I. he continued to hold the same post under Henry II., and Francis II. made him commissary-in-general of all the buildings in the kingdom. He gave the designs for all statues, decorations, fountains, goldsmiths' work, and of all court pageants. He built the first château at Meudon for the Cardinal de Lorraine, and adorned it with sculpture and paintings. He became the artist in highest renown, and was a protector of art, except when touched by jealousy of any extraordinary talent. He was an implacable enemy of Benvenuto Cellini, whom he tried to deprive of commissions by conspiring against him together with the king's mistress, Madame d'Estampes. The Gallery of Ulysses at Fontainebleau was considered one of the finest works of the kind in France. The painting is utterly ruined by time, so that the designs are known to us only through engravings. Primaticcio died in Paris in 1570. The Louvre contains two of his works, which are very rare in Italy; in Bologna the most remarkable is that in the Zambeccari Gallery, representing a concert of three women.

W. J. Stillman.

Prime, Samuel Irenæus: editor and author; son of Dr. Nathaniel S. Prime; b. at Ballston, N. Y., Nov. 6, 1812; graduated at Williams College 1829; studied theology at Princeton; was ordained to the ministry of the Presbyterian Church, and preached several years, but on account of ill-health withdrew from the pulpit in 1840, when he became editor of *The New York Observer*, the leading religious paper of his denomination—a post he retained till his death; several times visited Europe, and published some forty volumes, chiefly anonymous. Among his books are *Travels in Europe and the East* (2 vols., 1855); *Letters from Switzerland* (1860); *The Bible in the Levant* (1859); *Memoirs of Rev. Nicholas Murray* (1862); *The Alhambra and the Kremlin* (1873); and a *Life of Samuel F. B. Morse* (1874). D. at Manchester, Vt., July 18, 1885. His autobiography appeared, ed. by W. Prime, in 1886.

Prime, William Cowper: journalist; b. at Cambridge, N. Y., Oct. 31, 1825. Graduated at Princeton College, and practiced law in New York till 1861. He was afterward editor of the New York *Journal of Commerce*; traveled in Egypt and Palestine; was made Professor of the History of Art at Princeton in 1884. His published writings include *The Owl Creek Letters* (1848); *Boat Life in Egypt* (1857); *Tent Life in the Holy Land* (1857); *Coins, Medals, and Seals* (1860); *I Go A-fishing* (1878); *Pottery and Porcelain* (1878); *Holy Cross* (1879); and other works; edited *McClellan's Own Story* (1886), and wrote a biography of Gen. McClellan for that volume. H. A. Beers.

Prime Mover: the term employed to designate a machine, the office of which is to transform the energy expended in some natural source of power into available work. For example, a quantity of water falling from one level to another represents an expenditure of energy due to the force of gravity, equivalent in foot-pounds to the product of the weight of the water multiplied by the height of fall in feet. In falling without obstruction or resistance the velocity of the water continually increases, and the energy is usually dissipated in the shock at the bottom of the fall. To render this source of power available, a water-wheel may be introduced, which, receiving the impulses of the falling particles, causes a portion of the work to be transformed into useful work, and the water reaches the bottom of the fall with its energy diminished by precisely the quantity which has been so transferred or transmuted into the work absorbed by the water-wheel.

While prime movers generally have the characteristics of other machines in many respects, yet only a few machines can be classed as prime movers. In prime movers the construction and arrangement of their parts depend on the nature or source of the energy which is to be utilized, and demand the application of a wide range of the physical sciences. Questions of *economy of power* should receive first consideration. See Machines and Machinery.

The sources of energy in nature which are made available for useful purposes by the aid of prime movers are heat, the energy of falling water, the motions of the atmosphere, and electricity or magnetism. The latter being, however, regarded as referable to heat, and the second and third sources mentioned being manifestations of the force of gravity, the ultimate sources of available energy may be considered to be *heat* and *gravitation*. As regards *muscular* energy, men and animals may be regarded as prime movers—perfect exhibitions, in this respect, of the imperfect results of human efforts in artificial constructions.

The heat-engine, under the form of the steam-engine, holds the first place in importance among all the prime movers. In the investigations and experiments connected with economy in its use and its adaptation to various purposes, especially to the propulsion of steamships, it has engaged the attention of scientific men, practical engineers, and artisans to a greater extent than all others combined; and the developments arising from its use have given rise to a special branch of engineering science. The use of the water-wheel in the form of the turbine, the second prime mover in importance, has been greatly extended through the new facilities afforded for its construction by steam machinery and the arts and industries developed by it. Hot-air engines, gas-engines, and electro-dynamic engines are prime movers more restricted in their applications, but they possess respectively peculiarities which render them advantageous under certain conditions. The windmill is another prime mover which in favorable localities is of great value. See Dynamo-electric Machine, Gas-engine, Hot-air Engine, Steam-engine, Water-power, and Windmills.

Revised by R. A. Roberts.

Prime Numbers [*prime* is liter. first, i. e. in any series of multiples into which a prime number can enter, from Lat. *prī'mus*, first]: those whole numbers which can not be exactly divided by any other whole number except 1. Two numbers are prime with respect to each other when they can not both be divided by any whole number except 1. Thus 2, 3, 5, etc., are prime numbers; 6 and 25 are prime with respect to each other. No rule has been found for discover-

ing prime numbers by a direct process. A method of sifting out numbers not prime was described by Eratosthenes, and for that reason is generally known as Eratosthenes's sieve. The method is as follows: Since every even number is divisible by 2, we may omit or sift out all such numbers, and remembering that 2 itself is prime, we write down the series of odd numbers up to any limit, say up to 99: 1, 3, 5, 7, 9, 11, 13, 15, etc. We begin with the first prime number after 2, which is 3, and counting from it, we strike out every third number, because all such numbers are divisible by 3, and therefore are not prime. We then begin with 5, and counting from it we strike out every fifth number, because all such numbers are divisible by 5. We then begin with 7, and counting from it, we strike out every seventh number. The remaining numbers, up to the square of the next prime number whose multiples are to be struck out, are prime. In this way we find that the prime numbers less than 100 are 1, 2, 3, 5, 7, 11, 13, 17, 19. 23, 29. 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, and 97. The operation of sifting may be extended to any series of whole numbers, but beyond a certain limit the operation becomes tedious. In applying the method just described it is to be remembered that if a number can not be divided by a prime number less than its own square root, that number must be prime. Thus in the case supposed we need not go farther than 7, because 7 is the greatest prime number less than $\sqrt{100}$. From the nature of the process of Eratosthenes it is evident that the number of prime numbers in a given interval will be less the higher that interval commences. The number of prime numbers up to 10,000 is 1,230; the number between 10,000 and 20,000 is 1,033; between 20,000 and 30,000 it is 985, and so on. Many tables of prime numbers have been published of greater or less extent: those of Burckhardt extend to the number 3,036,000; Glaisher's tables extend from 3,000,000 to 6,000,000; Dase's from 6,000,000 to 9,000,000. The highest number that has been shown to be prime is $2^{31}-1=2,147,483,647$; this was found by Euler.

Revised by S. Newcomb.

Primitive Methodists: See Methodism.

Primitive Wesleyans: See Methodism.

Primogen'iture [Lat. *pri'mus*, first + *genitu'ra*, a begetting, being born, but in meaning deriv. of *primoge'nitus*, first-born; *pri'mus*, first + *gig'ni*, *genitus*, be born]: the preference in inheritance which the law accords to the eldest born. The sole and exclusive heirship of the eldest son in the English rule of primogeniture dates back directly only to the complete establishment of the feudal system of land tenure in England after the Norman conquest. On the Continent, however, in the feudal states which were erected on the ruins of the Roman empire, the principle had already completely triumphed over the Teutonic as well as the Roman ideas of succession. Its obscure origin and the rapidity with which it overran Western Europe at this time constitute one of the puzzles of legal history. In the multitude of different customary rules of descent which a study of primitive society discloses, it is seldom that the student comes upon any traces of it. The right of the eldest son prevails, indeed, but it is as a right of political succession, and not of succession to property. In this latter form it was unknown either to the Greek or to the Roman jurisprudence, and the "birthright" of the Hebrew and of the Hindu law, which is sometimes confounded with the rule of primogeniture, was at the most only a recognition of the claim of one of several sons (not necessarily the eldest) to a double portion of the inheritance.

The general acceptance of the doctrine of primogeniture in the Middle Ages would seem to indicate that it was peculiarly adapted to the necessities of that mixture of political, social, and property relations which we call the feudal system. With the well-nigh complete disappearance of that system, however, the rule of primogeniture has generally been swept away, surviving only, on the Continent, as a rule regulating succession to the crown. In England only has it been preserved in full force and virtue. There it still prevails, as a rule or canon of descent of real property, "that," to use Blackstone's statement of the rule, "the male issue shall be admitted before the female," and, "where there are two or more males in equal degree, the eldest only shall inherit; but the females all together." Of course, under a system of law in which the landowner may freely alienate his estate by will, it is really optional with him whether he will, by dying intestate, subject his real property to the rule of primogeniture or not. The system has been persistently attacked of late, but it has become too closely bound up with the habits and traditions of the English people to be easily dislodged.

The rule of primogeniture was introduced, along with the rest of the common law, into the English colonies in America, but the principle has long since been repudiated, by statute or constitutional inhibition, in all of the States as being unsuited to the spirit of their institutions. In the U. S., as also in Canada and the English colonies generally, all descendants of the same degree inherit the real property of their ancestor equally as tenants in common. See Maine's *Ancient Law* and *Early History of Institutions* and the *Commentaries* of Blackstone and Kent.

George W. Kirchwey.

Primrose [(by confusion with *rose*) < M. Eng. *primerole*, viâ O. Fr. from Lat. *pri'mula*, primrose, deriv. of *pri'mus*, first, named from its early flowering]: any plant of the genus *Primula*, although many have separate names. They are handsome flowering herbs, largely European. The true primrose is *P. grandiflora* of Europe. *P. officinalis* is the cowslip, of which the polyanthus is a cultivated form, all of these running into many varieties. The birdseye primrose (*P. farinosa*) belongs to a humbler division of the genus. This and the related *P. mistassinica* are indigenous to the northern parts of North America. *P. auricula*, the parent of the auriculas of the gardens, is a native of Southern Europe. The oxlip is *P. elatior*. The Chinese primrose (*P. sinensis*), now one of the commonest house-plants, represents a different section of the genus, to which *P. cortusoides*, a choice Siberian species, also belongs. *P. obconica*, from China, is a species much prized for greenhouse culture. It has pungent hairs which are irritating-poisonous to some persons. The evening primroses are species of *Œnothera*, of a wholly different family, and took the name from a very superficial likeness of the corolla to that of the true primrose.

Revised by L. H. Bailey.

Primrose Family: the *Primula'ceæ* (from *Primula*, the typical genus); a family of gamopetalous, dicotyledonous herbs, widely distributed over the world, but chiefly in the cooler parts of the northern hemisphere. Plants of this family are characterized by having stamens of the same number as the lobes of the corolla, and opposite them, on the tube or throat, a single style and stigma, and a one-celled ovary with a free central placenta, bearing several or numerous ovules. To this must be added the herbaceous character, to distinguish them from the *Myrtinaceæ*, tropical trees or shrubs which have a similar floral structure. Except a slight acridity, *Primulaceæ* are nearly inert plants, of no economic importance beyond the beauty of their blossoms. Besides the Primrose (*q. v.*) and its near allies, the cyclamen, the beautiful dodecatheon of the U. S., popularly known as American cowslip and shooting-star, and one species of *Anagallis*, are familiar in ornamental cultivation.

Revised by Charles E. Bessey.

Prince [viâ O. Fr. from Lat. *prin'ceps*, *prin'cipis*, one who is first, leader, chief, ruler, sovereign; *pri'mus*, first + *ca'pere*, take]: a title which sprang from that of the Roman *princeps senatus*, which became a title of the Roman emperors, and from them passed to mediæval and modern sovereigns. There are also sovereign rulers who have no higher title than prince. Nobles of the blood are in general called princes, whether they officially bear this or some inferior title. In continental Europe there are also princes who are not related to sovereign families (called in Germany *Fürst*, and not *Prinz*). Strictly, all English nobles of higher rank than viscount are entitled to be styled princes, but in practical use princes of the blood are the only ones so designated.

Prince, Thomas: clergyman and author; b. at Sandwich, Mass., May 15, 1687; graduated at Harvard 1707; went to England 1709; attended lectures at Gresham College, London; preached at Combs, Suffolk, 1712–16, and elsewhere in England; returned to Massachusetts 1717; was ordained colleague of Rev. Dr. Joseph Sewall, pastor of the Old South church, Boston, Oct. 1, 1718; devoted many years to the collection of materials for the civil and religious history of New England, and gathered a valuable library, which he bequeathed to the Old South church. D. in Boston, Oct. 22, 1758. When the Old South church was desecrated by British soldiery during the war of the Revolution, manuscript documents in the Prince library were stolen or destroyed. The books, tracts, and MSS. remaining, 1,500 in number, were deposited in the Boston Public Library in 1860. Prince

published, in addition to sermons, many occasional writings, including *An Account of the First Aurora Borealis* (1717); *Earthquakes of New England* (1755); and a revision of the *New England Psalm-book* (1758); and undertook a work valuable from its extreme accuracy of detail, *New England Chronology*, of which, however, only vol. i. (1736) and part of vol. ii. (1755) appeared, extending only to 1633 (new ed. 1826).

Prince Edward Island [named in 1798 in honor of Edward, Duke of Kent, father of Queen Victoria]: an island in the Gulf of St. Lawrence, constituting, since 1873, the smallest province of the Dominion of Canada (see map of Province of Quebec, Prince Edward Island, etc.). Area, 2,133 sq. miles. Pop. (1891) 109,088. Twenty-four minor islands belong to the province. There are numerous bays, harbors, and promontories. Northumberland Strait, on the S. and W., separates it from the mainland of Nova Scotia and New Brunswick. The soil is very fertile. The surface is generally level, with some low hills. The climate is insular and therefore not severe. The forests are greatly reduced. They consist of birch, elm, maple, ash, beech, pine, spruce, fir, hemlock, cedar, juniper or tamarack, poplar, and willow. Vast quantities of sea-manure are everywhere accessible. The waters teem with fish—mackerel, herring, cod, and many other species—and the north shore is one of the best fishing-grounds in North America. The manufacturing interests are not extensive, but ship-building is an important industry. A railway extends the whole length of the island. Wheat, oats, barley, rye, potatoes, buckwheat, and garden vegetables are raised. Cattle, horses, swine, sheep, and poultry are bred extensively. The island is divided into three counties—King's, Queen's, and Prince—each of which elects ten representatives to the Legislative Assembly. There has been a system of free public schools since 1821. The system includes grammar or higher schools, secondary schools, and normal schools for the training of teachers. There are three denominational colleges—Roman Catholic, Anglican, and Wesleyan—all at Charlottetown, the capital. During the summer the island is visited by regular lines of steamers and by thousands of fishing-vessels. In winter the island was formerly almost inaccessible, but this disadvantage has been partly remedied by a steamship owned by the Government, and specially designed for winter navigation. There is a submarine telegraph.

History.—The island (the Île St. Jean of the French) was discovered by the Cabots in 1497. It began to be settled by the French (1715), who increased rapidly for many years. In 1764, having come under British rule, it was abandoned by many of the French, and it was then parceled out among sixty-seven grantees, who agreed to furnish a numerous colony of Protestant settlers (not English) for the colony. Though these conditions were never fulfilled, the great estates were not broken up until 1875, when their absentee landlords were finally bought out under the Land Purchase Act of that year. The Roman Catholic religion was never fully tolerated till 1830. There is a Roman Catholic bishop of Charlottetown, and that body is more numerous than any other denomination. Revised by C. C. Adams.

Prince of the Peace: See Godoy, Manuel, de.

Prince of Wales, Cape: See Cape Prince of Wales.

Prin'ceps [Lat., the first man]: the civil title of the Roman emperors, as *imperator* was their military title. How the word first came to be used in this sense is a matter of dispute, many holding (with Mommsen) that it was a new designation, created to comprehend the various powers concentrated in the hands of Augustus, in 27 B. C., by virtue of which he became the "first citizen"; while others, with apparently better reason, maintain that it was nothing more than a continuation of the ancient title of *princeps senatus*, and that from its absolute use in the first instance by the senators (as *princeps noster*) it was gradually extended, until Augustus himself made official use of it in this way, and thus established the title as the imperial designation. It should be understood, however, that this dispute has regard only to the origin of the designation, and that in any case the word *princeps*, as applied to Augustus and the succeeding emperors, has a significance entirely new. For while no unprecedented powers had been lodged in the hands of Augustus, he was the first to unite in one person military authority, in the provinces and at home, with several of the most important civil offices, such as the tribunitian power, the censorship, and the supreme pontificate.

G. L. Hendrickson.

Prince Rupert's Drops: glass drops with an elongated, tapering form, made by throwing melted glass into water. A smart blow upon the large end makes no impression, but if the smallest part be picked off the small end, the whole falls into powder. They derive their name from the fact that Prince Rupert, a nephew of Charles I., introduced them into England.

Prince's Feathers: See Amaranth.

Prince's Islands: eight islands in the Marmora at the entrance of the Gulf of Nicomedia. Prinkipo, Chalki, Antigone, and Proti are the chief. Most enchanting in climate and natural scenery, in all ages they have been the favorite resort of the wealthy and luxurious classes of Constantinople. Many emperors and members of the Byzantine imperial families have resided there. Also they have been occupied by numerous monasteries, some of which still exist. At Chalki is the chief theological seminary of the Orthodox Church, manned by an able and learned corps of professors. The disastrous earthquake of July, 1894, wrecked many buildings and caused great loss of life. E. A. G.

Prince's Metal: See Brass.

Princeton: city; capital of Bureau co., Ill.; on the Chi., Burl. and Quincy Railroad; 22 miles W. S. W. of Mendota, 105 miles W. S. W. of Chicago (for location, see map of Illinois, ref. 3–D). It is in an agricultural and coal-mining region, and contains flour-mills, grain-warehouses, agricultural-implement works, foundry and machine-shop, 2 libraries (High School, founded 1867. Matson, founded 1879), 3 national banks with combined capital of $315,000, and 3 weekly newspapers. Pop. (1890) 3,396; (1900) 4,023.

Princeton: city; capital of Gibson co., Ind.; on the Evansv. and Terre Haute and the Louisv., Evansv. and St. L. Consolidated railways; 24 miles S. of Vincennes, 27 miles N. of Evansville (for location, see map of Indiana, ref. 11–B). It is in an agricultural region, and contains flour-, woolen-, and planing-mills, grain-elevator, carriage-factories, a public library (founded in 1879), a national bank with capital of $75,000, a State bank with capital of $100,000, and three weekly papers. Pop. (1890) 3,076; (1900) 6,041.

Princeton: borough; Mercer co., N. J.; on the Delaware and Raritan Canal; 10 miles N. E. of Trenton, 50 miles S. W. of New York city (for location, see map of New Jersey, ref. 4–C). It is on a high ridge, 3 miles from the main line of the Penn. Railroad, with which it is connected by a branch line, and commands an extensive view of the surrounding country. The borough is laid out with wide streets, beautifully shaded and ornamented with broad lawns, and contains some quaint colonial houses and many fine modern residences. The old graveyard has been called "the Westminster of America" because of the eminent persons buried there. There are 8 churches, Evelyn College for young women, a national bank with capital of $50,000, a State bank with capital of $100,000, a savings-bank, 2 weekly newspapers, and 4 college periodicals. Princeton is most widely noted as the seat of Princeton University (*q. v.* in the Appendix), and of the Theological Seminary of the Presbyterian Church in the United States of America (founded in 1812; now has about 300 students). It is also noted as the scene of a battle in the Revolutionary war, which proved the initiative of operations by which the British were driven from the greater part of the two Jerseys. Washington surprised and captured Trenton on Dec. 26, 1776, and concentrated his army there a few days afterward. Cornwallis, resuming command of the British in the Jerseys after the surrender of Trenton, made his headquarters at Princeton. On Jan. 2, 1777, Cornwallis advanced the greater part of his army toward Trenton, intending to attack the Americans on the following day. Washington, learning that only a small force remained at Princeton, made a night march thither, surprised the British at daybreak on Jan. 3 near the college, and routed and dispersed them within thirty minutes, inflicting a loss of 100 killed and wounded and of 230 prisoners, and sustaining a loss of less than 30. Though the forces engaged were small, the result was of great value in encouraging the colonists, who had become disheartened by many reverses. Pop. (1900) 3,899.

Princeton University: See the Appendix.

Pringle, Thomas: poet; b. at Blaiklaw, Teviotdale, Scotland, Jan. 5, 1789; graduated at Edinburgh University; became clerk to the commissioners on the public records of Scotland; began in 1811 to publish occasional poems; became in 1817 co-editor with James Cleghorn of the Edin-

burgh *Monthly Magazine*; was at the same time editor of the *Star*, a semi-weekly newspaper, and of *Constable's Magazine*; emigrated to South Africa 1820; taught school at Cape Town; became librarian to the colonial Government, and successively edited two newspapers; returned to England 1826; became secretary of the Anti-Slavery Society 1827; published *African Sketches* (1834), etc., and left a posthumous *Narrative of a Residence in South Africa* (1835). D. Dec. 5, 1834. See *Poetical Works of Thomas Pringle, with a Sketch of his Life*, by Leitch Ritchie (1838).

Printing [deriv. of *print*, shortened from *imprint*, from O. Fr. *empreindre* < Lat. *impri'mere*, impress; *in*, in, on + *pre'mere*, *pres'sum*, press]: the processes which are involved in making copies, generally in ink and by pressure, of letter-press or of designs engraved, etched, or drawn upon a solid surface. In its most restricted sense, and that in which it is used in this article, it is synonymous with typography (in its widest sense), and includes typesetting, electrotyping, stereotyping, etc., and the taking of impressions from the inked surface of the type thus set up, or of plates made from them on presses specially constructed for the purpose; but in a wider sense lithography, engraving, zincography, and embossing books in raised letters for the blind, as well as the reproduction of photographic images by the action of the sun on specially prepared paper, etc., are all included.

History.—From the earliest historic period some mode of engraving and producing impressions or devices has been known, but it seems not to have advanced beyond the form of seals until the time of the Babylonians and Assyrians. Their buildings were generally built of burnt brick, which were stamped with an inscription according to the character of the edifice, and bore the name of the reigning monarch. In many instances these impressions show clearly that the stamp was engraved in relief and applied to the plastic clay. The Assyrians, unlike any other nation of antiquity, employed terra-cotta prisms, cylinders, and tablets for all the purposes of writing and the preservation of their literature. (See Assyrian Literature.) The Egyptians also used stamps to impress the bricks used for their buildings. The stamps appear to have been used to mark the destination of the bricks. The Chinese have used a simple mode of printing from an early date. A work supposed to have been written during the reign of Wu Wang (in the twelfth century B. C.) mentions the blackening of engraved characters, but this is probably an allusion to some mode of making inscriptions more legible by blackening the letters. According to their chronicles, the early attempts of their present mode of printing were made about 50 B. C., but no great advance was made till the reign of Ming-Tsung (927–934 A. D.), when Fung-Taou made copies of the classical books by taking impressions from stone plates, into which the letters had been cut; in the impression therefore the letters were white on a field of black. Fung-Taou then printed an edition of the nine *King*, or classical books, for the imperial college at Peking, from wooden blocks engraved in relief: this work was completed in 952. In 1041 a Chinese blacksmith cut the most frequently used characters upon cubes of porcelain paste, which he then baked until hardened. These, being of different heights and thicknesses, were placed in a kind of cement, pressed down evenly, and printed from; but this process seems not to have extended after his time. Various attempts have been made to substitute separate characters for the engraved blocks, but it is rendered difficult because every word in Chinese requires a separate character, instead of each word being composed of elements resolvable into the simple alphabet of Western nations. It is estimated that there are about 80,000 of these characters, though not more than 14,000 to 15,000 are in regular use. Movable type, both of wood and of copper, have long been in use in China, and some large works have been printed from them. (See Encyclopædia.) The *Peking Gazette* is printed from movable wooden type (see Newspapers), and millions of pages of books and periodicals in Chinese are annually printed from movable type at the mission presses and elsewhere. The Greeks were early acquainted with engraving on metal, their maps being cut with lines below the surface, but it does not appear that they multiplied copies from them. The ancient Romans made use of metal stamps, with characters engraved in relief, to mark their articles of commerce and brand cattle. The old Roman potters appear to have possessed separate stamps for letters, as some of their clay lamps show that the inscriptions were made by impressing each letter separately. The British Museum contains several Roman stamps with the letters engraved in relief, which seem to have been used to print the owner's signature on documents. Although the Romans had no mechanical mode of multiplying literature, they had a well-organized system of slave-labor, which enabled books to be written cheaply, and nearly every one could boast of having one or more volumes. With the decline of Roman civilization literature was despised by all ranks of society. During the following centuries the taste for literature was cultivated by a few; the Church through her scribes fostered the transcription of the Bible, the classics were multiplied, and gradually the people acquired a thirst for knowledge which was but poorly supplied. With the introduction of the art of paper-making, about the beginning of the eighth century, epistolary correspondence increased, books were multiplied more rapidly, and with the endeavor to supply the people more cheaply with religious reading wood-engraving was invented, first to disseminate scriptural scenes, and afterward to make illustrations and texts for books in imitation of the manuscripts of the period.

Block-printing and Block-books.—Toward the beginning of the thirteenth century wood was engraved upon in Italy, Sicily, and Spain to produce designs with the aid of ink on fabrics of linen and silk. Playing-cards were produced by the same method, and afterward colored by hand or by means of stencil-plates. Old manuscripts of this time are in existence which have initial letters, and sometimes pictures printed, while the text is in handwriting. There is in the library of Upsala, Sweden, a curious volume known as the *Codex Argenteus*, or *Silvered Book*, a translation of the four Gospels, so called because the letters are in silver on leaves of purple vellum, supposed to have been made not later than the sixth century. From the indentation on the other side of the leaf, and the turned letters found occasionally, it seems to have been made by the separate stamping of each letter upon the leaf. About the beginning of the fifteenth century single prints of a religious character appeared, from Germany and Holland. These pictures, or image-prints, were made of many sizes, generally engraved in outline, and highly colored. The earliest known with date is that of St. Christopher carrying the infant Saviour upon his back across a river. It has a legend of two lines at the foot, with the date 1423. Three copies are known to be in existence. It is about 8 by 11 inches in size, printed on paper, and in ink almost black, differing thus from other image-prints, which are generally in a dull or faded brown ink. There are many other image-prints which are referred to about the same date. Manuals of devotion followed, of a limited number of pages, generally containing pictures with a few words beneath or in the interior, some having the pictures on one leaf and the explanation or text on the other. The most notable of these were the *Biblia Pauperum*, or *Bibles for the Poor*, or rather books for indigent preachers, consisting of a series of rude engravings, each occupying a page, on one side of the leaf only, and divided into compartments having pictorial illustrations of the most remarkable incidents mentioned in the Pentateuch, the Gospels, and the Apocalypse, and accompanied with explanations in Gothic characters. The two pages facing each other were engraved on one block of wood, and the book put together in sections of two leaves, two pages of illustrations being followed by two blank pages. It was a folio, printed on paper, in ink of a dull or rusty-brown color, and contained forty pages, each engraving being 10 inches long and 7½ inches wide, without folios; but the first twenty pages were marked in alphabetical order from *a* to *v*, and the last twenty with the same letters having a dot before and after, as *.a.* to *.v.* Its date is referred to about 1420. At least four distinct editions from wood, two Latin and two German, have been discovered. Of the first edition there are known to be fifteen copies, varying in slight particulars, but tending to prove a common origin. The workmanship of the *Biblia Pauperum* is like that of other block-books, of which notable examples of an early date are the *Apocalypsis Johannis*, three works on the *Virgin Mary*, the *Ennditkrist* or *Antichrist*, *Ars Memorandi*, *Ars Moriendi*, and *Speculum Humanæ Salvationis*. Sotheby, in his *Principia Typographica* (1858), describes twenty-one block-books, all distinct works.

Introduction of Typography.—There is no exact and entirely acceptable account of the invention of typography from the pen of any eye-witness or contemporary chronicler. Our knowledge of the subject has been gathered from the imprints of the first books; from casual and often inexact

notices of early writers, who relate hearsay testimony; and from legal records, sometimes of doubtful authority. All the notices are deficient in necessary details. They show that the invention was not fully appreciated, either by the printers or by the public. When the eye-witnesses were dead, and the merit of the invention was acknowledged, explicit and positive testimony began to appear, but this testimony was usually colored by family or national pride. The claimant of earliest date is Laurens Janszoon Koster, of Haarlem, whose name was first mentioned in print in 1588. It is said that Koster invented types of wood about 1428, and types of metal at a later date, that with these he printed the *Speculum Salutis* and other little books, and that about 1440 one John (by implication John Fust or Faust), then a workman in Koster's employ, stole his types and his secret, carried them to Mentz, and there introduced typography. Koster died soon after, leaving no known successor nor any school or process of printing that can be claimed as his. Dr. Van der Linde, in his *Haarlem Legend*, has proved the falsity of the Koster legend, but William Blades, in his *Pentateuch of Printing*, holds that even if the Koster legend be proved untrue, there is evidence of a petty but unsuccessful practice of typography in Holland before 1450. This evidence is indirect, inferential, and unsatisfactory. Other claimants for the honor of the invention are Albert Pfister, of Bamberg, Germany, an engraver on wood, whose first dated book is of the year 1461; Pamphilo Castaldi, of Feltre, Italy (to whom a statue was erected there in 1868), who is said to have taught Fust how to make types before 1454; John Mentel, of Strassburg, who is said to have been a printer as early as 1440; and Procope Valdfoghel, a goldsmith of Prague, who taught "artificial writing" by means of metal letters at Avignon, France, in 1444. The testimony in favor of these and of other claimants of minor importance has not withstood critical investigation. John Gutenberg is the only claimant who is known to have received honor as the true inventor during his lifetime. He did not put his name on any of his books; he did not personally make any claim to be the inventor; he did not clearly describe his invention. Most of our knowledge of him and his work is derived from legal documents and the testimony of friends, who meagerly and often inexactly described his processes. The records of a suit at law in which judgment was recorded Dec. 12, 1439, show that he was then at variance with his copartners, Dritzehen, Riffe, and Heilmann. It appears from the written testimony that he had been engaged in the development of a secret process, from which all the partners hoped to get great profit at the fair of Aix-la-Chapelle to be held in 1440. Only one of the witnesses testified that the work was printing. It does not appear that Gutenberg was then successful as a printer, for there is no book that can be even plausibly claimed as the result of his work in Strassburg. The genuineness of this legal record has been challenged by Dr. Hessels, but it has been accepted as trustworthy by most bibliographers. Unfortunately, it was destroyed by the Prussian army in the siege of Strassburg in 1870. In 1448 Gutenberg was a resident of Mentz, with a printing-office in the house of his uncle. In 1455 he appears as defendant in a suit brought by John Fust or Faust for the recovery of 1,550 guilders, lent for the purpose of "making tools" for "vellum, paper, and ink," and for the "work on the books." Fust won the suit and took possession of the printed work and types of Gutenberg. This did not prevent Gutenberg from establishing a new printing-office, which he is supposed to have managed until his death in 1468. As Fust and his son-in-law, Peter Schoeffer, continued to print after 1455, and as there is some reason to believe that there was a third unknown and unnamed printing-house in Mentz before 1455, it is difficult to specify the books made by Gutenberg. The *Letters of Indulgence of 1454*, *1455*, and *1461*, and six small pamphlets have been attributed to him, on account of the similarity of their types with the types of his books, but the evidence is not sufficient. The *Bible of 42 lines*, usually bound in three volumes, folio, two columns to the page, published before 1456; the *Bible of 36 lines*, three volumes, folio, two columns to the page, of unknown date (certainly before 1460, and possibly before 1450); and the *Catholicon of 1460*, a Latin dictionary of 748 pages folio, two columns to the page, are the best specimens of the work reasonably accredited to his press—all of them unmistakable productions of a master. In 1465 Gutenberg was appointed by the elector as one of his courtiers, in recognition of his services. When he died the elector forbade his printing-office to be removed from Mentz. Gutenberg's neglect to assert himself as the inventor of printing was incompletely remedied by his friends and successors, but it was generally admitted before the year 1500, by printers everywhere, in France, Germany, Italy, and the Netherlands, that Gutenberg was the inventor of typography. A tablet certifying his right as an inventor was put up soon after his death in the church at Mentz, and another in 1509 in a law school of that city. Statues have been erected to him in Mentz, Frankfort, and Strassburg. The merit of Gutenberg's invention was largely in his superior method of making types by means of punch, matrix, and mould. When he began his experiments he found already in common use paper, printing-ink, engraving in relief, some form of printing-press, and the art of printing playing-cards and block-books. Possibly isolated types were then in use, but they could not be used to profit, because they were not scientifically made and sufficiently exact. That Gutenberg derived advantage from the successful experiments of earlier block-book printers is probable, but he must have added to the common stock of knowledge much more than he found. Gutenberg's method of type-making was the only key to the invention of practical typography. It was so considered by him when he speaks in the *Catholicon of 1460* of the new art as dependent on "the admirable proportion, harmony, and connection of the punches and matrices." Fust and Schoeffer further say in the *Psalter of 1457* that the book was made by the "masterly invention of printing and also of type-making." The printing-press is never mentioned by any early writer as an important factor in the development of the invention. Gutenberg's process of type-making has been improved in details, but its elementary principles have not been found susceptible of any improvement.

A few years after the sacking of Mentz (1462) the pupils and the workmen of Fust and Schoeffer were dispersed, the discovery was made public, and the art spread over Europe. From Mentz the art was transplanted to Rome in 1467 by Sweynheym and Pannartz; to Paris in 1469; to England in 1477; and to Spain in 1474. Hawkins, in his *Titles of the First Books* (New York, 1884), gives a chronological table of 236 places where the art was practiced during the fifteenth century, with the names of the printers when known, and of the first productions of their presses. Of the various editions of books published in the sixteenth century, one-half were Italian, of which one-half were Venetian; one-seventeenth were English.

Printing in America.—The date of the introduction of printing into America is uncertain, but from the record of three early Spanish authorities it is believed that the art was introduced into Mexico by Viceroy Antonio de Mendoza, who arrived in that country in Oct., 1535. The first printer's name was Juan Pablos, and the first work printed the *Escala espiritual para llegar al Cielo* of San Juan Climaco, a translation from the Latin into Castilian by the printer himself. No copy of the work exists. The first book with date establishes the fact that a press was working in the city of Mexico in 1540. It is called *Manual de Adultos*, dated Dec. 13, 1540, a quarto in Gothic letter, printed by Juan Cromberger, whose imprint is also on several other books printed from 1540 to 1544. This Cromberger was a celebrated printer of Seville, and books bearing his imprint at this place also appeared both before and after the dates of the Mexican works. It is suggested, to reconcile all the statements brought to light, that Juan Pablos may have been at Seville in the employ of Cromberger, who was charged by Mendoza with the establishment of a printing-press in the city of Mexico, and who sent Juan Pablos over to conduct the business in the name and for the benefit of his master; that after Cromberger's death Pablos became the owner of the establishment, and was in this way, although not the first owner of a printing-press, entitled to the honor of calling himself the first printer of Mexico. The next press established in the New World was at Lima, Peru, about 1584, the earliest known book printed there being the *Doctrina Christiana*, a quarto in the Quichua and Aymara languages, printed by Antonio Ricardo in 1584. Several other religious works by the same printer in 1585 and 1586 are in existence. Between 1540 and 1600 there is recorded the issue of ninety-three works in the city of Mexico and seven in Lima. In 1639 the first press in North America was erected at Cambridge, Mass., in the house of the president of Harvard College, Rev. Henry Dunster, through the efforts of Rev. Joseph Glover, who died while bringing the press and materials to this place. It was

placed under the direction of Stephen Daye, by whom the first work issued was *The Freeman's Oath*, followed by *An Almanack* in the same year. Daye was succeeded about 1649 by Samuel Green, under whom, in 1660–63, was printed the celebrated Indian Bible of Eliot, and other of his works in the Indian language. This press is still active, and known as the "University Press." The next press was established in Boston in 1676, after which printing gradually extended throughout the colonies. In 1775 the whole number of printing-houses in the British colonies was fifty.

Early Printed Books.—It is interesting to note the peculiarities of the first printed works. An edition consisted of a limited number, for 200 or 300 was then esteemed a large issue. The size was either large or small folio, sometimes quarto. The leaves were without running title, direction-word, folios, or paragraphs. The words were printed close together; abbreviations were numerous; the orthography was arbitrary; the sentences were distinguished only by the single or the double point, but subsequently the virgule / was used for the simple pause, answering to our comma. The initial letters at the beginning of a chapter or important division were left blank to be filled in by hand. In some works the embellishments surrounding the text were illuminated in colors, even gold and silver, and charged with saints, birds, flowers, etc. The printer's name, residence, etc., were either omitted or put at the end. The date was often omitted, sometimes obscurely indicated, or printed either at full length or by numerical letters, and sometimes in several ways together, as, "One Thousand cccc. and lxiiii.," etc., but always at the end. A variety of characters was uncommon; as a rule a Gothic letter of the same size was used through the work.

Type.—These are the letters or characters used in typography. A type is a thin metallic bar, like Fig. 1, which represents the letter M, and has the following characteristics: *c* is the face; *f*, the body; *g*, the nick; *a* to *b*, the width or set; *b* to *d* the height of the printed character; *c* to *e*, the height to paper; *d*, the shoulder; from *d* to the face is called the beard; *h*, the groove left in dressing by cutting off the superfluous metal left by the mould, which leaves two parts for the bottom of the type, called the feet; the thicker stroke of a letter is called the stem or body-mark; the fine lines at the top and the bottom of a letter are the serifs; a projection over the body, as the top and the bottom of *f*, is a kern. Types are made of type-metal, a composition of which the principal ingredient is lead. The type-founders of the present day use alloys which are generally trade-secrets. The alloy most approved is composed of certain proportions of lead, antimony, tin, and copper, so that the metal shall be hard, yet not brittle; ductile, yet tough; flowing freely, yet hardening quickly. This composition on solidifying contracts but very slightly and insures the sharpness of the lines of the face; the antimony gives hardness, the tin toughness, and the copper tenacity. Different sizes of type are made of varying qualities of metal, designated ordinary metal, hard metal, and extra-hard metal. Comparatively soft metal is used for spaces and large type, while small type is composed of hard metal. Type is made more durable by a process which deposits a thin film of copper over the face. Roman and Italic type are most commonly employed in printing books in Europe and America, and these have undergone every change in form that taste or fancy could suggest, as may be noticed in the multitude of sizes, shades, and ornamentation exhibited in the display-lines of books, papers, circulars, and posters.

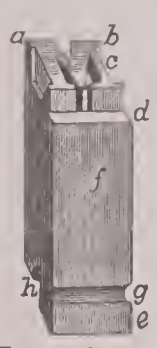


FIG. 1.—Type.

Wood Type.—The large letters used in handbills and posters are made of wood, usually maple or bay mahogany, which is prepared as for wood-engraving. By the old method the outline of the character was first carefully cut upon the face of the block, and this was afterward put under a revolving drill, which cut away the superfluous wood, when it was finished by an engraver. William Leavenworth, of Allentown, N. J., in 1834 applied the pantograph to the cutting of wood type. In this a tracing-point at one end follows the outline of a large model letter, and is repeated at the other end by a revolving cutter, which cuts the letter from a block of wood, after which it is dressed with a graver.

Sizes of Type.—The various sizes of type have grown gradually into use, as the requirements of books and newspapers have dictated, or the pride of punch-cutters has accomplished. The names given to them are arbitrary and unmeaning. The following are the old names of the sizes most used in books and newspapers: 1. Brilliant; 2. Diamond; 3. Pearl; 4. Agate or ruby; 5. Nonpareil; 6. Minion; 7. Brevier; 8. Bourgeois; 9. Long primer; 10. Small pica; 11. Pica; 12. English; 13. Great primer.

The following is a specimen of the sizes of type up to great primer, the numbers corresponding to the numbers and names above.

1.—abcdefghijklmnopqrstuvwxyz
2.—abcdefghijklmnopqrstuvwxyz
3.—abcdefghijklmnopqrstuvwxyz
4.—abcdefghijklmnopqrstuvwxyz
5.—abcdefghijklmnopqrstuvwxyz
6.—abcdefghijklmnopqrstuvwxyz
7.—abcdefghijklmnopqrstuvwxyz
8.—abcdefghijklmnopqrstuvwxyz
9.—abcdefghijklmnopqrstuvwxyz
10.—abcdefghijklmnopqrstuvwxyz
11.—abcdefghijklmnopqrstuvwxyz
12.—abcdefghijklmnopqrstuvwxyz
13.—abcdefghijklmnopqrstuvwx

These alphabets show clearly the difference in the height of face and the thickness of the letters of the various fonts. Larger sizes, with a few exceptions, are named according to the number of pica lines in depth, as four-line pica, five-line pica, etc. Between nonpareil and minion there is a size in Great Britain known as emerald. Newspapers use minion, nonpareil, and agate extensively. Diamond is seldom used for entire works. The Oxford University Press issued in 1875 the "smallest Bible in the world," in English, printed on India paper, from diamond type; it contained 984 pages, each 72 lines long, including the head, and 37 ems wide. The bound volume is $2\frac{6}{8}$ inches wide, $4\frac{5}{8}$ inches long, and half an inch thick. The American Bible Society issued in 1857 a diamond Bible, containing 882 pages, each 72 lines long, and 41 ems wide, which has the usual thin paper and leather binding. If presented in the English dress, it would be about a quarter inch wider and longer, but 100 pages thinner. Brilliant is rarely employed, except for references or side-notes to Bibles, etc. Small as this type is, a type-cutter of Berlin has formed a type so minute as to be scarcely readable without a good magnifying-glass. More surprising still, as early as 1828 Henri Didot, of Paris, had cut characters of almost microscopic fineness, 25 lines to the English inch, with which he printed an elegant edition of Horace in 64mo.

The names here given to types are those of the old system, which is steadily falling into disuse in Europe and America. The U. S. Type Founders' Association in 1886 changed the names and dimensions of all bodies, as is shown in the following table:

New name.	Fraction of an inch.	Old name.
3-point	0·0415	Excelsior.
$3\frac{1}{2}$ "	0·0484	
4 "	0·0553	Brilliant.
$4\frac{1}{2}$ "	0·0622	Diamond.
5 "	0·0692	Pearl.
$5\frac{1}{2}$ "	0·0761	Agate.
6 "	0·083	Nonpareil.
7 "	0·0968	Minion.
8 "	0·1107	Brevier.
9 "	0·1245	Bourgeois.
10 "	0·1383	Long primer.
11 "	0·1522	Small pica.
12 "	0·166	Pica.

These numerical names define the size of each body and its relation to all other bodies. The French system of points, from which the American system was copied, has its point of larger size—·0376 + cm., which is too large for the nicer subdivisions of bodies made by type-founders in the U. S. Eleven points French are nearly as large as twelve points American. The French system has been adopted in Germany, Spain, Belgium, Switzerland, and Italy.

Height, Measurement, and Standard.—The height to paper, or the distance from the face to the feet of type, varies in the type made by the foundries of Europe and America. The standard English height is ·9166 inch; the U. S. new

standard is ·9186 inch; the French standard is higher; the Russian standard is more than 1 inch. There is no generally accepted standard of width for the alphabet of twenty-six letters, which must vary with the fashion of the face and the size of the body. As types decrease in size below bourgeois they must be made of steadily increasing width. Different fonts will vary from twelve ems to sixteen ems to the alphabet. Book-compositors require fonts from pica to bourgeois to measure not less than thirteen ems, and below bourgeois not less than fourteen ems; for smaller sizes a greater width is exacted. For very thin types that fall below the standard extra compensation is allowed. The earliest exact standard is the French, in general use on the Continent, which divides pica, one-sixth of an inch deep, into twelve parts, called points, and conforms each size to a certain number of these points. The standards vary in Great Britain and the U. S., though generally, a pica being about one-sixth of an inch, two nonpareils are equal to one pica, two pearls to one long primer, two diamonds to one bourgeois. The following table will give an idea of the proportions of types to space, etc., taking Bruce's standard of length, in which 201·58 lines of diamond are contained in a foot, and every size is made 12·2462 per cent. smaller than the size following it:

SIZE.	Lines in a foot.	Ems in a pound.	Square inches in 1,000 ems.
Pearl	179·59	800	4·55
Agate	160	690	5·29
Nonpareil	142·54	520	6·93
Minion	126·99	360	10·10
Brevier	113·13	290	12·60
Bourgeois	100·79	270	13·86
Long primer	89·79	200	18·20
Small pica	80	170	21·16
Pica	71·27	130	27·72

Types made by the point system will show slight variations from the figures of this table.

One pound of composed type occupies 3·5 sq. inches. For the various processes in making type, see TYPE-FOUNDING.

Fonts.—A complete assortment of type of any one face or size is called a *font* or *fount*, which may be varied to any extent. Type-founders have a scheme for the proportional quantity of every letter required for a font, and a peculiar scale is necessary for every language. In Great Britain founders select a scale having 3,000 of the small letter *m* for its basis. In the U. S. the founders adopt nearly the same scheme by weight, and proportion all fonts, large or small, accordingly, a font of 500 lb. containing 20 lb. 8 oz. of *a* and 28 lb. 4 oz. of *e*. The following table shows the relative proportion of every character required in a font of 800 lb. of pica for ordinary work in the English language:

A FONT OF PICA, WEIGHING 800 LB.

Small letters.		Points, etc.		Capitals.		Small capitals.	
a	8,500	,	4,500	A	600	A	300
b	1,600	;	800	B	400	B	200
c	3,000	:	600	C	500	C	250
d	4,400	.	2,000	D	500	D	250
e	12,000	-	1,000	E	600	E	300
f	2,500	?	200	F	400	F	200
g	1,700	!	150	G	400	G	200
h	6,400	’	700	H	400	H	200
i	8,000	(	300	I	800	I	400
j	400	[	150	J	300	J	150
k	800	*	100	K	300	K	150
l	4,000	†	100	L	500	L	250
m	3,000	‡	100	M	400	M	200
n	8,000	§	100	N	400	N	200
o	8,000	‖	100	O	400	O	200
p	1,700	¶	60	P	400	P	200
q	500			Q	180	Q	90
r	6,200	Figures.		R	400	R	200
s	8,000	1	1,300	S	500	S	250
t	9,000	2	1,200	T	650	T	325
u	3,400	3	1,100	U	300	U	150
v	1,200	4	1,000	V	300	V	150
w	2,000	5	1,000	W	400	W	200
x	400	6	1,000	X	180	X	90
y	2,000	7	1,000	Y	300	Y	150
z	200	8	1,000	Z	80	Z	40
&	200	9	1,000	Æ	40	Æ	20
ff	400	0	1,300	Œ	30	Œ	15
fi	500						
fl	200	Accents.		Spaces.			
ffi	150	6	200	3-em spaces	18,000		
ffl	100	à	200	4-em “	12,000		
æ	100	â	200	5-em “	8,000		
œ	60	ô	200	Hair “	3,000		
—	150	All other accents, 100 each.		Em quads	2,500		
——	90			En “	5,000		
———	60			Large quadrats, 80 lb.			

This is the proportion for Roman letters, etc. An Italic font to accompany this would be in the proportion of one-tenth of the Roman, not including spaces and small capitals. To give an idea of the number of pages this will set, suppose the page of pica type to be 8¾ inches long by 5¼ inches wide, or 53 lines long by 35 lines or ems wide. This will give 1,855 ems in a page; there being 130 ems in a pound, this will make the page weigh nearly 14¼ lb., which, divided into 800 lb., gives about 56 pages. This calculation shows only how many pages could be set if every character were used, but copy always exhausts the characters unequally. Fonts of book-type vary from 50 lb. to 20,000 lb.

Arrangement of the Type in Cases.—The type when received from the founder are arranged in a case containing

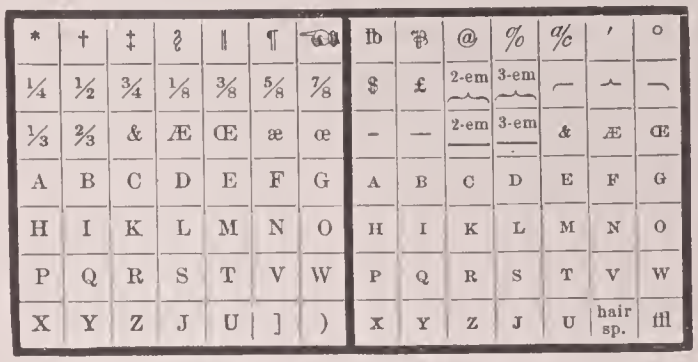


FIG. 2.—Upper case.

boxes of various sizes for the different characters. The lower case has remained nearly the same as it was 200 years ago. It is a tray of wood, about 1¼ inches deep, 32½ inches long, and 16¾ inches wide. Cases go in pairs, the upper case (Fig. 2) containing 98 boxes for capitals, etc., and the lower case (Fig. 3) containing 54 boxes for small letters, figures, and

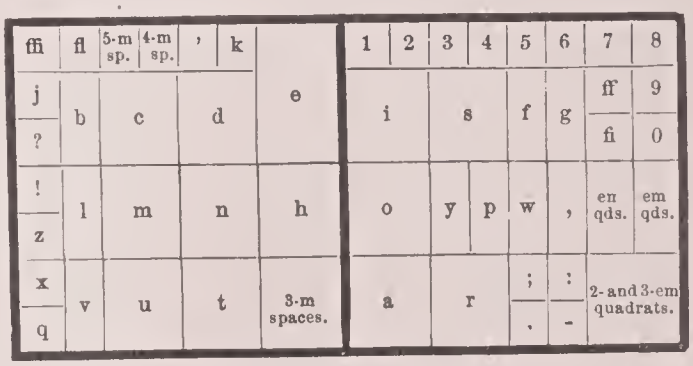


FIG. 3.—Lower case.

spaces. Fig. 2 shows the case adopted by the book-compositors of the U. S., having the capitals on the left side and the small capitals on the right. Newspaper compositors prefer the capitals on the right side and the small capitals on the left. The lower case is so arranged that the letters most frequently used are placed in large boxes toward the middle and in front of the compositor. These cases are placed on a frame or stand about the height of the breast, and in a sloping position from the top to the bottom of the case, the capital case on the upper part of the frame, whence called upper case, and the case containing the small letters on the lower part of the frame, hence called lower case. These cases contain only Roman letters. Italics and all other varieties are kept separately in similar cases. The spaces noticed in the cases are of different widths, so made to equalize the spacing. The *em* is a square space; *en*, 2 to an em; 3-em, 3 to an em; 4-em, 4 to an em; 5-em, 5 to an em; and hair-spaces, 6 to 13 to an em; 2- and 3-em quadrats are double or triple *ems*.

Composition or Typesetting.—The compositor in setting up type uses a small frame of steel, having three sides and a bottom, called the composing-stick (Fig. 4). It is usually from 6 to 12 inches long, 2 inches wide, and ⅝ inch deep, and will hold about 20 lines of minion. Larger sizes are occasionally used for wide measures. Two sides are immovable, the third side being movable to be adjusted to the width of the page, and then clasped, as in the Grover patent (Fig. 4), or secured with a screw. A setting-rule, type high, and of the required measure, is also used with the stick; it is made of a strip of steel or brass, having a short pointed projection at the top of the right end or on both

FIG. 4.—Composing-stick.

ends. It enables the type to be put quickly in its place, and is used in emptying matter from the stick, in lifting matter, and to support matter in the left hand while distributing with the right. Having received a "take" or small portion of the copy of a work, which is placed conveniently on the upper case, the compositor holds in his left hand the stick, made up to the required measure, like a small trough, the rule resting against the back, and stands in front of the frame or the left of the middle of the case. Observing and remembering a few words of the copy, he looks to the proper box for the first letter, picks it up with the right hand so that the nick (Fig. 1, *g*) shall be outward and from him, and lays it in the stick with the nick looking toward the opening, which brings the letter right side up. While putting the first letter in the stick, his eye at the same time looks toward the next box, and, his hand following immediately, he again picks up a letter with the nick from him, and places it by the side of the other. He does not look at the face of the letter, but glances at the nick (Fig. 1, *g*), and takes it for granted that if it come from the right box it must be the right letter. He secures every letter successively with the thumb of the left hand as the type are placed side by side in line from left to right. As nearly as the letters will allow in print, the type are set in the stick thus: ⊥ʎdoƃɹɐdɥʎ. The compositor always reads the type in this manner, and does so as quickly as the ordinary reader comprehends the printed page. When he comes to the end of his line, and finds that he has a syllable or word which is either too long or too short to fill out the measure, he has to perform an operation which requires care and judgment. This is called *justification.* The first and the last letter must be at the extremities of the line; and the distances between the words must be made as nearly as possible uniform by changing the spaces, already described, and thus getting in or driving out the whole of the syllable or word. The first line being justified, the rule is lifted to the front, and the compositor proceeds with the next line, and so on till the stick is full. If the matter is open, thin strips of metal (called "leads") are placed between the lines. Placing the rule at the front, he clasps the stickful with the thumbs on each upper corner, the forefingers on each lower corner, and the side of the first and second joints of each middle finger at the left and right sides of the type, presses the corners and the sides toward the center, and thus readily lifts the mass of separate letters; but it requires some practice to do this neatly. The stickful is placed on a galley, or oblong tray of wood or brass, having a raised edge of half an inch on two, three, or four sides, but generally on the left side and top. Having completed his portion, the matter, as it is now called, is ready to be made up.

Distribution of the Type.—When the compositor has set most of the type out of the case, he distributes *dead* matter. The matter is first wet with water to hold the type slightly together. Placing twenty lines or so on the rule, held in the left hand and resting against the inside of the thumb and on the side of the third finger, he takes a few words between the thumb and middle finger of the right hand, separates the letters by the pressure of the forefinger, and, when his hand is over the proper box, lets the letter fall. This he continues till the case is full.

Composing and Distributing Machines.—Much labor and ingenuity have been expended in efforts to substitute machinery for hand-labor in setting type, and though about 100 patents have been granted, but few machines are in use. The only typesetting machines now doing practical work in the U. S. (1894) are the Mergenthaler or Linotype, the Thorne, the MacMillan, and the Burr. The Mergenthaler is also a type-making machine. It produces lines of newspaper type in solid bars, at the rate of three or four lines a minute. The Lanston machine makes single types and composes them. The Thorne machine makes use of the type of type-founders, composing and distributing them at the rate of 4,000 ems or more an hour. The MacMillan also makes use of founded type, which it composes at the same rate of speed, but its distribution has to be done on a separate machine. The Paige machine uses type already founded, which it composes, distributes, and justifies at a very high rate of speed. The Burr machine makes use of founded type, which it composes rapidly, but it requires a separate machine for distribution. Every machine, however fast or accurate, has disadvantages. Most of the typesetting of the world is still done by hand.

Unit of Measurement.—In the U. S. the compositor is paid according to the number of ems he sets (in Great Britain by the number of ens), without compensation for filling his case or for correcting errors. Difficult manuscript or intricate composition, however, is generally done at a certain price per week. In Continental Europe matter is measured generally by the number of letters, a more equitable method, as modern newspaper type varies from 12 to 18 ems to the alphabet. The em of measurement is the square of the body of type to be measured; the en of measurement is one-half of that square. In measuring the width of columns or pages, the letter m is placed sidewise in the stick, thus,

mmmmmmmmmmmmmmmmmmmmmmmmmmm;

and the number of these, multiplied by the number of lines in length, gives the number of ems; for instance, this cyclopædia is set in brevier type, 27 ems wide in a column, 84 lines long (not counting head and foot lines), and two columns in a page—$27 \times 84 \times 2$, making 4,536 ems in a page. The average number of pieces of metal, spaces and letters, is 2·25 to an em, so that 1,000 ems contain about 2,250 pieces. In an average page of this cyclopædia there are 1,680 words, 10 words to a line, 5 letters to a word; in addition, the spaces average 2·25 ems in a line, and 409 ems in a page. Words, therefore, in the English language average 5 letters, and in type 2·5 ems each. The number of ems the average compositor will set in an hour is 800. Many compositors are reported to have set from 1,500 to 2,000 ems per hour, and a large number average over 1,300 ems.

Make-up.—In newspaper-work or work requiring many corrections, or for other reasons, a proof is taken of the matter secured in a galley in long pieces, read, and corrected, sent to the author, and then made up, read, corrected, and sent to press or stereotyped. Usually, it is placed in the hands of the "maker-up," who, having set the appropriate headings, places a head-line at the top of the matter, containing the running-title of the book or the appropriate subdivisions of the work, divides the matter into pages with a gauge, affixes the foot-line—a blank line put at the bottom of a page—containing sometimes the signature or folio, and binds the page with cord. A proof, termed the "first proof," is taken, given to the proof-reader, who carefully compares it with the author's copy by the aid of a copy-holder, who reads aloud, and the errors noted are corrected by the compositor. A second proof, or "revise," is compared with the first, and sent to the author for his revision. His corrections are made, and the third or "press proof" is carefully read, generally by a more skillful proof-reader than the first, when the corrections are made, and the matter is ready for the press or for stereotyping or electrotyping. See STEREOTYPING.

Imposition is the method of so arranging the pages that they will be in consecutive order when the sheet or section of a book is folded. When the pages are to be stereotyped or electrotyped, only a few pages in their regular order are secured together and cast; yet these cast pages are afterward imposed on the press in the same manner as described below. For over 400 years imposition remained merely a trial process, the few early modes having been handed down to the present time without any attempt at systematic explanation. The pages are laid upon a marble or iron table, called the *stone.* Any number of pages may be imposed in one form, from 2 to 128, according to the size. The first page in simple forms is placed in the left-hand corner, with the foot of the page toward the imposer, and when completed the last page is found at its side. The second page and the next to the last are together; the third and the third from the last, and so on, advancing one from the first folio and receding one from the last, until the two middle pages are reached, which are in the 4to the 2d and 3d; in the 8vo. the 4th and 5th; in the 12mo. the 6th and 7th; in the 16mo, the 8th and 9th; in the 24mo. the 12th and 13th, and so on. (The terms 4to, 8vo, etc., here refer to the number of pages in a form, the usual designation of printers.) The imposition of the octavo, Fig. 5, and

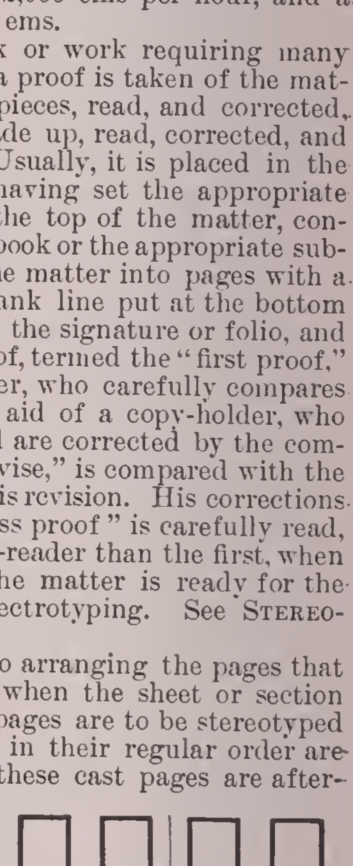


FIG. 5.—Imposition of the octavo.

of the duodecimo, Fig. 6, will illustrate the principle, the folio at one end of the page representing the head.

The pages are adjusted to the required distance apart according to the size of the paper, an iron "chase" or frame is placed around them, and wood or metal furniture, half an inch high, of various thicknesses, is placed, some at the head of the pages, called "head-sticks," some between the pages,

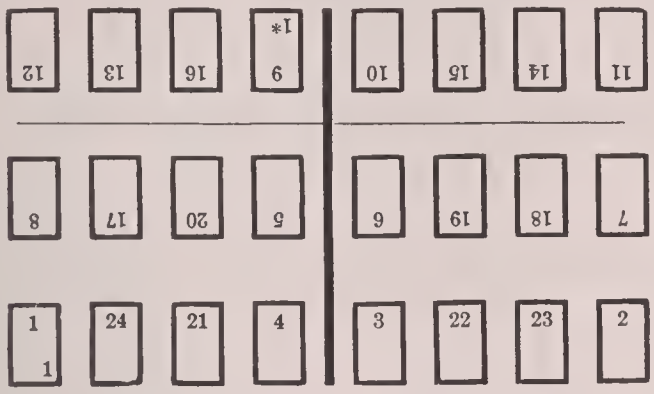


FIG. 6.—Imposition of the duodecimo.

called "gutters," and others at the sides and feet, called "side" and "foot sticks." The latter are larger at one end than the other, so that small wedges of wood or metal, called "quoins," may be driven tightly between them and the sides of the chase, locking the type firmly, making it like a solid piece, which may be lifted and placed on the press. The general practice up to recent date was to place the pages which would appear on the outside of a sheet in a single chase, and the inside pages in another chase, requiring every sheet to be printed from two forms for one copy. All the pages of a single sheet are now usually placed in one chase, and the paper turned over on the press, making two copies at two impressions. The chase is crossed by two iron bars, represented by the long lines across Fig. 5 and Fig. 6, which support and keep the chase from springing.

Signatures.—The signature is a figure or a letter of the alphabet placed at the foot of the first page of every form, or a section or sub-section of a form, to denote the order of the sheets, and serves as a guide to the binder. In an edition of *Terence*, printed by Antonio Zarot at Milan in 1470, signatures were used, and it is the first printed book known to have them. Catch-words were once extensively used, placed at the foot of the page, to show the connecting word on the next page, and are said to have been first used by Vindelius de Spira in Venice; but the Assyrians used catchwords. The English generally use for signatures the alphabetical letters, omitting J, V, W, which were not used in the Gothic letters of the early printers; and if the sheets extend beyond Z, the letters are doubled or preceded by a figure. The practice in the U. S., and in most European nations, is to use figures, a section to be inset being distinguished by a star after the signature figure. The star shows that that part of the sheet is cut off and placed inside the first part when folded. This is the simplest and readiest for the binder.

Sizes of Books.—The descriptive names of the sizes of books refer to the size of the leaves, and originated from the number of leaves into which a sheet of paper was folded after printing. The facility of paper manufacture has placed within the reach of printers any size of sheet, so that the size of the page of a book now depends only on the wish of the publisher. The book when bound is termed according to the nearest size of the regular sheets.

SIZE OF BOOK.	Pages in a sheet.	Size of leaf, untrimmed, in inches.
Royal 4to	8	11×14
Medium 4to	8	9½×12
Imperial 8vo	16	8×11½
Super-royal 8vo	16	7×10½
Medium 8vo	16	6×9½
Crown 8vo	16	5½×8½
Medium 12mo	24	5½×7½
" 16mo	32	4½×6½
" 18mo	36	4×6½
" 24mo	48	3½×5½
" 32mo	64	3×4½

The size of paper called medium, 19 by 24 inches, is the standard by which all sizes of books, not otherwise specifically described, are classified; and quarto, octavo, duodecimo, etc., mean that the leaves of books of these sizes are nearly the fourth, eighth, twelfth, etc., of the medium sheet.

Printing-ink is a mechanical mixture of prepared oil and smoke-black or other coloring-matter. News ink has more of oil, and book ink more of black. When properly made it "distributes" or freely spreads out in a very thin film on the inking rollers and the types, is readily transferred to paper by impression, and adheres to it when dry without smearing or fading.

Printing-rollers.—In the early days of printing the ink was applied to the type by large leather-coated balls. Each ball was fitted to a handle of wood. The interior of the ball was stuffed with wool or hair to make it elastic. One of these the pressman took in each hand, and, applying them to the ink-table, daubed and knocked them together to distribute the ink equally, and then blacked the form by beating the balls upon the face of the type. Rollers wound with cloth and covered with soft leather were next introduced, but to B. Forster, of England, is due the invention (about 1820) of the present roller. These rollers consist of a composition of glue and molasses, boiled together, and moulded upon a cylinder of wood encasing an iron rod, which works in a handle or in a proper frame for large presses. This cylindrical inking roller is rolled over the type, and applies the ink in a quick and even manner. Other compositions have been tried for rollers, but this was preferred for many years on account of its peculiar softness, even retention of the ink, and cheapness. The composition now most approved for its greater durability is a combination of glue, glycerin, and sugar.

Paper.—The paper used in newspaper-printing is always dampened before use, as wet paper takes the ink better than dry, and is now generally wet by a wetting-press. Paper is usually supplied by the ream of 20 quires of 24 sheets, or 480 sheets per ream. For the perfecting press paper is supplied from 3 to 5 miles long, a single web containing from 5,000 to 10,000 sheets. After printing, for book-work the sheets are hung up to dry, placed between sheets of thin smooth mill-board, placed in an hydraulic press, and subjected to great pressure, which smooths and restores the brilliant appearance of the paper. The sheets are afterward forwarded by the binder. See BOOKBINDING.

BIBLIOGRAPHY.—The bibliography of printing is voluminous; but a few of the prominent treatises are mentioned below. The origin of typography has been treated by Dr. A. Van der Linde in *The Haarlem Legend* (translated by J. H. Hessels, London, 1871) and in *Gutenberg* (Stuttgart, 1878); by J. H. Hessels in *Gutenberg* (London, 1882); A. F. Didot, *Essai sur la Typographie* (Paris, 1851); A. Bernard, *De l'origine et des Débuts de l'Imprimerie en Europe* (2 vols., Paris, 1853); Karl Faullman, *Geschichte der Buchdruckerkunst* (Leipzig, 1882); T. L. De Vinne, *The Invention of Printing* (New York, 1878). The development of typography among English-speaking peoples has been treated of by Ames in his *Typographical Antiquities* of various editions, of which Herbert's is best; C. H. Timperley, *Dictionary of Printers and Printing* (London, 1839); W. Blades, *William Caxton* (London, 1861–63); Talbot B. Reed, *Old English Letter Founderies* (London, 1887); Isaiah Thomas, *History of Printing in America* (2 vols., Worcester, 1810). The practice of typography has been explained by T. C. Hansard, *Typographia* (London, 1825); Ringwalt, *Encyclopædia of Printing* (Philadelphia, 1871); A. Marahrens, *Handbuch der Typographie* (Leipzig, 1870); T. Lefèvre, *Guide Pratique du Compositeur* (Paris, 1855); and *The Dictionary of Printing and Bookmaking* (New York, 1893). Good facsimile plates of early books have been published by Sotheby, *Principia Typographia* (3 vols., London, 1858); J. W. Holtrop, *Monuments Typographiques* (The Hague, 1868); Weigel and Zestermann, *Die Anfänge der Druckerkunst in Bild und Schrift* (2 vols., Leipzig, 1866). Bigmore and Wymans's *Bibliography of Printing* (3 vols., London, 1880) is a useful catalogue of all the authorities.

Revised by THEODORE L. DE VINNE.

Printing-presses: machines for taking impressions from an inked surface upon paper, used for books, newspapers, handbills, etc.

The Earliest Form.—Gutenberg's printing-press consisted of two upright timbers with crosspieces of wood to stay them together at the top and bottom, and two intermediate cross-timbers. On one of these the type was supported, and through the other a wooden screw passed, its lower point resting on the center of a wooden "platen," which was thus screwed down upon the type after it had been inked and the paper spread over it. The mechanical principle embodied

in this machine is found in the old cheese and linen presses.

This simple form of press continued in use for about 150 years, or until the early part of the seventeenth century, without any material change. The forms of type were placed upon wood or stone beds, incased in frames called "coffins," moved in and out laboriously by hand, and after each impression the platen had to be screwed up with the bar, so that the paper which had been printed might be removed and hung up to dry.

Blaeuw's Press.—The first recorded improvements in this press were made by William Janson Blaeuw, a printer of Amsterdam, about 1620. He passed the spindle of the screw through a square block which was guided in the wooden frame, and suspended the platen from this block. He also placed a device upon the press for rolling the bed in and out, and added a new form of iron hand-lever for turning the screw. Blaeuw's press was introduced into England, and used there as well as on the Continent, being substantially the same as that Benjamin Franklin worked upon when in London in 1725.

FIG. 1.—The Franklin screw-lever press.

Introduction of Iron Printing-presses.—Little further improvement was made in the printing-press before the year 1798, when the Earl of Stanhope caused one to be made, the frame of which, instead of being of wood, was one piece of cast iron. A necessity had arisen for greater power in giving the impression, especially in the printing of wood-cuts, and the tendency was naturally toward larger forms of type, requiring greater exertion on the part of the printer. The Earl of Stanhope retained the screw, but added a combination of levers to assist the pressman in gaining greater power with less expenditure of energy. These machines, although very heavy and cumbersome, came into use to some extent.

The next practical improvement was made by George Clymer, of Philadelphia, who, about 1816, devised an iron machine, entirely dispensing with the screw. A long, heavy cast-iron lever was placed over the platen, one end attached to one of the uprights of the cast-iron frame and the other capable of being raised and lowered by a combination of smaller levers, worked by the pressman after the manner of the ordinary hand-press. The impression was given and the platen raised and lowered by a spindle or pin attached to the center of the large cross lever at the top. Clymer carried his invention to England, where it was introduced to some extent, and was known as the Columbian press. In England Rutheven, Brown, and others made iron hand-presses, all improving upon the Stanhope. In 1822 Peter Smith devised a machine with a cast-iron frame, in which a toggle-joint, at once simple and effective, took the place of the screw with levers.

The Washington Press.—In 1827 Samuel Rust, of New York, perfected an invention which was a great improvement on the Smith press. The frame, instead of being all of cast iron, had the uprights at the sides hollowed for the admission of wrought-iron bars, which were securely riveted at the top and bottom of the casting. This gave not only additional strength, but greatly diminished the amount of metal used in the construction. The toggle motion was also a great improvement over that in the Smith press. This patent was purchased by R. Hoe & Co., who improved upon it. The new invention was known as the Washington press, and in principle and construction has never been surpassed by any hand printing-machine.

The bed slides on a track and is run in and out from under the platen by turning a crank which has belts attached to a pulley upon its shaft. The impression of the platen is given by means of a bent lever acting on a toggle-joint, and the platen is lifted by springs on either side. Attached to the bed is a tympan-frame covered with cloth, and standing inclined to receive the sheet to be printed. Another frame, called the frisket, is attached to the tympan, and covered with a sheet of paper, having the parts that would be printed upon cut away, so as to prevent the chase and furniture from blacking or soiling the sheet. The frisket

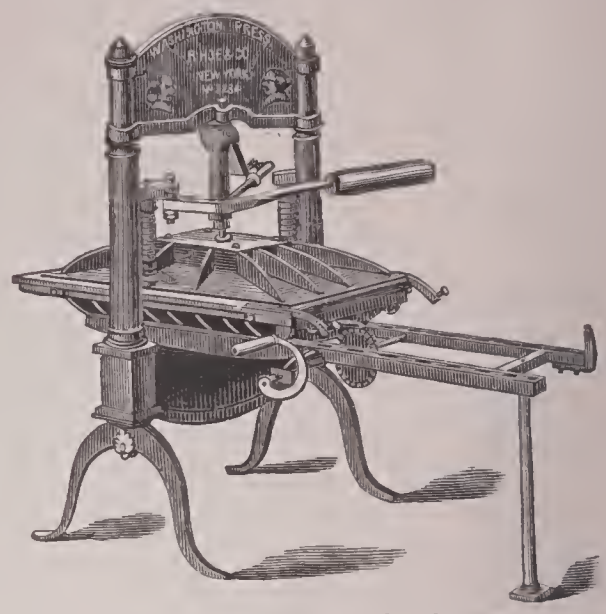


FIG. 2.—The Washington hand-press.

is turned down over the sheet and tympan and all are folded down when the impression is taken. Automatic inking-rollers were attached to this machine.

The bed-and-platen system of printing was up to the middle of the nineteenth century the favorite method for fine books and illustrations, and it is still used to a great extent. The first "power" or steam press upon this principle was made by Daniel Treadwell, of Boston, in 1822. The frames were of wood, but probably only three or four were ever constructed. The best press of this description is that devised and patented by Isaac Adams, of Boston, in 1830 and 1836,

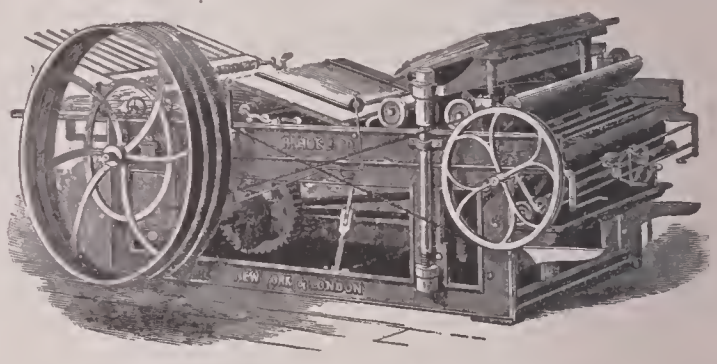


FIG. 3.—The Adams bed-and-platen press.

and by Otis Tufts, of the same place, in 1834. This was first made with a wooden and afterward with an iron frame. In 1858 Adams's business became the property of Hoe & Co., who continued to manufacture these presses, with added improvements. In these machines the type is placed upon an iron bed, after the usual manner of the hand-press, and this bed is raised and lowered by straightening a toggle-joint by means of cams, thus giving the impression upon the iron platen fixed above it, and firmly held in position by upright iron rods secured to the foundation of the machine. The ink-fountain is at one end of the press; the inking-rollers travel twice over the form, in a movable frisket-frame, while the bed is down; the paper is taken in by grippers on the frisket and carried over the form, when the bed rises and the impression is given; finally, the sheets pass forward from the frisket by tapes to a sheet-flier, which delivers them on the fly-board. One thousand sheets per hour is the maximum speed of the larger sizes of the Adams press.

Job-presses.—Many different kinds of small presses on the bed-and-platen principle are made; a typical one is the Gordon, illustrated on the next page. This can print over 1,000 cards or small sheets per hour. Special presses are also made for printing cards or tickets and numbering or lettering them consecutively.

Cylinder Presses.—The method of printing from plates or forms carried upon a flat bed backward and forward beneath a cylinder had been employed in a rude form by printers of copperplate engravings in the fifteenth century. With the re-introduction of this system began an entirely new era in the history of the printing-press. It should be understood,

however, that the vast number of patents granted for printing-machines in which the cylinder is connected with the bed, or by the operation of two cylinders together, one holding the form and the other giving the impression, are almost all

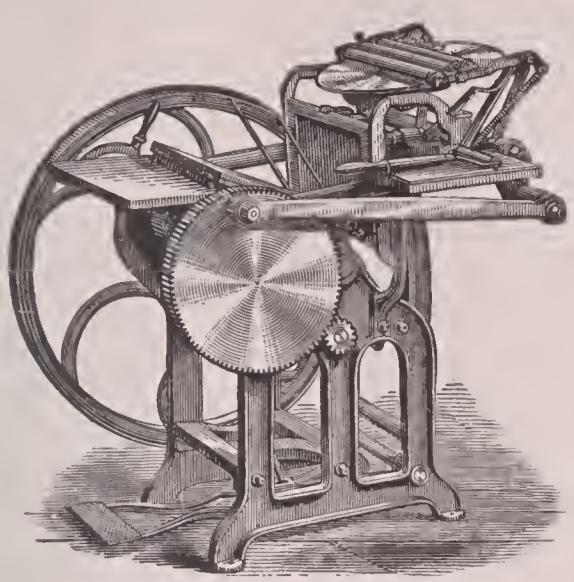


Fig. 4.—The Gordon press.

for improvements and devices of detail, the radical principles upon which they are founded remaining the same. There will be here described only those presses which have been in use as practical improvements.

The Flat-bed Cylinder Press.—The credit of actually introducing into use a flat-bed cylinder press is due to a Saxon named Friederich Koenig, who visited England in 1806, and through the assistance of Thomas Bensley, a printer in London, devised a machine which in 1812–13 was used by him, and printed, among other publications, a part of Clarkson's *Life of William Penn.* Koenig was assisted also by a mechanic named Andrew Bauer, a fellow countryman. The form of type was placed on a flat bed, the cylinder above it having a threefold motion, or stopping three times, the first third of the turn receiving the sheet upon one of the tympans and securing it by the frisket; the second giving the impression, and allowing the sheet to be removed by hand; and the third returning the tympan empty to receive another sheet. He also devised what has proved, even to this day, to be the best mechanism for producing reciprocating motion of the type-bed. This consists of a pinion carried on the inner end of a long shaft which is turned by gearing from the side of the press-frame, and has in its length a universal joint, allowing an up-and-down motion of the pinion. Underneath the bed and fastened to it is a "rack," or double row of teeth set back to back, with a crescent-shaped segment of hard metal at each end. The shaft being set in motion revolves the pinion, which moves the bed by engaging the teeth in this rack. On reaching the end of the rack, the pinion turns around over a pin or stud against the segment at the end of the rack, and immediately re-engages its teeth in the opposite side, so carrying the bed back again. This motion is repeated at the opposite end of the rack, and the bed again stopped and returned.

The Continuously Revolving Cylinder Press.—In 1814 Koenig patented a continuously revolving cylinder press. The part of the periphery of the cylinder not used for giving the impression is slightly reduced in diameter, so as to allow the form to return under it freely after giving an impression. He showed designs adapting it for use as a single-cylinder press, and also as a two-cylinder press, both for printing one side of the paper at a time; likewise a two-cylinder press for printing both sides of the paper at one operation. In this latter press the two forms were placed one at each end of a long bed, and the paper after being printed on one side by one cylinder was carried by tapes over a registering roller to the other cylinder, where it was printed upon the opposite side. This press, termed a "perfecting" press, was afterward improved by Applegath and Cowper, so as to be considered at the time a very efficient machine.

Koenig erected in the office of the London *Times* in 1814 two of the two-cylinder presses mentioned above, which printed on one side of the paper only, at the rate of 800 sheets per hour. He was not alone in his efforts to perfect a cylinder press. Various patents were gotten out by Bacon and Donkin in 1813; by Cowper in 1816, and again in 1818; and by Applegath in 1818.

Napier's Improvements.—The most ingenious and practical device in connection with the movements of a flat bed and a cylinder for printing-machines was patented by Napier in 1828 and 1830. He was the first who introduced "grippers" or "fingers" for the conveyance of the sheets around the cylinder during the impression, and for delivering them after printing. Tapes or strings had previously been used. He was also the first to construct presses in which the impression-cylinders are of small size, and make two or more revolutions to each sheet printed; and he devised the toggles for bringing the cylinders down to print on the form and then raising them to let the form run back without touching.

The Single Large Cylinder Press.—About 1832 Robert Hoe made the first cylinder press ever used in the U. S. It was the pattern known as the single large cylinder, the cylinder making one revolution for each impression in print-

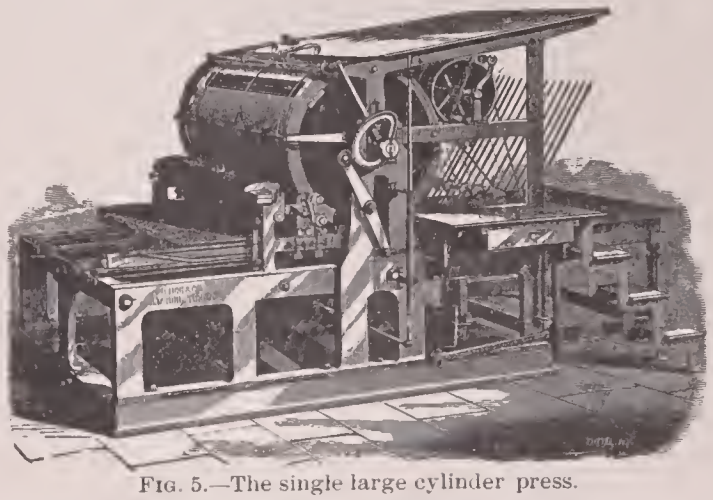


Fig. 5.—The single large cylinder press.

ing, and never stopping. Only a portion of the cylinder was employed to take the impression, the remainder of its circumference being turned down small enough to allow the type on the bed to pass back under it without touching. Similar presses were made later by other manufacturers, and this form of press is still in use, with patented automatic sheet-fliers, and other improvements.

The Stop Cylinder Press.—The press upon which the finest letterpress and wood-cut work is turned off is known as the Stop Cylinder. This was devised and patented by a Frenchman named Dutartre in 1852, and was later introduced into the U. S., and improved in many respects. The type is secured upon an iron bed, which moves back and forth upon friction-rollers of steel by a simple crank motion,

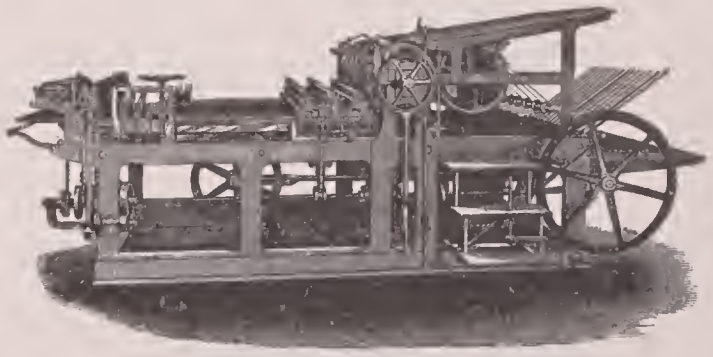


Fig. 6.—The stop cylinder press.

stopping and starting without noise or jar. The cylinder is stopped and started by a cam motion pending the backward travel of the bed, and during the interval of rest the sheet is fed down against the guides and the grippers close upon it before the cylinder starts, thus insuring the utmost accuracy of register. After the impression the sheet is transferred to a skeleton cylinder, also containing grippers, which receive and deliver it over fine cords upon the sheet-flier, which in turn deposits it upon the table. The distribution of the ink is effected partly by a vibrating polished steel cylinder, and partly upon a flat table at the end of the traveling bed, the number of inking-rollers varying from four to six. The average output of one of these presses with a bed 36 by 54 inches is from 1,000 to 1,500 impressions per hour. The very finest engraving, or cut-work, such as would be done with the greatest deliberation upon the Washington hand-press, is printed upon it at a speed of 700 impressions per hour.

Up to 1847 American newspapers were printed upon single small-cylinder and double-cylinder machines. The output of one of the single-cylinder presses reached 2,000 impressions per hour, or about as fast as the feeder could lay down the sheets. With the double-cylinder press the travel of the bed was of such length that the form of type passed backward and forward under both cylinders. Two feeders accordingly put in the sheets, the maximum speed obtained from each cylinder being about 2,000, or 4,000 per hour for the two cylinders, printed upon one side. The growing demand for papers containing the latest news, however, necessitated faster machines. The presses of Middleton, Dryden & Ford, and others in England failed to meet the requirements there, as did the single cylinder and double cylinder in the U. S.

The Type-revolving Machine.—Experiments made in 1845 and 1846 resulted in the construction of a press known as the Hoe type-revolving machine. The first of these machines was placed in *The Public Ledger* office in Philadelphia in 1846. The basis of these inventions consisted in an apparatus for securely fastening the forms of type on a central cylinder placed in a horizontal position. This was accomplished by the construction of cast-iron or brass beds, one for each page of the newspaper. The column rules were made "V"-shaped, i. e. tapering toward the feet of the type. It was found that, with proper arrangement for locking up or securing the type upon these beds, it could be held firmly in position, the surface forming a true circle, and the cylinder revolved at any speed required without danger of the type falling out. Around this central cylinder from four to ten impression-cylinders, according to the output required, were grouped. The sheets were fed in by boys, and taken from the feed-board by automatic grippers, or fingers, operated by cams in the impression-cylinders, which conveyed them

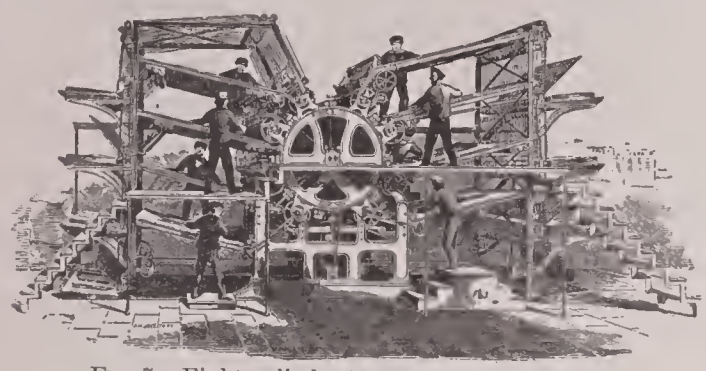


Fig. 7.—Eight-cylinder type-revolving machine.

around against the revolving form of the central cylinder. Here, again, a great advantage was gained by the use of the patented sheet-flier, consisting of a row of long wooden fingers fastened to a shaft, and operated by a cam and springs, the sheet after printing being conducted out underneath each feed-board by means of tapes to the sheet-fliers, which laid them in piles on tables, the number of fliers and tables corresponding to the number of impression-cylinders. The inking was accomplished by the use of composition-rollers placed between each of the impression-cylinders, the fountain being below, underneath the main type-cylinder. The portion of the surface of this type-cylinder not occupied by the type itself was utilized as a distributing-table, its surface being lower than that of the type, and the inking-rollers rising and falling alternately to place the ink on the type and receive a new supply from the distributing-surface. The speed obtained was about 2,000 sheets to each feeder per hour, thus giving, with what was called a four-feeder or four-cylinder machine, a running capacity of about 8,000 papers per hour printed upon one side. As the demands of the newspapers increased more impression-cylinders were added, until these machines were made with as many as ten grouped around the central cylinder, giving an aggregate speed of about 20,000 papers per hour printed upon one side. A revolution in newspaper-printing took place. Journals which before had been limited in their circulation by their inability to furnish the papers rapidly increased their issues, and many new ones were started. The first one put up abroad was erected in 1848, in the office of *La Patrie* in Paris. In 1856 Edward Lloyd, of *Lloyd's Weekly London Newspaper*, ordered a six-cylinder machine, and later the London *Times* ordered two ten-cylinder presses to replace an Applegath machine.

In the meantime experiments had demonstrated the possibility of casting stereotype plates on a curve. The process was brought to perfection by the use of flexible paper matrices, upon which the metal was cast in curved moulds to any circle desired, and these plates were placed upon the type-revolving machine upon beds adapted to receive them instead of the type-forms. The newspaper publishers were thus enabled to duplicate the forms, and run several machines at the same time.

Improvements by Applegath and Cowper.—After the return of Koenig to Germany an Englishman named Applegath, in connection with a machinist named Cowper, made various improvements, mostly in the way of simplifying Koenig's presses, and in 1848 constructed for the London *Times* an elaborate machine, entirely upon the cylindrical principle. All of the cylinders of this machine were vertical. The type was placed upon a large upright central cylinder, but the circumference, instead of presenting a complete circle, represented as many flat surfaces as there were columns in the newspaper, the forms thus being polygonal. Around this central or form cylinder were placed eight smaller vertical cylinders for taking the impression, rollers being introduced to ink the type as it passed alternately from one of these impression-cylinders to another. The sheets were fed down by hand from eight flat horizontal feed-boards through tapes, then grasped by another set of tapes and passed sideways between the impression-cylinder and the type-cylinder, thus obtaining sheets printed upon one side. The impression-cylinder delivered them, still in a vertical position, into the hands of boys, one stationed at each cylinder to receive them. The results obtained from this machine were in a measure satisfactory, as the number of papers printed per hour upon one side, from one form of type, was increased to 8,000. The press used in the London *Times* office was the only one of this kind ever made.

Use of a Continuous Web.—In 1835 Sir Rowland Hill suggested the possibilities of a machine which should print both sides at once from a roll of paper. Cotton cloths had long been printed in this way, the cylinders being engraved and the cloth after printing being reeled up again. William

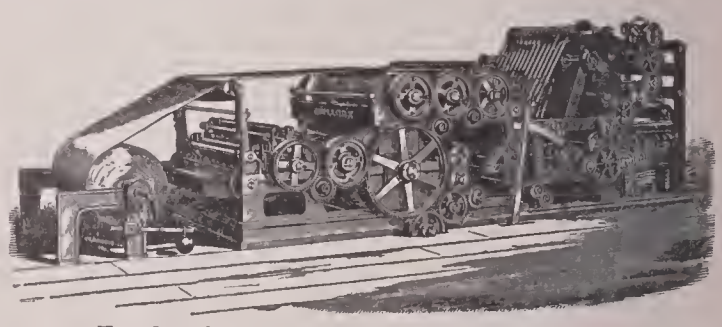


Fig. 8.—The Bullock stereotype perfecting press.

Bullock, of Philadelphia, constructed in 1865 the first machine to print from a continuous web or roll of paper. It consisted of two pairs of cylinders—i. e. two form or plate cylinders and two impression-cylinders. The second impression-cylinder was made of large size to provide additional tympan-surface, to lessen the offset from the first printed side of the paper. The stereotype plates were not made to fill the whole circumference of each of the form-cylinders, since by means of knives in cylinders the sheets were cut before printing. The sheets were carried through the press by tapes and fingers, and delivery sought to be accomplished by means of a series of automatic metal nippers placed upon endless leather belts at such distance apart as to grasp each sheet successively as it came from the last printing-cylinders. This machine was unreliable, especially in the delivery of the papers, but it was finally so far perfected that it came into use to a considerable extent.

Introduction of the Rotary Perfecting Press.—Meanwhile the proprietors of the London *Times* had begun experiments with the view of making a rotary perfecting press, and started the first one in their office about 1868. It was similar in construction to the Bullock press so far as the printing apparatus was concerned, excepting that the cylinders were all of one size and placed one above the other. The sheets were severed after printing, brought up by tapes, and carried down to a sheet-flier which moved back and forth and "flirted" the sheets alternately into the hands of two boys seated opposite one another on either side of the sheet-flier.

Marinoni, of Paris, also devised a machine on a similar principle, making the impression and the form cylinders of one size and placed them one above the other, but having separate fly-boards for the delivery of the sheets.

In 1871 R. Hoe & Co. also turned their attention to the construction of a rotary perfecting press to print from a continuous web of paper. The greatest difficulties were—1. The set-off of the first side. Devices were used to overcome this, and the ink-makers were induced to pay special attention to the manufacture of rapid-drying inks. 2. The need of paper in the roll of uniform perfection and strength. The paper-makers were led to produce large rolls of paper meeting these requirements. 3. The necessity of a rapid severing of the sheets after printing. 4. The need of a reliable and accurate delivery.

These last two operations were not accomplished satisfactorily until the appearance of the Hoe machine. In this press the sheets were not entirely severed by the cutters, but simply perforated after the printing. They were then drawn on by accelerating tapes, which completely separated them, to a gathering cylinder so constructed that six perfect papers, or any other desired number, could be gathered one over the other. These, by means of a switch, were at the proper moment turned off to one sheet-flier which deposited them on the receiving-board. The first of these machines was placed in the office of *Lloyd's Weekly London Newspaper*, and the first one used in the U. S. in the *Tribune* office in New York. There was no limit to their capacity for printing excepting the ability of the paper to stand the strain of passing through the press, which could produce from a single set of stereotype plates 18,000 perfect papers an hour, delivered accurately on one feed-board. The average speed, however, in printing-offices was 12,000 per hour.

The Walter press, made by the London *Times*, was used by it, and also by the London *Daily News* and by *The New York Times*. Further than that it made no progress. Meantime the Hoe machine was adopted by most of the large newspapers in the U. S. and Great Britain. These new methods of course entirely superseded the type-revolving machine, which had held the field in the newspaper world for over twenty years and of which 175 had been made.

Introduction of Automatic Folders.—It was desirable that the presses should deliver the papers folded. The first apparatus to accomplish this was similar in design to the hand folding-machines in common use in printing-offices. The sheets, fed by hand into these machines, were carried by tapes running upon pulleys under striking blades, which forced them between pairs of folding rollers. After the first fold they were again carried in a similar manner under striking blades, placed at right angles to the first, and again struck down between rollers to receive a second fold. This action was continued until the desired number of folds had been secured. Folders of this description were attached to the fast presses, but none made could be worked faster than about 8,000 per hour, until in 1875 Hoe & Co. patented a rotating folding cylinder which folded the papers at the rate of 15,000 per hour. The first of these folding-machines were put upon presses made for the Philadelphia *Times*, and operated in the Centennial Exhibition in 1876.

Striking blade folders were used in the Bullock press, and in machines made by C. Potter, Jr., & Co., and others. Andrew Campbell, a printing-press manufacturer, also constructed a rotary perfecting press, but his devices were not original. Four or five machines were made by him, and these soon went out of use.

Further Advances in Fast Printing.—About 1876 Messrs. Anthony and Taylor, of England, took out patents for devices by which the webs of paper could be turned over after printing on one side and the opposite or reverse side presented to the printing cylinder. Edward L. Ford, engaged in the publication of a newspaper in New York, patented the uniting of the product of two or more printing mechanisms, thus producing (in restricted form) a multiple number of pages at one time. He was unable, however, to develop his plans to any practical result, but deserves the credit of being the first to patent, if not to conceive, the idea of the association of printed sheets for this purpose.

The Double-supplement Press.—Further experiments upon the manipulation of webs of paper resulted in the production of the Hoe double-supplement press, the first specimen of which was purchased by James Gordon Bennett, of *The New York Herald*. For a third time a complete revolution of the methods of fast newspaper printing took place. The most remarkable features of this machine are its extreme simplicity, considering the work it performs, and its great speed, accuracy, and efficiency. It turns out either four, six, eight, ten, or twelve page papers at 24,000 per hour, and sixteen-page papers at 12,000 per hour, the odd pages being in every case accurately inserted and pasted in, and the papers cut at the top and delivered folded. This machine is constructed in two parts, in one portion the cylinders being twice the length of those in the other, the shortest cylinders being used for the supplements of the paper when it is desired to print more than eight pages. The plates being secured on the cylinders, the paper enters from the two rolls into the two portions of the machine, through each of which it is carried between the two pairs of type and impression cylinders, and printed on both sides, after which the two broad ribbons or "webs" pass over turning-bars and other devices, by which they are laid evenly one over the other, and pasted together. The webs of paper then pass down upon a triangular "former," which folds them along the center margin. They are then taken over a cylinder, from which they receive the final folds, a revolving blade within this cylinder projecting and thrusting the paper between folding rollers, while at the same moment a knife in the same cylinder severs the sheet, and a rapidly revolving mechanism, resembling in its motion human fingers, causes their accurate disposal upon traveling belts, conveying them on for final removal.

Previous to the introduction of the double-supplement press, Hoe & Co. had made what is known as their double perfecting machine. This embraces substantially the printing and folding devices embodied in the double-supplement machine, and is the connecting link between it and the ordinary "single" or two-page-wide press.

The Quadruple Newspaper Press.—The next improvement in fast presses was the construction of the quadruple newspaper press. The first one was constructed by R. Hoe & Co. in 1887 and placed in the office of *The New York World*. The same principles were embraced in this as

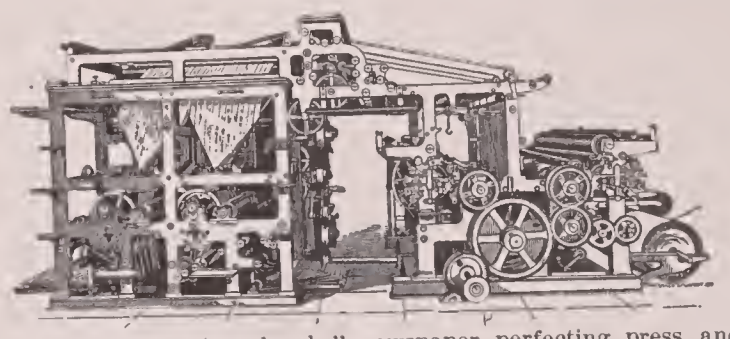


FIG. 9.—The Hoe "quadruple" newspaper perfecting press and folders.

in the double supplement, but developed to a greater extent. The supplement portion of the press was increased in width. By means of ingenious arrangements of the turning-bars and manipulation of the webs of paper this press was made to produce eight-page papers at a running speed of 48,000 per hour; also 24,000 per hour of either ten, twelve, fourteen, or sixteen page papers, all delivered in perfect form, cut at the top, pasted, and folded ready for the carrier or the mails. This press, together with the double-supplement press, superseded almost all others in the large offices of the U. S., as well as in Great Britain and Australia.

The Sextuple Press.—In 1889 the same firm undertook the task of constructing a machine for *The New York Herald*, which would even eclipse the quadruple machine. It is known as the sextuple machine, and occupied about eighteen months in construction. It is composed of about 16,000 pieces, and weighs about 58 tons. The form and impression cylinders are all placed parallel, instead of any being at right angles, as in the quadruple and double-supplement presses. The press is fed from three rolls, and can print, cut, paste, fold, count, and deliver complete in an hour 24,000 *Heralds* of fourteen, twenty, or twenty-four pages each, 36,000 of sixteen pages each, 48,000 of ten or twelve pages each, or 72,000 (20 per second) of eight pages each. It has six plate-cylinders, each carrying eight stereotype plates a page in size, and making at full speed 200 revolutions per minute.

Type-revolving Perfecting Presses.—About 1871 a machine called the Prestonian was made by Foster, a machinist of Preston, England, and several were set to work, but did not enjoy any great degree of favor. They embodied a combination of the Hoe type-revolving machine with the endless sheet perfecting press. The form of type for one side of the paper was placed upon one cylinder, with impression-cylinders around it, in the manner of the Hoe press, and the form for the other side on another cylinder, and the paper passed from one set of impression-cylinders to the

other. The objection to this machine was its lack of speed. The same principle, however, had been developed years before in the type-revolving perfecting presses, having two sets of type-forms on separate large cylinders, and feeding

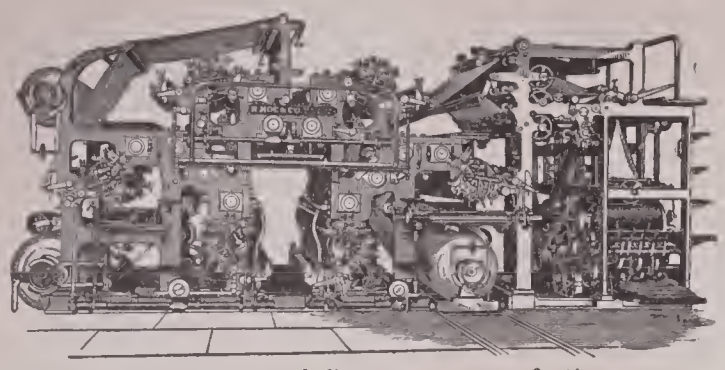


Fig. 10.—The Hoe "sextuple" newspaper perfecting press and folders.

the sheets in by hand, conveying them from one impression-cylinder to the other and against the forms by means of fingers or grippers. The sheets were then delivered on a sheet-flier. These presses were especially designed for printing books of which large numbers were required, such as text-books and spelling-books. The contents of a whole book could be placed on these cylinders and printed and delivered at one impression. One of these machines, built in 1852, is still (1895) in operation at Messrs. D. Appleton & Co.'s printing-office in Brooklyn.

The Rotary Type Endless Sheet Perfecting Press.—In 1881 Hoe & Co. turned their attention to the making of a machine which should print from one form of type at a greater speed than had ever yet been attained. The result was the rotary type endless sheet perfecting press. The principle of this machine was in a measure that of their type-revolving press. The forms of type for both sides of the paper were placed on a central cylinder, which was surrounded by impression-cylinders and inking-rollers. The roll of paper was placed at the end of the press, passed around the impression-cylinders arranged at one side of the form cylinder, and then turned upside down at the lower part of the machine, thence being carried upward. The opposite or unprinted side was presented in turn between each impression-cylinder and the forms. If four impression-cylinders were placed around the central cylinder, then at each revolution of the latter four perfect papers were printed. If eight impression-cylinders were placed around the central cylinder, then eight perfect papers were printed at one revolution of the main or form cylinder. The speed attained by this machine with four impression-cylinders was about 12,000 per hour, and from machines with eight impression-cylinders 24,000 copies per hour were printed all folded.

The Prudential Perfecting Machine.—In 1889 a patented perfecting machine called the Prudential was made, in which the plates, or forms, for both sides are placed upon one cylinder, one side of the form of matter being placed upon one end, or half, of the cylinder, and the other side upon the opposite portion of the cylinder. One impression-cylinder only is used, and the inking apparatus is greatly extended. This machine is remarkable for the great variety of work it will do. At a high rate of speed, sheets of 8, 16, 24, and so on up to 96 or 128 pages may be printed and delivered folded in either 12mo, 8vo, 4to, or folio sizes, ready for the binder. The press does the work of ten flat-bed cylinder presses and ten hand-feed folding-machines. Curved electrotypes are now made successfully, and this press is the first to bring the printing of the average book and catalogue within the range of web-press work. While in general principles the press is similar to the large newspaper perfecting presses, though very much smaller in bulk, it has increased facilities for distribution, and finer adjustments throughout. The plates admit of underlays and overlays the same as on a flat-bed press. There are no tapes, the folding being done on rollers and small cylinders without smutting the printing. In the folding-machine there are knives which cut the sheet into the right size for folding, after which they are automatically delivered counted in lots of fifty each. The speed on a thirty-two-page form is about 16,000 copies per hour.

The Century Magazine's Press.—In 1886 Hoe & Co. made an advance toward perfection in the rotary system of printing, and constructed for Theodore L. De Vinne, the printer of *The Century Magazine*, a perfecting press to do the plain forms of that periodical.

This press prints from curved electrotype plates, and the product at every revolution of the cylinder is sixty-four pages, neatly printed, truly cut, and accurately registered and folded, ready for the binder. This web press is not so fast as the web press of daily newspapers, but it performs more operations and does more accurate work. It is not large or noisy, but the paper goes through the cylinders at the rate of nearly 200 feet a minute. It does the work of ten presses of the stop cylinder or two-revolution type.

The Rotary Art Press.—The success of this perfecting press induced the makers to devise a machine on the rotary principle adapted for the finest kind of illustrations; in short, to make a press which should do work as fine as it was possible to do on the hand-press, or the stop cylinder. The result was the setting up, in 1890, at the De Vinne Press, of a machine known as the rotary art press. This machine is described in the *Century* of Nov., 1890, as follows: "Sixty-four plates of the *Century*, truly bent to the proper curve, are firmly fastened on one cylinder 60 inches long and about 30 inches in diameter; sixteen inking-rollers, supplied with ink from two fountains, successfully ink these sixty-four plates with a delicacy and yet with a fullness of color never before attained. The shafts of the impression-cylinder and the plate-cylinders, 4½ inches in diameter, do not give or spring under the strongest impression. Although rigid in every part, in the hands of an expert pressman it can be made responsive to the slightest overlay. This machine is fed by four feeders from single sheets in the usual manner, and does the work of four stop cylinders in superior style."

The Once-a-Week Press.—Another rotary perfecting machine for fine cut-work was made in 1891 by the same manufacturers, and is known as the Once-a-Week press. In this machine the apparatus for printing the first side is placed at right angles with that for the second side. The paper, after being taken from the roll through the first pair of cylinders, printing the inside or type side of the periodical, takes a half turn over obliquely placed turning-bars, passing the paper reversed into the other portion of the printing apparatus. This second portion of the machine, being intended to do the finest quality of cut-work, is supplied with a more elaborate inking apparatus, and eight form-rollers, which distribute the ink in thin layers over the plates. In the folding apparatus tapes are entirely dispensed with, and the sheets of heavy cut-work are folded and delivered fresh from the press, without any smutting or set-off of the ink.

Ingenious devices are found in a machine which was constructed in 1892, and put up in the office of the Hartford, Conn., *Courant*. From a single set of stereotype plates this machine produces either four, six, eight, ten, twelve, fourteen, or sixteen page papers at a speed of 12,000 per hour, all cut at the top, pasted and folded, and the supplements inserted in their proper places. With duplicate sets of plates it will print four, six, or eight page papers at 24,000 per hour. Two narrow rolls are placed nearly end to end at the back of the machine. The paper from one of these goes through the machine and is printed, then over the "former," and on to the final cutting cylinders without interruption. The peculiarity of the invention consists in taking the paper from the other roll, which is run at half the speed of the first, conveying it into the printing mechanism of the cylinders by accelerating its motion, and presenting the small sheet which has been severed for the two-page supplement between the cylinders in such a way that it receives the impression from the two supplement plates. This machine covers a floor-space of only 18 feet by 8½ feet, and is 8 feet high.

Color-printing.—It has been found that a combination of three primary colors properly printed will produce any picture required. To these black is sometimes added, making four printings for a complete colored picture. Taking advantage of this the daily newspapers have attempted to meet the popular taste for colored pictures, and to that end presses have been constructed for some of the leading New York newspapers. In the presses for printing in colors the forms for the different colors are placed upon separate cylinders, opposite to each of which are attached impression-cylinders. The paper passing through this series of cylinders receives in perfect register the different colors, having first been printed in black upon one side. These colored supplements are delivered from the machines folded, without smutting. The art of simultaneous color-printing on the rotary principle is still in its infancy.

Robert Hoe.

Prior, Matthew: poet and diplomatist; b. at Wimborne-Minster, Dorsetshire, England, July 21, 1664. He was educated at St. John's College, Cambridge, where he formed an intimacy with Charles Montagu, afterward Earl of Halifax, and with him wrote a poem, *The City Mouse and Country Mouse* (1687), intended as a travesty upon Dryden's *Hind and Panther*. Introduced at court by his patron, Prior became a favorite with William III.; was secretary of the commissioners who concluded the Treaty of Ryswick 1697; secretary of embassy at Paris 1698; Under-Secretary of State 1699; commissioner of trade 1700, in which year he published his *Carmen Seculare*, in praise of King William; entered Parliament 1701; became soon afterward a vehement Tory; was sent to Paris with Bolingbroke 1711 to make private proposals for peace; was charged with treason for his conduct in this negotiation on the accession of the Whigs to power in 1714; and was imprisoned two years in his own house, during which time he wrote *Alma, or the Progress of the Mind*. D. at Wimpole, Cambridgeshire, Sept. 18, 1721, and was buried in Westminster Abbey. His collected poems were first published in 1709, and in a sumptuous folio in 1718, a subscription edition which brought him £4,000. He excelled in epigram, society verse, and the short humorous fable. A selection of his poetry was edited by Austin Dobson in 1889.

Revised by H. A. Beers.

Priscian, surnamed Cæsariensis, probably because he was born at Cæsarea: the most celebrated Latin grammarian; flourished about 500 A. D., and was a teacher of Latin at Constantinople, where he received a salary from the court. His *Commentariorum Grammaticorum Libri XVIII.*, of which the first sixteen books treat upon the eight parts of speech recognized by the ancient grammarians, and the last two on syntax, were edited by Krehl (Leipzig, 1819) and Hertz (Leipzig, 1855–59, 2 vols.). Other works extant are a grammatical catechism on parts of the *Æneid*, a treatise on the symbols used to denote numbers and weights, an essay on accents, another on the meters of Terence, etc., edited by Lindemann (Leyden, 1818) and by Keil (Leipzig, 1860). Two poems, *De Laude Anastasii imperatoris*, written about 512, and *Periegesis*, both in hexameters, are printed in Baehrens's *Poetæ Lat. Minores* (vol. v., pp. 264–312).

Revised by M. Warren.

Priscia'nus, Theodorus: physician; a pupil of Vindicianus. He lived at the court of Constantinople in the fourth century A. D., and is the author of a work, *Rerum Medicarum Libri Quatuor*, first printed in 1532 at Strassburg, in which he tries to combine the ideas of the methodical and dogmatical schools with those of the empirical.

Priscil'lian: Bishop of Avila, in Spain; belonged to a noble Spanish family; founded a sect whose doctrines were a blending of Manichæism and Gnosticism. In 379 the existence of the sect became known, and in 380 the Council of Saragossa condemned its doctrines and excommunicated its founder. The influence of Priscillian was too powerful, however, and his most zealous adversary, Bishop Ithacius of Ossonoba, was compelled to fly. He sought refuge with the usurper Maximus, who had Priscillian brought to trial before the Council of Treves, condemned, and put to death in 385. It was the first instance of a Christian being put to death for heresy, and it aroused the indignation of St. Martin of Tours, St. Ambrose, and others. The sect spread subsequently from Northern Spain to Languedoc, and even into Northern Italy, but disappeared entirely in the sixth century, after the second synod of Braga in 563. See Lübkert, *De Hæresi Priscilliani* (Copenhagen, 1840), and Mandernach, *Geschichte des Priscillianismus* (Treves, 1851). Up to 1885 it was supposed that no works of Priscillian had been preserved, but in that year G. Schepss discovered in a Würzburg MS. eleven tractates, which he proved to be by Priscillian, and edited in the *Corpus Eccl. Lat.*, vol. xviii. (Vienna, 1889). See also by the same writer *Archiv. für Lat. Lexicographie* (iii., 309–328), and *Priscillian ein neuaufgefundener Lat. Schriftsteller* (Würzburg, 1886).

Revised by M. Warren.

Prism [from Lat. *pris'ma* = Gr. πρίσμα, prism, liter., something sawed out, deriv. of πρίειν, πρίζειν, saw]: a polyhedron two of whose faces are equal polygons, having their sides parallel and all the remaining faces parallelograms. The first-named faces are called bases, and the remaining ones make up what is called the lateral surface of the prism. The distance between the bases is the altitude of the prism. For the Nicol prism, see Polarization.

Prismoid [Gr. πρίσμα, prism + suffix *-oid*, having the form of, Gr. εἶδος, form]: a polyhedron resembling a prism. It is a frustum of a wedge. The volume of a prismoid is equal to the sum of its parallel bases plus four times the section midway between the bases multiplied by one-sixth of the altitude.

Prismoidal Formula: a formula for computing the volumes of certain solids, mainly used by civil engineers for earthwork calculations. Let L be the length of any prism, A the area of one end, B the area of the other, and M the area of a section half way between the two ends. Then the volume of the prism is

$$V = \tfrac{1}{6}L(A + 4M + B).$$

This formula applies not only to prisms, pyramids, and solids bounded by planes, but also to those bounded by warped surfaces, and to those inclosed by surfaces which are generated by conic sections.

The two-term prismoidal formula, due to Halsted, is

$$V = \tfrac{1}{4}L(A + 3N),$$

in which N is the area of a section at two-thirds the altitude from the base A.

Mansfield Merriman.

Prison [from O. Fr. *prison*: Ital. *prigione*: Span. *prisión* < Lat. *prēn'sio, -o'nis* (or *prehensio*), seizure, confinement, deriv. of *prendere* (*prehendere*), seize]: primarily, a place of detention for debtors or persons charged with political or other crimes until they were tried or adjudged guilty or innocent of the offenses for which they were committed; later, the prison has become, to some extent, the place and instrument of punishment. The idea of punishment by imprisonment itself does not seem to have entered into the minds of the rulers of ancient times, though the prison was often, from its crowded and filthy condition, its want of ventilation, the foul fevers and plagues engendered there, and the starvation inflicted on its hapless inmates, a place of cruel torture and often of speedy death; but the ancient idea of punishment was embodied in the stocks, scourging, beating with rods, the bastinado, the knout, the wheel, the rack, the thumb-screw, the iron boot, mutilation of the eye, the ear, the nose, the hand, the foot, etc.; the crown of thorns, walking over hot irons or coals, branding, whipping at the whipping-post or the tail of a cart, the pillory, the ball and chain, the treadmill, or the galleys; or, where the punishment was intended to be death, the stake, the terrible death by crucifixion, beheading, stoning, the administration of poison, or, in more modern times, hanging, the guillotine, or the garrote.

Prisons of Egypt and Palestine.—Detention of debtors and of political and other offenders was very early an admitted necessity. The earliest instances of its use are found among the Egyptians, whose superior civilization led them to devise measures of police of which other nations, less advanced, had not yet felt the want. Thus we find in Gen. xxxix. 20 that "Joseph's master took him and put him into the prison, a place where the king's prisoners were bound; and he was there in the prison." This was primarily a place of confinement for political prisoners. There are numerous references to prisons in the Old Testament, as well as among profane writers contemporary with its later books, but always as a place of detention simply, though in the case of Jeremiah the dungeon connected with the prison (Jer. xxxviii. 6), from the depth of its miry bottom and its filthiness, seems to have been intended for the destruction of the prisoners who were cast into it. All the Oriental monarchies had their prisons; but though these were, as they are still, wretched, ill-ventilated, and filthy dens, in which it would seem to be impossible to support life, and where the poor culprit who had no money or friends was welcome to die of starvation and foul air as soon as he liked, yet the only theory of the prison was that it was simply a place of detention, and no length of endurance of its horrors was allowed to mitigate in any way the severity of the physical tortures or punishments inflicted on him if he was found guilty of the offense with which he was charged.

Greek and Roman Prisons.—Among the Greeks and Romans the prison, though more cleanly, was generally only a place of detention, though the "inner prison," low, close, and hardly ventilated at all, was occasionally made a place of temporary torture. By the laws of Rome, a Roman citizen could not be cast into prison except by the direct command of the emperor and for some very grave offense; and the violation of this law was severely punished. The usual method of detention for a Roman citizen was to chain his right arm

to the left arm of a soldier, who was made responsible for his safe-keeping; sometimes each arm was chained to a soldier: this guard was changed every twelve hours. In the first century after Christ there was at Rome one prison, and possibly more, intended for the confinement of prisoners condemned to death or awaiting a final hearing before the emperor. This was the Mamertine prison, consisting of two (possibly three) distinct vaults, one below the other. The upper was 16 feet in height, 30 in length, and 22 in breadth; the lower was smaller and lower, and the only access to it was by a hole in the middle of the ceiling, through which the prisoners were let down. This was originally the case also with the upper vault, called the dungeon of Ancus Martius. There were houses of detention in Rome which were used for the safe keeping of slaves. Even at a later period the Code Justinian has very little to say of prisons; its penalties were scourgings, tortures, mutilations, and death.

Mediæval Prisons.—With the downfall of the Roman empire, and the assumption of power over small districts of territory by the feudal barons, there came a change. The great tower of every castle, the *donjon*, had its *keep* or strong-room, often underground, to which foe or rival was forthwith consigned. They were utterly unfit for the confinement of human beings, and the names *oubliettes* (little places of the forgotten) or *vade-in-pace* (go in peace) by which they were designated in grim jest by their builders or owners indicated but too truly their murderous purpose. Of a somewhat better character, though still cheerless and almost hopeless prisons, were those isolated fortresses where chiefs, nobles, and kings in the Middle Ages were often incarcerated. The Tower of London belonged to the same class.

Prisons of the Inquisition.—The prisons of the Inquisition in Italy, Spain, Portugal, France, Belgium, and Austria, though not in the main intended so much for punishment as for detention—the punishment (often within the prison-walls) consisting mainly in the racks, wheels, boots, thumb-screws, and other instruments of torture which a fiendish ingenuity exhausted itself in contriving, and in the *autos-de-fé* and other modes of inflicting the death-penalty—were yet, in some cases, places of protracted and cruel punishment, in which every idea of horror and apprehension which could torture the mind of the victim was suggested, to aggravate the distress of confinement. Even during the nineteenth century the victims of this cruel imprisonment have died by slow torture.

Prisons of the Eighteenth Century.—On the Continent, and even in Great Britain, the idea that imprisonment, except in the case of political offenders, constitutes any part of the punishment of crime does not seem to have dawned upon the minds of statesmen, political economists, or penologists—if the latter class could be said to have existed—until well into the eighteenth century. There were jails, houses of detention, prisons—if they might be called such—both in Great Britain and on the Continent, but they were filled with debtors, persons arrested for crime and awaiting trial, and those who had been sentenced to banishment or transportation, to slavery, to the galleys, or to execution. The jails and prisons were so filthy and ill-ventilated that deadly fevers, the plague, and the black death would occur in them, and frequently spread over the adjacent country. At what was known as the "Black Assize" in England, in the seventeenth century, over 300 persons, including judges, jury, lawyers, and spectators, fell victims to a malignant jail-fever which was communicated by the prisoners brought out of the jail for trial. The moral pollution of these jails was as great as the physical: the grossest intemperance and licentiousness prevailed in all of them, and the fee for the prostitution of the female prisoners was a recognized perquisite of the keepers.

John Howard and his Associates.—Attempts were made to reform and improve the jails in England, as well as on the the Continent, by John Howard in the latter part of the eighteenth century; they were attended with some success, though not so great as his philanthropic efforts and the final sacrifice of his life to the cause warranted. Beccaria in Italy, and Sir William Blackstone, Jeremy Bentham, and Mr. Eden (afterward Lord Auckland) in Great Britain, took up the work and went forward with it. At this time, however, Great Britain was largely engaged in schemes of transportation, which her statesmen believed would rid them of her vicious population, and they were not inclined to give much heed to measures of prison reform. They had sent convicts to Virginia from 1619 to 1770, until they would no longer be received, and, after the beginning of settlements in Australia and the adjacent islands, had forwarded thousands to Botany Bay, Sydney, Tasmania, North and West Australia, and to British Guiana, till about 1850; but, contrary to their expectations, the number of criminals at home did not decrease. Most of the continental states had tried the same experiment of transportation, and with about the same success. France, while sending off large numbers of criminals, consigned very many to the galleys, where they learned only evil, and at their discharge became leaders in crime. Russia sent the greater part of her criminals, as well as her political offenders, to the mines in Siberia, and most of the other powers rid themselves of their criminals by transportation wherever they could find the opportunity, sometimes sending them to the territories of the U. S., to Mexico, and to South America. These efforts did not lessen the number of actual criminals. As yet the possibility of the reformation of criminals was not conceded.

Prison Reform in Great Britain.—All efforts to keep down the number by transportation having failed, and the benevolent labors of John Howard, of Mrs. Elizabeth Fry, and of the aldermanic committee of London having proved ineffectual to remedy the evil, Sir T. Fowell Buxton, a member of Parliament, published in 1818 an *Inquiry whether Crime and Misery are produced or prevented by the Present System of Discipline.* After a conflict of nearly thirty years the prisons and prison-systems of Great Britain and Ireland were very thoroughly reformed; transportation ceased, and the convict prisons, though more expensive than they should be, are well managed, and many of their prisoners are reformed. Many of the convicts are employed in the great naval shipyards at Dartmouth and Portsmouth. The jails are cleanly, well-ventilated, and for the most part have some employment for the prisoners, which keeps them from mischief and contributes a small sum toward the expense of their support. The reformatories for young offenders have, by reforming the young criminals, prevented the increase of the criminal class, and greatly diminished the number and magnitude of crimes in the kingdom. In Scotland and Ireland, by a different application of the same principles, a still greater measure of success has been attained. What is known as the Crofton or Irish system of prison discipline has proved very successful in Ireland.

Prisons in the United States.—In the U. S. transportation has never been attempted as a means of ridding the community of the dangerous classes. Before the Revolutionary war the criminal code was very severe; death was the penalty of a great number of crimes; in one of the States 115 crimes punishable by death were enumerated; in other States the number was from 80 to 100. Burglary, horse-stealing, highway robbery, and even grand larceny, as well as forgery, counterfeiting, and many other crimes now punishable by a moderate term of imprisonment, subjected the criminal to the death-penalty. At the same time the prisons were in a wretched condition, hardly better than those of Great Britain. In 1786 Pennsylvania made the first effort at improvement of her prisons by the adoption of the *solitary* plan of discipline. Reforms were accomplished in Boston by the Prison Discipline Society, which existed from 1824 to 1844. The Prison Association of New York was organized in 1844. The "separate plan" in operation at the Eastern penitentiary at Philadelphia is very expensive; the work is unprofitable, the proceeds of it not defraying more than one-sixth of the expenses of the prison; and, though there is not so much insanity or fatuity as under the solitary system, the prisoners fail in self-reliance, and are very seldom of any service to the community after their discharge. In 1821–23 the "congregated or silent system" (now known as the Auburn system), was adopted at Auburn, N. Y., and soon attained such a reputation that it was adopted by other States, and with various modifications is now the prevalent system in the U. S. See PRISON DISCIPLINE.

In many of the congregate prisons the labor of the prisoners is let to contractors at a given sum per day; in several of the States the whole expenses of the prison are thus defrayed, and in some a surplus is paid into the State treasury. In some cases the State employs the convicts and disposes of the products of their labor, but these generally fail to defray the entire expenses. Many objections have been made to the contracting of the labor of prisoners, and in several States it has been superseded by what is known as the "piece price," and "State account" systems.

County Jails.—Of all the prisons in the U. S., county jails

are the most unsatisfactory. With rare exceptions, prisoners of all grades and of all ages are herded together in a common hall, and the contaminating influences of association are so injurious that all penologists are agreed in the conclusion that no large progress can be made in reducing crime until this evil is corrected. The remedy clearly consists in such a separation of prisoners awaiting trial as will not permit any prisoner to associate with any other prisoner. This rule has been enforced in England for many years, and its violation by any jailer is made a penal offense by act of Parliament. In the U. S. this system was first adopted in Massachusetts, in the Suffolk County jail in Boston about 1860, and the results have been so satisfactory that it has been extended to all other jails in the State where the construction of the jail will permit. In Ohio a similar requirement has been made by legislative enactment, and in several Western States new jails have been constructed with a view to confining prisoners in separate cells. See IMPRISONMENT.

Revised by R. BRINKERHOFF.

Prison Discipline: the proper care and regulation of persons suffering detention or punishment by incarceration. Three systems of prison discipline divide the study and the suffrages of the civilized world—viz., the Auburn, or congregate silent system; the Philadelphia, or separate cell system; and the system of progressive classification—sometimes called the Irish system, because first applied in Ireland—sometimes the Crofton system, from the name of the man who devised and applied it in the form it has there, although Capt. Alexander Maconochie, of the British navy, was the real author of the system. The essential principle of the Auburn system is that of absolute separation of the prisoners by night and associated silent labor by day. This system is almost universal in the U. S., and has also a foothold in various European countries, where, too, the old system of common dormitories has far too wide a prevalence, though it has no defenders. Some of the convict prisons of the U. S. do not even claim to conduct their discipline upon the strictly silent principle; in others, where the claim is made, the rule of silence has but a partial enforcement, while in comparatively few is the rigidity of the old discipline of absolute non-intercourse maintained in full force. The essential principle of the separate-cell system is that of a complete bodily separation of the prisoners in labor, recreation, and rest. The Eastern penitentiary at Philadelphia is the only State prison in the U. S. conducted upon the separate system. There are, however, two local prisons in Pennsylvania, at Chester and Media, where the system is still in operation. This system, known throughout the world as the Pennsylvania system, has been adopted with some modifications in several European countries, notably in Belgium, where it is in operation in all convict prisons, apparently with good results. In the U. S. it has not proved satisfactory. Isolation lies at the foundation of both these systems. The difference between them is one of application rather than of principle.

The System of Progressive Classification.—Capt. Alexander Maconochie was, on his own application in 1840, invested with the governorship of the British penal colony of Norfolk island, at that time containing a criminal population of 1,500, made up of the worst convicts ever sent out by the mother-country. He there became the originator and founder of the system of progressive classification as an agent in prison discipline and the reformation of prisoners. The discipline inaugurated by him was called by its author the "social system of prison treatment," because of the play therein given to the social instincts of humanity; but it is commonly known among penologists as the "mark" system, because of the use which it makes of marks in recording the progress of the prisoner in industry, education, order, and virtue. Capt. Maconochie sought to make prison life an image of free life. He treated the convict as a laborer, with marks for wages. His marks were made to play the part of money, for with them the prisoner was required to purchase his food, clothes, schooling, etc., while only the surplus of these earnings counted toward his liberation. Under this system the prisoner is not to be sentenced to a certain number of months or years, but to earn a certain number of marks over and above his keep. Maconochie fixed on ten marks as a fair day's wages, the men being paid by piece-work, and not by time, and for every ten marks saved the convict shortened his imprisonment by a day. At the stores he purchased his daily supplies, paying for them in marks. The rations were served out at three rates. The coarsest cost three marks per day, the next four, and the best five. The self-denying prisoner might thus save seven and the self-indulgent five marks each day for the purchase of his liberty. As extra marks were allowed for overwork, it was possible to hoard at the rate of eight or ten a day as the fruit of diligence and self-denial. Moreover, the marks furnished the means of disciplinary punishment, a proportionate fine in marks being the penalty for every act of disobedience or failure in duty. While, by this machinery of marks, Capt. Maconochie trained his convicts to habits of industry and frugality, he adopted different means to accomplish his other objects. He divided the convicts' sentences into three periods. During the first or penal stage the men worked under a sharp and stringent discipline. At the conclusion of this they were allowed to form themselves into companies of six each—the members of each company being left to choose their own companions—and then they entered into the second or social stage. In this stage the six prisoners forming a company had a common fund of marks, into which common stock the daily earnings of each member were paid, and from which the supplies and fines for the whole company were deducted. They were thus made responsible for each other's conduct, and naturally became watchful both over themselves and their companions. In the last or individualized stage the companies were broken up, and, though every man was still kept at work to earn his daily tale of marks, he was in other respects comparatively free. He had his own hut and garden, his own piggery and poultry-yard, the products of which he might sell to the officers of the colony or the ships that touched at the island. By thus giving the probationer property and rights of his own, Maconochie hoped to teach him respect for those of other people. He was four years on Norfolk island. His success was wonderful, though he was never allowed by the British Government to bring all the principles of his system into play, and so give it a full and fair trial.

A few years after Maconochie's retirement from Norfolk island, Capt. (later Sir) Walter Crofton, following in his footprints, devised and established a new system of convict prisons for Ireland. He adopted the mark system of Maconochie, with modifications which improved it in many important respects. The Crofton system consists of three stages: A penal stage of separate imprisonment, continuing eight months; a reformatory stage, longer or shorter according to the length of the sentence, with separation at night and associated labor by day, in which the principle of progressive classification is applied with a gradual lifting of restraint and enlargement of privilege, including an increased share in his earnings as the prisoner advances from class to class; and a testing stage, designed to verify the reformatory power of the preceding discipline, and also to serve as a period of natural training which shall gradually prepare the prisoner for full liberty. The Crofton system may be shortly defined as an adult reformatory, in which the will of the prisoner is brought into accord with the will of the prison-keeper, and held there for so long a time that virtue becomes a habit, and where the object is to teach and train the prisoner, during his detention, in such manner that on his discharge he may be able to resist temptation and inclined to lead an upright, worthy life. This must be done by placing the prisoner's fate, as far as possible, in his own hands, and by enabling him, through industry and good conduct, to raise himself, step by step, to positions of increased freedom and privilege; while idleness and bad conduct, on the other hand, keep him in a condition of coercion and restraint.

CROFTON SYSTEM IN THE UNITED STATES.

In the U. S., reformatories for adult criminals upon the general principles of the Crofton system have been established in New York, Massachusetts, Pennsylvania, Ohio, Michigan, and Minnesota.

The Elmira Reformatory.—The first of these, the Elmira Reformatory, upon which the others are mainly patterned, was opened in 1876 at Elmira, N. Y., and is known as the New York State Reformatory. Prisoners received at Elmira are such as are convicted of their first offense for felony, and are held under what is known as the indefinite or indeterminate sentence; that is, they are not sentenced for any specific period of time, but may be held for the maximum period for which they might have been sentenced for the crime committed, and can not be discharged until they have served the minimum period provided by statute for such offense; but having served such minimum period they

may be allowed, under regulations established by the board of managers, to go upon parole outside of the buildings and inclosures, but to remain, while on parole, in the legal custody and under the control of the board, and subject at any time to be taken back to the institution.

Classification of Inmates.—The reformatory plan includes the dividing of prisoners into three grades, viz., the upper first, the lower first, and the second; and all enter the lower first, to rise or fall according to compliance with reformatory requirements. The measure of every man's career in the reformatory is the record appearing upon the pages bearing his name in the conduct, labor, and school ledgers. By maintaining a good record for six successive months prisoners in this grade may advance to the upper-first grade, from which alone they may secure release prior to the expiration of the maximum time for which they could have been imprisoned. In this they wear a uniform of sky-blue, their cells are more commodious, and they have more privileges in many ways. If their records continue perfect another six months they become candidates for conditional release, provided satisfactory employment can be secured for them. The downward step from the lower-first grade leads to the second or convict grade. Into this drop the lower-first grade men whose conduct, school, or labor records are imperfect for two or three months in succession. Those who are reduced to this class forfeit all credit marks, and may secure readmission to the next higher grade only by earning a perfect marking for three successive months. Those who fall to the second grade a second time may not emerge from it for six months, and the third degradation is not followed by advancement for a year. The uniform of the convict grade is a bright red. Its wearers are quartered in the smallest cells, are deprived of all room furniture not essential to health and cleanliness, have no sheets on their beds, receive no tea or coffee with their rations, lose the privilege of drawing literature of any kind from the library, and lose their right to receive trade instructions as such.

While men of the upper-first grade are allowed to write one letter each month, and those of the lower first one in every two months to known relatives, second-grade men are not permitted to have any communication whatever with the outside world.

In the cell blocks, on the drill-ground, and at general assemblages the members of the different grades are grouped and kept separate one from another; but it is impossible, of course, to maintain this separation in the shops and trade-schools. The engagements of each inmate are intended to absorb his thoughts completely during the most of his waking moments, and they are sufficiently varied, though systematized, to prevent any of the noxious effects upon the mind that are often the effect of monotonous habits. Their engagements are work in the shops, trade-schools, and other occupations, and the day is closed with military drill and dress parade. In the evening are class meetings in school studies and other educational opportunities.

The results of reformatory treatment under these conditions have been very satisfactory, and the records show that of the graduates of Elmira over 80 per cent. have reinstated themselves in society, and are earning an honest living.

Other Reformatories.—The reformatory at Concord, Mass., was opened in 1884. Like Elmira it has three grades, and a marking system by which the prisoner rises or falls, but unlike Elmira it receives misdemeanants as well as felons, and there is no limit as to age or number of offenses, and only a part of the prisoners are subject to the indeterminate sentence. The prison for women at Sherborn, Mass., established in 1877, is also conducted on a system similar to that of Elmira, although it has four grades instead of three. It is wholly under the management of women, and as a prison for women it has no superior.

Corporal Punishments.—In the U. S., in the best-regulated prisons, corporal punishments are no longer considered a necessity for the maintenance of discipline, and in many they are entirely abolished. In the Western penitentiary of Pennsylvania, at Allegheny, no form of physical torture has been tolerated since about 1870, and so also at the great prisons at Joliet, Ill., and the military prison at Leavenworth, Kan., and better discipline is reported than in previous years when the lash or its equivalents were in use.

In New Jersey, Minnesota, Kansas, and other States, corporal punishments are prohibited by law, and a majority of the most enlightened prison-wardens in the U. S. regard them as a relic of barbarism, and worse than useless in the maintenance of order in prison.

Prison Associations.—Among the agencies in the U. S. which have been largely instrumental in educating the public mind to the requirements of better methods in dealing with the criminal classes are the various prison associations, State and national, and State boards of charity and correction. The most important of these is the National Prison Congress, which was organized in 1870 and brings together annually, for the discussion of prison questions, prison officials and others interested in prison management. The annual reports of these various associations constitute a library upon prison subjects, and as knowledge accumulates penology is more and more becoming an exact science.

Among the principles already established sufficiently to be considered axioms by penologists in the U. S. are—

1. County jails should be solely places for the detention of prisoners awaiting trial, and in them no prisoner should be permitted to associate with any other prisoner. 2. Prisoners convicted of misdemeanors should be sent to district workhouses and employed at productive labor. 3. Prisoners convicted of felony should be sent to penitentiaries, of which there should be at least two in each State—one a reformatory for young men, and the other for life-prisoners and incorrigibles. 4. All sentences, except for life, should be indefinite, subject to parole and police supervision within a minimum and maximum limit. 5. All able-bodied prisoners should be kept at productive labor, but those in reformatories should receive such educational and industrial training as will enable them to earn an honest living after discharge. 6. All prisoners upon discharge should be systematically aided to obtain employment. 7. Prisoners convicted more than twice for felony should be adjudged incorrigible and sentenced for life, or at least for long periods, with the privilege of parole for good conduct at the maximum limit of a first conviction. 8. Prison officers should be as thoroughly trained for their duties as are army and navy officers, and their tenure of office should be as secure and their compensation as liberal. 9. Prisoners convicted of violations of Federal laws should be confined in prisons owned and controlled by the general Government. 10. In all prisons moral and religious culture should be the leading reformatory influences, and a prison school, with competent instructors, should be an indispensable requirement.

Revised by R. Brinkerhoff.

Prisoners of War: See War.

Pris'tidæ [Mod. Lat., named from *Pris'tis*, the typical genus, from Gr. πρίστις, assumed to mean sawfish (deriv. of πριειν, saw), properly πρῆστις, a kind of whale, liter., blower, spouter, deriv. of πρήθειν, blow, spout]: a family of selachians of the order *Raiæ*, represented by the sawfishes. The body combines peculiarities of the sharks and rays, being elongated like the former, but with the pectoral fins developed and the branchial apertures inferior, as in the latter; the shagreen is very fine; the snout produced into a very long, flat, dagger-like appendage, which is armed on each edge with a row of strong, compressed, straight teeth. The nostrils are inferior: mouth small and transverse; teeth on the jaws minute; branchial apertures inward from the base of the pectoral fins; spiracles large, behind the eyes; dorsal fins two, unarmed, the first more or less behind the ventrals; pectorals with the front margins free, and not extending on the head. The teeth which are on the margin of the saw are of peculiar development, and must not be confounded with the true teeth of the jaws; the skeleton of the saw-like appendage has from three to five hollow sub-cylindrical tubes which taper toward the end, and are incrusted with a grain-like osseous deposit. The sawfishes are found in all tropical seas, and one species (*Pristis antiquorum*) occurs on both coasts of the U. S., especially in the more southern waters. An East Indian species lives in part in fresh water.

Revised by F. A. Lucas.

Pritchett, Henry Smith: See the Appendix.

Privateering: the act or practice of cruising in a privateer for the purpose of preying on merchant vessels of a hostile power. As there may be legalized land forces of an irregular character to supplement a regular army, on the condition of their conforming to the rules and usages of war, so upon the high seas the war navy of a belligerent may be assisted in certain of its duties by private armed vessels.

These vessels, with their crews, might be hired by the governments, or impressed into the sovereign's service, whether owned by natives or by foreigners—the latter called the *jus angariæ* or *droit d'angarie*; or they might be vessels owned and manned by private persons, but kept up at the public

expense; or public vessels with a crew and outfit provided for by private persons; or, finally, private vessels officered and sent to sea at the charges and risk of private persons under a government commission. Of these four ways of sending vessels out to sea, the last-named only has been in vogue in the most modern times. In commercial states this has been a favorite way of employing sailors and merchant ships when trade was crippled by war; and to a nation with a small navy but with a large seafaring class it offered the prospect of something like equality on the sea with a nation possessing a good-sized fleet.

Although sometimes bounties have been offered to privateers for the capture of the men-of-war of an enemy, this can hardly be considered a usual part of their duty or be reasonably expected of them. They are neither built, armed, nor manned with such service in view, but rather to prey upon the commerce of an enemy, being entitled to a share in their captures.

In commissioning privateers it is usual for a government to put their owners and captains under bonds. A letter of marque is given, which alone entitles a vessel to any share in a capture made from the enemy, after adjudication by a prize court, and the absence of which exposes a vessel calling itself a privateer, with its crew, to harsh treatment, as having almost a piratical character. Any great irregularity or lawlessness will involve forfeiture of vessels and other penalties, including by English usage damages from the owners; but, in truth, lawlessness and harsh treatment of the enemy could never be prevented. The motive of the expedition being plunder, the captain and officers having no professional honor, the crews being often a motley collection of adventurers, privateering was long felt to be a great evil, and earnest voices were raised against it, especially by enlightened men in the U. S. Thus Franklin inserted a provision forbidding reciprocally the issue of letters of marque in the treaty between the U. S. and Prussia negotiated by him in 1785. At length, in 1856, the parties to the Declaration of Paris brought about a new era in international law by the four rules relating to warfare on the sea, one of which was that "privateering is and remains abolished." Other nations were invited to give their assent to these rules on the condition of accepting all or none, and nearly all Christian states accepted them. Several of them were such as the U. S. had always contended for, but adhesion was refused on the ground that the republic would have no adequate force, if it abandoned privateering, to cope with nations possessing a large navy, as its own policy was to have a small one. The offer, however, was made—but without effect—to adopt the rules, provided that the signers of the Declaration of Paris would go further and exempt all innocent traffic of enemies on the sea from capture. This was called the Marcy amendment. In 1861 Mr. Seward, being Secretary of State, made offer to two of the principal European powers, on the part of the U. S., to come under the operation of the four rules; but as it was understood that the stipulation would be for the entire republic, including the Confederate States, and as thus these powers would be parties in imposing a rule of warfare on the Confederate States, as, in short, it was a scheme to prevent them from using privateers by the aid of international law, the offer was declined. See DECLARATION OF PARIS.

The abandonment of the use of privateers by so large a number of states, and the provision for the safety of enemies' goods on neutral vessels in the same document, put a new face on maritime warfare. At the outbreak of a war, if the risk of capture is great enough, neutral vessels henceforth will take the place of belligerent ones for commercial purposes, and the motive of capture is greatly diminished for public cruisers, the only ones now remaining. Thus it can be no very great concession that belligerents may safely use their own merchant ships, unless neutrals regard it of importance for them to get the business of times of contest into their hands. The parties to the four rules may still legitimately employ privateers against non-signers.

Subjects of the U. S. are, by statute, forbidden to accept letters of marque from powers at peace with it, and this, apart from the Declaration of Paris, is a common rule. Privateers were not employed by either North or South in the civil war in the U. S., the Confederate ships commonly called privateers being really commissioned men-of-war, though in some cases illegally fitted out.

Revised by T. S. WOOLSEY.

Private Road: See the Appendix.

Privet [other Eng. names for the same are *primprint*, *primet*, Scotch *privie*. The introduction of the *v* is unexplained; *primet* is probably connected with *prime*, to trim]: the *Ligustrum vulgare*, an oleaceous shrub of Europe, now naturalized to some extent in the U. S.; chiefly used as a hedge-plant, both in the Old and New Worlds. It makes a close, handsome hedge, though it is not thorny. Its wood, though small, is saved for turners' use in Europe, and its berries yield a pink coloring-matter used by map-colorers. There are several rather ornamental allied species, one of which, *L. japonicum*, is known popularly as the California privet. Revised by L. H. BAILEY.

Privilege [from Lat. *privile'gium*, an ordinance in favor of an individual; *pri'vus*, private + *lex*, *le'gis*, law]: a benefit or immunity which is not enjoyed by all. Some forms of privilege are considered in the articles on LIBEL AND SLANDER and on MONOPOLIES (*qq. v.*). The present discussion will be confined to the privileges of legislators, and to those of citizens under the U. S. Constitution.

Privileges of Legislators.—Members of the British House of Commons are not liable to be sued for any words uttered in the House, however injurious they may be to others; nor can they be detained by the civil process of any court during a session of Parliament, nor during a convenient time before and after the close of a session. The U. S. Constitution provides that the Senators and Representatives "shall in all cases, except treason, felony, and breach of the peace, be privileged from arrest during their attendance at the sessions of their respective houses, and in going to and returning from the same; and for any speech or debate in either house they shall not be questioned in any other place." (Art. I., § 6.) Similar privileges are secured to State legislators by the State constitutions.

Privileges and Immunities of Citizens.—Article IV., § 2, of the U. S. Constitution declares: "The citizens of each State shall be entitled to all privileges and immunities of citizens in the several States." This guaranty is confined, it will be noticed, to those privileges which belong to citizenship. It does not extend to the privilege of taking fish in the public waters of another State. Public fisheries are the property of the State, and its inhabitants have a right in them by virtue of citizenship and domicile, and not by virtue of citizenship only. Nor does it secure to the citizen of one State that community interest in property owned by his wife in another State which is accorded by the laws of the latter to its resident citizens. (*Conner* vs. *Elliott*, 18 Howard 591.) Nor does it apply to artificial persons—corporations—which possess only such attributes as are bestowed by the State creating them. Many political rights, such as the right of suffrage and the right to hold office, are not within this constitutional guaranty, for these do not pertain to citizenship necessarily. In every State large numbers of citizens do not possess them. The provision in question applies to "those privileges and immunities which are fundamental, which belong to the citizens of all free governments, and which have at all times been enjoyed by citizens of the several States which compose this Union, from the time of their becoming free, independent, and sovereign; . . . protection by the Government, with the right to acquire and possess property of every kind, and to pursue and obtain happiness and safety, subject, nevertheless, to such restraints as the Government may prescribe for the general good of the whole." (*Corfield* vs. *Coryell*, 4 Washington Circuit Court 371.) Hence a statute which makes it unlawful for any person to appoint a non-resident trustee in a deed or other instrument is unconstitutional. *Shirk* vs. *La Fayette*, 52 *Federal Reporter* 857.

The Fourteenth Amendment to the Constitution prohibits the States from making or enforcing "any law which shall abridge the privileges or immunities of citizens of the United States." This provision recognizes a citizenship of the U. S. which is distinct from that of a State, and it guards only the privileges and immunities that pertain to the former; "those which arise out of the nature and essential character of the national Government, the provisions of the Constitution or its laws and treaties made in pursuance thereof." (*Butchers' Association* vs. *Crescent City Company*, 16 Wallace 36.) In the decision just mentioned the following were named as such privileges: "To come to the seat of government to assert any claim upon that Government, to transact any business with it, to seek its protection, to share its offices, to engage in administering its functions. Free access to its seaports; . . . to the sub-treasuries, land-offices,

and courts of justice in the several States. To demand the care and protection of the Federal Government over life, liberty, and property when on the high seas or within the jurisdiction of a foreign government. To peaceably assemble and petition for redress of grievances. The writ of *habeas corpus*. To use the navigable waters of the United States however they may penetrate the territory of the several States. To become a citizen of any one of the several States by a *bona fide* residence therein." Freedom from State discrimination against citizens of other States in respect of commercial transactions is an immunity of U. S. citizenship, unless such discrimination is a valid exercise of the police power.

The amendment under consideration applies only to State action, and not to that of individuals. Congress, therefore, is not authorized to declare it a crime for individuals to conspire to deprive any person of his privileges and immunities as a citizen of the U. S. *Civil Rights Cases*, 109 U. S. 3.

FRANCIS M. BURDICK.

Privy Council: "This is a most noble, honorable, and reverend assembly of the king . . . in the king's court or palace; with this council the king himself doth sit at his pleasure. These councilors, like good sentinels and watchmen, consult of and for the public good, and the honor, defense, safety, and profit of the realm. . . . They are called *concilium regis privatum*, *concilium secretum*, *et continuum concilium regis*. . . . To these counsellors all due honor and reverence is to be given, for they are incorporated to the king himself, and bear part of his cares; they are his true treasurers, and the profitable instruments of the state." (4 Coke's *Institutes* 53.) Such was the privy council for centuries—a council within the great council; a small body selected by the king to be in constant attendance upon him, and to aid him in the performance of legislative and judicial as well as administrative duties.

Its name dates from the reign of Henry VI., while it attained its greatest importance under the Tudors and the first two Stuarts. During this period its judicial functions were so grossly abused in its court of the star chamber that they were "clearly and absolutely dissolved, taken away, and determined" by the Long Parliament in 1640. With the Restoration the privy council revived, but not its court of the star chamber. However, "the king in council was still the resort of the suitor who could not obtain justice in one of the dependencies, and the act which took away the original jurisdiction of the king in council at home did not touch petitions from the adjacent islands or plantations." Anson's *Law of the Constitution*, pt. ii., p. 442.

Its judicial functions remained somewhat uncertain until 1833, when they were defined by statute (3 and 4 William IV., c. 41). They are exercised by the judicial committee of the privy council, consisting of the lord-president, those members of the council holding or having held high judicial office, the lord justices of appeal, two other persons being privy councilors whom the crown may appoint, and one or two paid members who have held the office of judge in the East Indies. A quorum consists of four members, and only those members attend who have been summoned. This judicial committee does not give formal judgment in a case, but humbly advises the Queen to give effect to the conclusions it has reached. Its report, when approved by the Queen at a meeting of the privy council, is adopted by an "order in council" as the judgment of the Queen in council. It is a rule of this committee, having its origin in the secret and consultative character of the ancient council, that after a case has been decided "no publication is afterward to be made by any man how the particular voices or opinions went." (*Order in Council*, 1878.) The jurisdiction of this committee embraces all appeals made to the crown in council, the most important of which are appeals from the colonial courts, and such other matters as the crown may choose to refer to it.

Its legislative functions are exercised by means of orders in council, which are made under authority bestowed by statute or which issues from the royal prerogative. In the former case it is acting simply as a delegate of Parliament, and in subordination to the national legislature. Even in the latter case, according to some authorities, the crown in council is not legislating, is not enacting law, but is enforcing it. Dicey declares that "the only instances where, in modern times, proclamations or orders in council are of any effect are cases either where at common law a proclamation is the regular mode, not of legislation, but of announcing the executive will of the king, as when Parliament is summoned by proclamation, or else where orders in council have authority given to them by act of Parliament." (*The Law of the Constitution*, p. 50.) The better view seems to be that the crown still retains a fragment of its ancient power to legislate without the assistance of Parliament; that, especially in matters connected with the colonies, where Parliament has neither legislated nor vested the exclusive power of legislation in some other body nor forbidden the crown to legislate, it may enact new laws by means of orders in council. Burgess, *Political Science*, vol. ii., p. 199; Cox, *The Institutions of English Government*, 27–30.

Its administrative functions are exercised at present by committees or boards. The most powerful of these, as it is the one that has absorbed all of the most important privileges of the ancient privy council, is the CABINET (*q. v.*). Other committees are those for trade and plantations, for education, for local government, for corporations, for the Channel islands. When a petition is addressed to the crown touching matters within the administrative jurisdiction of the council, it is referred to the appropriate committee for advice. Many matters are brought before the council as a body. Modern legislation has created new boards and transferred to them much of the business which belonged formerly to the council.

Appointment, Oath, and Dismissal.—A person becomes a privy councilor by royal nomination, upon taking the oaths of office and allegiance at a council meeting. "The members composing the privy council may be said to fall into three groups. Members of the cabinet must necessarily be made members, as the confidential advisers of the crown. Beyond these there are great offices which, though unconnected with politics, are usually associated with a place on the council board. Beyond these, again, is a group of persons eminent in political life or in the service of the crown, upon whom the rank of privy councilor is conferred as a complimentary distinction." (Anson's *Law of the Constitution*, pt. ii., p. 135.) At present the number of privy councilors is about 200. The tenure of office is for life, subject to dismissal at the pleasure of the crown. The oath binds the councilor to be a true and faithful servant of the crown; to resist to his uttermost any affront to the monarch and to report the same; to truly declare his opinion upon all matters before the council; to keep secret all matters treated of in the council; to bear faith and allegiance unto the crown, and in all things to do as a faithful and true servant ought to do to the crown. See Nicolas, *Proceedings and Ordinances of the Privy Council*; Dicey, *The Privy Council*; Palgrave's *Original Authority of the King's Council*; and Finlason's *Judicial Committee of the Privy Council*.

FRANCIS M. BURDICK.

Privy Seal: the minor seal of the British Government, affixed to papers of minor importance, and also to important documents preparatory to the affixing of the great seal. The privy seal is in the care of a great officer of state, usually one of the cabinet, called the lord privy seal.

Prize [from O. Fr. *prise*, a taking or seizing, something taken or seized, deriv. of *prendre* (perf. partic. *pris*), take]: something taken on the sea, as belonging to an enemy in war or to a neutral—i. e. to a person resident in a neutral state who is identified with such enemy. A vessel of a nation taken by its own cruisers, if engaged in illegal trade, may also be called a prize. A prize can become the property of the captor only after trial and condemnation by a competent court. This will be the prize-court of the state to which the captor belongs. In Great Britain questions of prize are decided by her Majesty's high court of justice, which is one division of the Supreme Court of Judicature, in which the old admiralty and other courts were merged by act of 1873. A corresponding court in France is the council of prizes, subject to appeal. In the U. S. admiralty cases are tried by the U. S. district courts, with appeal to the Supreme Court.

Revised by T. S. WOOLSEY.

Prjeval'sky, or **Prejevalsky**, NICOLAI MICHAELOVITCH: explorer; b. on the family estate of Otradny, government of Smolensk, Russia, Mar. 31, 1839; descendant of a Cossack of the Zaporog, whose heroism gave him the surname of Prjevalsky (from the Polish *Prje*, very, and *valit*, to make war), and who was ennobled by Stephen Bathory, King of Poland. He was educated in the civil gymnasium of Smolensk, where he was noted for an extraordinary memory. In 1855 he entered the military profession, and five years later the Military Academy, where he showed

stronger predilections for history and natural science than for military subjects. In 1863 he rejoined his regiment as adjutant, but remained with it only a year. He then obtained the post of lecturer on history and geography in the cadet school at Warsaw. In 1867 he received an assignment as geographical explorer, and was sent to the Ussuri country in Eastern Siberia, where he remained two years. His results were published in Russian in 1870. From the maritime province he traveled southward to the Yang-tse river, thence northward through the desert of Gobi to Irkutsk, reaching the latter place in 1873. In 1876–77 he explored Lob-Nor and the Altyn-Tag Mountains. He crossed into Tibet in 1879, but was turned back before Lhassa was reached, and returned to Russia through great dangers and hardships. In 1883–85 he again explored the desert of Gobi, the sources of the Hwang-ho and the Lob-Nor district, and again unsuccessfully attempted to reach Lhassa. Later he was placed in command of a large force and instructed to reach Lhassa at all hazards, but he died on Nov. 1, 1888, of typhus fever, before the expedition had been fully organized.

Though of Polish descent, he was an intensely patriotic Russian. His geographical work was recognized by many honors received from geographical societies and others throughout the world. His explorations after the first were described in numerous publications, which have been translated from Russian into the other European languages. A sketch of his life was published in St. Petersburg in 1890, by N. T. Dubrovin. MARK W. HARRINGTON.

Pro'a, or **Pra'hu** [from Malay *prāū*, *prāhū*]: a canoe-like sailing vessel of the Malays, Ladrone islanders, etc. The lee side is straight and flat from stem to stern, the other rounded. Both ends are alike. The vessel carries a lug-sail of matting. A framework projects to windward, and counterbalances the effect of the wind upon the sail, which would otherwise upset the craft. Proas are commonly some 30 feet long and very rapid sailers. They were once much used by pirates. The name is often applied to Malay vessels of other kinds, some propelled by oars and paddles, and some by sails also.

Proach, Lucky: See FATHER LASHER.

Probability, Theory of, or (more usually) **Calculus of Probabilities** [*probability* is from Lat. *probabi'litas*, deriv. of *proba'bilis*, probable, liter., provable, deriv. of *proba're*, try, approve, prove]: the application of mathematical reasoning to the art of judging in cases where only probable evidence can be obtained. The mode in which the judgment may be thus assisted can be best seen by beginning with some simple examples before laying down any general principles. Suppose a die to have two of its six sides painted black, the remaining four being left white, and a person to be required to judge whether, upon the die being thrown, a white or a black side will be uppermost. Common sense will teach him to guess the white side, not because he can certainly say it will be thrown, but because it will be more likely to be thrown. In common language it would be said that the chances were two to one in favor of white. In mathematical language a slightly different expression is used, the probability of an event being a proper fraction, of which the denominator is the entire possible number of chances or cases, while the numerator is the number of those cases which favor the proposed event. In the case just supposed, for instance, there are six sides to the die, of which one and one only must be thrown. Four of these sides being white, the probability of white being thrown is $\frac{4}{6} = \frac{2}{3}$, and that of black is $\frac{2}{6} = \frac{1}{3}$. If one of the four white sides were painted yellow, the probabilities would be white $\frac{1}{2}$, black $\frac{1}{3}$, yellow $\frac{1}{6}$. If the event is impossible, there are no cases which favor it, and in the notation just indicated its probability is 0. If all the cases favor it, and its occurrence is therefore certain, the probability is 1. As no degree of probability can exceed certainty, all degrees of probability are somewhere between the limits 0 and 1.

The mathematical solution of problems in probabilities consists, first, in dividing the possible processes or results into elementary and equally probable cases; and, secondly, in finding how many of these cases favor the proposed event. In the case just supposed of a single die this is very simple, and no one could mistake the mode of arriving at a solution; but when the result depends on the concurrence of a number of circumstances, the reasoning becomes much more complex. Suppose, for instance, that two dice are thrown. Then any one of the six sides of one die may be combined with any side of the other, making, in all, thirty-six combinations. To find the probability of any result from the throw of such a pair, we must find how many of these combinations will give rise to the combination in question, and divide the number by 36. In making this calculation there is great room for mistakes; indeed, the subject of probabilities is by far the most slippery one with which the mathematician or logician has to deal. Suppose, for instance, that a sharper should offer to a countryman to give him three cents every time two *ones* were thrown with two dice, provided the other would give him two cents every time a *one* and a *two* were thrown. At first sight the countryman might consider the two results equally probable, and therefore feel sure, in the long run, of gaining; but he would be sure to lose, because two different numbers are twice as likely to be thrown as a pair of the same number. To have two *ones* each die must fall with *one* uppermost; but to have a *one* and a *two*, one may be a *one* and the other a *two*, or the first may be *two* and the second *one*; so that for this result there are two cases out of thirty-six, while in the first there is but one. It can not be doubted that an understanding of this calculus would afford a very material aid to the judgment in weighing and estimating the probabilities of events in the affairs of life; for, although these events, or the causes which give rise to them, can not generally be made the subject of mathematical calculation, yet the examination and enumeration of the various combinations of circumstances which may give rise to an event affords our only means of judging of its probability. The longer a man's experience of worldly affairs and the sounder his judgment, the more nearly he will conform to the rules and methods of the mathematical calculus in estimating probabilities. An eminent writer happily described the calculus of probabilities as common sense expressed in numbers.

One of the most generally useful rules of this calculus is that although an event may be extremely improbable if it has but one opportunity to happen, yet if we increase the numbers of opportunities indefinitely it will be sure to happen in the long run. By the same principle, if the concurrence of a large number of circumstances is necessary to the production of an event, each of these circumstances may be, in itself, very probable, and yet their concurrence, and consequently the event itself, very improbable. The mathematical rule for determining probability in such a case is that the probability of the concurrence of all the events is equal to the continued product of the probabilities of all the separate events. As one example, suppose that a law requiring the concurrence of the two houses of Congress and the President were as likely as not to be rejected by any one of them, and that each one of the three authorities formed his own opinion independently of the other two. Then the probability of each authority approving the law being $\frac{1}{2}$, the probability of its passing all three would be $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$. We can get at the same result in this way: Out of 8 laws introduced into the House only 4 would pass and go to the Senate. Out of these 4 the Senate would pass 2, and of these 2 the President would approve 1. On this principle an event which has to pass the ordeal of a great number of small dangers is sure to fail at last, though each separate danger may itself be small. Suppose, for instance, that a bridge has 100 holes in it, and that a person passing over this bridge has 9 chances out of 10 of going safely past each individual hole. Notwithstanding so many chances in his favor for any particular hole, the chance that he would escape them all is only 1 in 37,650. That is, if we take the fraction $\frac{9}{10}$, which expresses the probability of passing any one hole safely, and multiply it by itself 100 times, the result will be about equal to $\frac{1}{37650}$. One of the principal marks of the practical wisdom of age and experience is the ability to recognize this principle, and there are plenty of proverbs which are really founded on it.

One of the most curious and important results of this calculus is seen in what is termed the law of averages, or the tendency of chance events which occur in great numbers to follow regular laws. The life of an individual is proverbially one of the most uncertain things in human affairs; but when we take large bodies, like the population of a state or a great city, the deaths follow a law so exact that mathematical tables of their probable number can be formed, and on these tables life-insurance companies can arrange their rates of premium with the moral certainty that the death-rate will not vary seriously from that calculated. Not only the total number of deaths, but the proportion of deaths from the most fortuitous causes follow

nearly their regular law. No doubt if we could learn how many men are killed by falling from houses, we should find it wonderfully constant from year to year. In cases like this the constancy of the result is the consequence of some widespread underlying cause, hidden by other accidental causes acting in different ways in individual cases. Thus a table of mortality is the combined expression of a certain law of the human constitution and certain conditions of the climate. The number of deaths by falling from scaffolding expresses the degree of general carefulness or carelessness which characterizes men engaged in building. The general rule is that in order that a law of averages may be closely followed it is necessary that the seemingly accidental events enumerated should be the result of two sets of causes, of which one is invariable throughout the whole period of time, while the other is entirely accidental in each individual case. When the variable or chance causes are not purely accidental, but affect large masses or vary from year to year, there is no longer any such exact law. For instance, if a large fraction of the population died from occasional epidemics, there could no longer be an exact law of mortality. The great classic treatise on this subject is Laplace, *Théorie Analytique des Probabilités*, which involves much profound mathematics. Bertrand's *Calcul des Probabilités* (Paris, 1889) is most interesting, philosophical, and amusing, using only elementary mathematics; De Morgan's *Theory of Probabilities* is the best-known book in English.

S. Newcomb.

Probate Courts: See the Appendix.

Proboscid'ea [Mod. Lat., from Lat. *probos'cis*, *probos'cidis* = Gr. προβοσκίς, προβοσκίδος, proboscis; πρό, in front, before + βόσκειν, feed, graze]: an order of mammals distinguished by the extension of the nose into a proboscis and the columnar form of the legs and feet, and typified by the elephants of the present epoch. The placenta is deciduate and zonary; the incisors variable in number—$\frac{2}{0}$, or in extinct forms $\frac{2}{2}$ or $\frac{0}{2}$—but always with persistent pulps, and developed as long tusks curved outward; the feet have the palmar and plantar surfaces invested in extended pad-like integuments, which also underlie the toes; the carpal bones are in two regular (not interlocking) rows, and are broad and short; the toes are in all the known forms five to each foot, and incased in shallow hoofs. The order is represented by one living family (*Elephantidæ*), to which belong the extinct mastodons; and to it by almost all authors an extinct family (*Dinotheriidæ*) has been also referred; these are distinguished from each other by great differences in the structure of the skull, as well as in the development of the teeth, the peculiar dentition of the elephants not being shared by the dinotheriids. See Elephant, Dinotherium, Mammoth, and Mastodon. Revised by F. A. Lucas.

Proboscis Monkey: See Kahau.

Pro'bus: Roman emperor from 276 to 282 A. D. He was put to death in the latter year by his own soldiers, after a very efficient administration of six years, chiefly occupied with the defense of the northern frontier. G. L. H.

Probus, Marcus Valerius: the most distinguished of Roman grammarians bearing the name of Probus. Coming from Berytus (now Beyrout), he taught in Rome in the latter half of the first century A. D., and edited, after the manner of the Alexandrine grammarians, the text of Horace, Vergil, Lucretius, Terence, Persius, and probably other writers. The *Commentary* to the *Eclogues and Georgics* of Vergil, still extant, under his name is of later date, as are several grammatical treatises bearing the name of Probus. See especially Teuffel, *Gesch. der Röm. Lit.* (§ 300), where the abundant literature on the subject is cited. M. Warren.

Procedure [from O. Fr. *procedure*, deriv. of *proceder*, proceed < Lat. *proce'dere*; *pro*, forward + *ce'dere*, go]: in the usage of modern legal writers, all the formal steps and proceedings in the conduct of a judicial controversy as established by the legal rules which control their use.

Development of Procedure in General.—Certain uniform principles seem to have determined the nature and moulded the history of procedure in every national jurisprudence that has made a complete progress from rude beginnings to a condition of comparative philosophical and equitable perfection. The earliest stages are always characterized by an intense formalism; the remedies which the law affords are restricted almost wholly to such as can be pursued by the use of arbitrary technical forms, each appropriate to a particular wrong or remedy, which must be followed with scrupulous exactness; and the defenses which can be interposed are likewise restricted by forms equally arbitrary and technical. The growth of the jurisprudence for a considerable period consists in the modification of these forms and their extension to new facts and relations; in time the dominion of forms is relaxed, the technical and arbitrary features gradually disappear, and at last the methods of administering justice become simple, and are based upon equitable notions. The state of legal procedure and the judicial remedies of a nation closely reflect the condition of its civilization; and the number and scope of remedies, and the methods of enforcing them, must keep pace with the culture of the nation and provide for its wants. The necessities, however, arise first, and the law afterward responds to them. This course of development marks an entire progress of the Roman Law (*q. v.*), and has been exhibited no less clearly in the development of the jurisprudence of England and the U. S.

Development of Procedure in English Law.—The most striking feature of the procedure originally prevailing in England is the separation into two distinct and widely differing systems, the common law and the equitable—the former exclusively used by the courts of law for the enforcement of legal rights in connection with the jury trial; the latter employed by the courts of equity for the enforcement of equitable rights alone without the jury.

Of the two, the common-law methods were much the elder. From the earliest periods rights were enforced in the law courts by means of different actions, the most important of which, denominated "real actions," were solely used for the recovery of lands. Prior to Edward I. there existed but three actions for the recovery of money—debt, covenant, and trespass. By virtue of a statute passed in the reign of that king (13 Edw. I., c. 24) other forms were afterward invented. The highly technical real actions were subsequently abandoned, with a few occasional exceptions, and the following actions became established as the ordinary means of enforcing legal rights: "ejectment," to recover possession and to try the title of lands; "detinue" and "replevin," to recover possession of chattels; "covenant," to recover damages for the breach of a sealed agreement; "debt," to recover a fixed and certain sum of money owed by the defendant, not as damages; "assumpsit," to recover damages for the breach of a contract not under seal, whether written or verbal, express or implied; "trespass," to recover damages for a wrongful act of violence to person or property; "case," to recover damages for a wrong to person or property unaccompanied with violence, or when the injury was consequential; "trover," to recover damages for the wrongful detention and conversion of chattels. The rules which governed these actions were technical and formal, and the courts were more often employed in deciding whether the proper kind of action had been brought, or whether the correct formulas of words had been used, than in adjudicating upon the actual merits of causes and determining the real rights of the parties. Inseparably connected with this diversity of actions was the common-law system of pleading; the two reacted upon and supported each other, and the technicalities of the one brought out and strengthened the formalism of the other.

The procedure in equity was based upon more simple and natural notions, and, however much it may have become encumbered by dilatory and unnecessary practices, these were not inherent and essential. No forms of actions existed, but a single method sufficed for all kinds of claims, defenses, and reliefs. The complainant stated his case with great minuteness of detail in a "bill," the defendant set forth his version in an "answer"; and upon these pleadings and the proofs the chancellor rendered his decree. In this judgment the rights, claims, and liabilities of all the parties were adjusted, and relief could be granted alike to defendants or to complainants. It was therefore a cardinal principle of the equity procedure that all persons interested in the controversy and who could be affected by the decree should be made parties to a suit.

All these principles, methods, and rules of the common-law and the equity procedure were incorporated into the jurisprudence of the U. S., and although they have been modified in many of the commonwealths, in others they are retained substantially as they existed at the time when Blackstone wrote his *Commentaries*.

The Codes.—A revolution has finally been effected in the U. S. and in England in every respect identical with that which took place in the Roman law when the prætor's ex-

traordinary jurisdiction was extended to all kinds and classes of litigations. In 1848 the Legislature of New York adopted a code of civil procedure—chiefly planned and created by David Dudley Field—which entirely abandoned all former existing methods, and inaugurated a new system for the enforcement of rights and the recovery of remedies. Its central principle is the abolition of all distinction between actions at law and suits in equity, and of all forms of action, and the establishment of a single judicial instrument called the "civil action," by which all rights are maintained, duties enforced, and reliefs obtained. Legal and equitable claims, defenses, and remedies may be combined, and the single judgment of the court may determine and establish the final sum of all the rights and interests belonging to the litigant parties. With the common-law forms of action the common-law forms of pleading are also abandoned, and in their stead is substituted one simple and natural mode which only requires the parties to state in ordinary language the actual facts which constitute their causes of action or defenses. The system has been accepted—sometimes with unimportant modifications, but often without any change from the original type—in most of the States and Territories, and may be styled the "reformed American procedure." Passing beyond the limits of the U. S., it prevails in several of the British colonies, and has been adopted in all its essential principles in England itself. The first step in England was made by the Common Law Procedure Act of 1854, but it was not fully adopted until, by the Judicature Acts of 1873 and 1875, all law and equity courts were consolidated into one tribunal, and all distinctions abolished between legal and equitable forms of actions and procedure. The history of procedure does not present another so remarkable instance of legislation. See Bigelow's *History of Procedure in England*; Stephen's *History of the Criminal Law of England*, and the general treatises on pleading and practice. Revised by F. STURGES ALLEN.

Procellar'idæ [Mod. Lat., named from *Procella'ria*, the typical genus, from Lat. *procel'la*, storm]: a family of birds of the order *Tubinares*, including the petrels and albatrosses. These have a gull-like body; the neck rather short; the bill moderate, and composed of several pieces, and in some species, if not in all, the bill is shed and renewed as well as the plumage; the nostrils at the end of tubular processes, which are more or less immersed in grooves; the wings are generally elongated and pointed, rarely (as in *Pelecanoides*) short; front toes connected by a web, posterior rudimentary or wanting; the skull is schizognathous, and in most respects agrees with that of the gulls and loons, but exhibits some distinctive characters, and has been regarded by Streets as indicating a peculiar superfamily (*Nectriomorphæ*). The family is generally divided into three subfamilies: (1) *Procellarinæ*, including most of the small species; (2) *Diomedeinæ*, comprising the albatrosses; and (3) *Pelecanoidinæ*, represented by the single aberrant genus *Pelecanoides*. See ALBATROSS, FULMAR, MOTHER CAREY'S CHICKEN, and PETREL. Revised by F. A. LUCAS.

Process [viâ O. Fr. from Lat. *proces'sus*, a going forward, advance, progress, process, deriv. of *proce'dere*, go forward; *pro*, forward + *ce'dere*, go]: in law, a generic term primarily used to designate all the means by which a defendant is compelled to appear and answer to an action brought against him (*original process*), the means of enforcing the judgment recovered therein against him, and also the means by which his property is secured or taken in satisfaction of such judgment (*final process*); and also various other judicial writs or orders issued pending the suit or action upon collateral or interlocutory matter, as to summon witnesses, juries, etc. (*mesne process*). In the criminal procedure it denotes the warrants or other writings authorizing and directing the arrest of persons charged with offenses. In a more general sense it embraces all judicial writs commanding public officers or private individuals to do a specified act; and, finally, it is used, although not technically, as synonymous with "proceeding." Actions at law were formerly begun in England by a process called the "original writ," which was issued in the king's name, contained a statement of the complaint, and was addressed to the sheriff, commanding him to summon the defendant. This writ was practically abolished in the reign of William IV., when it was enacted that all personal actions should be commenced by the writ of CAPIAS (*q. v.*), directing the sheriff to arrest the defendant; or if he was not to be arrested by the writ of SUMMONS (*q. v.*), directing the defendant to appear. The corresponding process in chancery suits was the "writ of subpœna," while that in the ecclesiastical and admiralty courts was termed a "citation"; both were, like the summons, personal orders to the defendant. At present all actions are commenced in England by a process in the nature of a summons. In the U. S., wherever the reformed procedure has been adopted, all actions in the superior courts are begun by a summons or notice to the defendant directing him to appear and answer within a specified number of days; in several of the States it is issued directly by the plaintiff or his attorney, in others by the clerk of the court in which the suit is brought. In those commonwealths which retain the common-law methods different forms of preliminary process are used, but, under whatever names, they are generally analogous to the writ of summons. A peculiar local practice prevails, however, in New England, of beginning legal actions by attaching the defendant's property. (See ATTACHMENT.) Final process is of two kinds —that against the property and that against the person. Final process is now commonly called EXECUTION (*q. v.*). In addition to these preliminary and final steps, there may be, under certain circumstances and in a special class of actions, intermediate (*mesne*) proceedings in the nature of process against the defendant—namely, an order or warrant of arrest, by virtue of which he is taken and held to bail or detained, and a warrant or order of attachment, by virtue of which his property is seized and held to wait the final judgment. Revised by F. STURGES ALLEN.

Procession of the Holy Spirit [*procession* is from Lat. *proces'sio*, deriv. of *proce'dere*, *proces'sum*, go forth; *pro*, forward, forth + *ce'dere*, go]: a term based on John xv. 26, where Christ says of the Spirit whom he will send from the Father that "he *proceedeth* from the Father" (*παρὰ τοῦ πατρὸς ἐκπορεύεται*, hence *ἐκπόρευσις*, *processio*). It designates in the orthodox theology the characteristic individuality (*ἰδιότης*, *proprietas*, *character hypostaticus*) of the third Person of the Holy Trinity, as the eternal generation (*γεννησία*, *generatio*) is the characteristic property of the Son, and the unbegotten paternity (*ἀγεννησία*, *paternitas*) the exclusive peculiarity of the Father. There is an old difference between the Greek and Latin Churches about the *single* procession (from the Father *alone*) and the *double* procession (from the Father *and the Son*). The Nicene Creed as enlarged at Constantinople (381) asserts only the procession from the Father (*Sp. S. qui ex Patre procedit*), in verbal adherence to the passage in John, and the Greek Church understands this in an exclusive sense (from the Father *alone*). The Latin Church, after Augustine, taught the double procession, and afterward embodied it, without asking the consent of the Greeks, in the Nicene Creed by the insertion of *filioque* ("and from the Son"). This famous clause first appeared in 589, at a synod of Toledo in Spain (in strong opposition to Arianism), and in spite of the protest of Pope Leo III. (809) it was gradually adopted in the Latin Church, from which it passed into the Protestant churches. This difference has caused a great deal of bitter controversy since the days of Photius, Patriarch of Constantinople (d. 891). The councils of Lyons (1274) and of Florence (1439) endeavored to settle it, but in vain. The Greek divines plead in favor of the single procession the letter of the Scripture, the original text of the Nicene Creed, and the dignity or monarchy (*μοναρχία*) of the Father as the sole fountain, cause, and root of the Deity; they also make a sharp distinction between the eternal metaphysical *procession* of the Spirit from the Father alone, and the historical *mission* of the Spirit from the Father and from the Son (John xiv. 26; xvi. 7). The former belongs to the Trinity of essence, the latter to the Trinity of revelation, and begins with the day of Pentecost. The Latin divines infer the double procession (taking this term in a wider sense) from the double mission and from the essential unity (or *homoousia*) of the Son with the Father, so that if the Spirit proceeds from the essence of the Father he must proceed also from the essence of the Son, both being the same. A compromise was suggested by the formula that the Spirit proceeds from the Father *through the Son* (*διὰ τοῦ υἱοῦ*). When Pius IX. invited the Eastern patriarchs to the Vatican Council in 1870, they renewed the old protest against the heretical *Filioque*. The Döllinger Union Conference between Old Catholics, Orientals, and Anglo-Catholics discussed this controversy at Bonn in Aug., 1875, and came to an agreement which surrenders the *Filioque* as an unauthorized interpolation to the Creed, and indorses the single procession of

the Spirit from the Father alone, but through the Son, as taught by John of Damascus, the last of the Greek Fathers. See Holy Ghost. Philip Schaff.

Procida, prō'chĕĕ-dăă (anc. *Prochyta*): island; in the province of Naples, Italy, lying between Ischia and Cape Miseno. It is not more than 8½ miles in circumference, and is composed of volcanic tufa; the town of Procida, on the east side, stands on a high and rugged rock which is almost surrounded by water. The principal edifice, besides the churches, is the royal palace of the Bourbons, who frequently came here for health or amusement. Procida was originally a Greek settlement, and in spite of the long Roman domination, of the devastations of the Saracens, of Spanish and British occupations, the inhabitants still claim to be of Greek descent. They are occupied in agriculture, in tunny-fishing, and in the search for coral. Pop. 13,131.

Proclamation of Emancipation: See Emancipation, Proclamation of.

Pro'clus: philosopher; b. at Byzantium, Feb. 8, 412 A. D.; educated at Xanthus in Lycia, from which his family descended; studied at Alexandria and Athens, and became a celebrated teacher in the latter city, where he died Apr. 17, 485. He was the last member of the Neoplatonic school who acquired any celebrity. He labored hard to make converts from Christianity. There is no complete edition of his works which are still extant. That by Cousin (6 vols., Paris, 1820–27) contains the treatises on *Providence and Fate*, the *Ten Doubts about Providence*, the *Nature of Evil*, and the commentaries on the *Alcibiades* and *Parmenides*. There are translations in English by Thomas Taylor of the *Commentaries on the Timæus*, the *Theology of Plato*, the *Commentary on Euclid*, and of *Five Hymns* (London, 1816).

Proc'ne: See Philomele.

Proconsul [= Lat.; *pro*, for + *consul*]: a magistrate in the ancient Roman government who exercised consular authority over a province or an army, but not over Rome. In many cases he was a consul, who after the expiration of his term of service was sent to control a province, but sometimes the proconsul was not even of consular rank.

Proco'pius: author; b. at Cæsarea, Palestine, in the beginning of the sixth century A. D.: studied at Constantinople; accompanied Belisarius as his secretary on his campaigns in Asia, Africa, and Italy, and held after his return to Constantinople the highest dignities in the civil service of the Byzantine government. His extant works include *Historiæ*, a representation of the history of his own time, clear, trustworthy, and interesting, translated into English by Henry Holcroft (London, 1653); *Ktismata*, a work on the public buildings erected during the reign of Justinian; and *Anecdota*, translated into English under the title of *The Secret History of the Court of the Emperor Justinian* (1674). The Procopian authorship of the *Anecdota* has been questioned, but recent investigation seems to be decidedly in favor of the genuineness of the work. See Krumbacher, *Geschichte der byzantinischen Litteratur*, p. 43; Teuffel, *Studien und Charakteristiken*, p. 267. A complete edition of his works was published by W. Dindorf (3 vols., Bonn, 1833–38). Revised by B. L. Gildersleeve.

Procopius the Great: soldier; b. about 1380; was ordained a priest, but on the outbreak of the Hussite war he joined the army and distinguished himself so greatly that after Ziska's death in 1424 he was chosen commander-in-chief by the Taborites. On the approach of the German armies of crusaders the different Hussite parties, among which were the Orphans under Procopius the Less, united under the leadership of Procopius the Great, and a war ensued (1527–32), remarkable at once for the valor and cruelty which the Hussites evinced. They made successful campaigns in Saxony, Silesia, Moravia, Hungary, Austria, and Bavaria. In 1433 the Hussites consented to send eight delegates to the Council of Basel. Procopius was one of them, and he took part with great energy in the debate, but after the lapse of fifty days the Bohemian delegates grew tired and returned to Prague. Papal commissioners followed them, and at last a compromise was brought about between the Roman Catholics and the Calixtines. The Taborites, however, refused to have anything to do with the pope, and thus arose a controversy between them and the Calixtines which soon grew into open warfare. At the battle of Bömischbrod (May 30, 1434) a sudden panic seized the Taborite army; it was utterly defeated, and both Procopius the Great and Procopius the Less fell.

Procrus'tes [in Gr. Προκρούστης, the stretcher]: a surname commonly given to the famous robber Polypemon or Damastes, who used to place all persons that fell into his hands on an iron bed, and cut off or stretch out their limbs until they fitted the bed. He was slain by Theseus near the Cephissus in Attica.

Procter, Bryan Waller: poet; familiarly known under his pseudonym of *Barry Cornwall*; b. in London Nov. 21, 1787; educated at Harrow; studied law in Wiltshire; removed to London, where he was admitted to the bar in 1831, but did not attain prominence as a counsel. The lucrative position of commissioner of lunacy, however, which he held for many years, supplied the means as well as sufficient leisure for the culture of his literary and poetic tastes. In 1819 he published a volume entitled *Dramatic Scenes and Other Poems*, which was the beginning of his literary career. In 1821 his tragedy of *Mirandola* was produced at the Covent Garden theater with much success. It is as a writer of refined, melodious, and inspiring songs that he is best remembered and esteemed. D. Oct. 5, 1874. His *Poetical Works* have had wide circulation in Great Britain and the U. S.—His daughter, Adelaide Anne Procter, b. in London Oct. 30, 1825, wrote two volumes of verse, *Legends and Lyrics* (1858 and 1860). D. Feb. 2, 1864. Her works were reissued in 1865 with an introduction by Charles Dickens.
Revised by H. A. Beers.

Proctor [M. Eng. *proketour*, viâ O. Fr. from Lat. *procura'tor*, manager, agent, deriv. of *procura're*, take care of, manage; *pro*, for + *cura're*, to care, deriv. of *cura*, care]: in law, an officer of the admiralty and ecclesiastical courts in England, empowered to bring and conduct proceedings therein on behalf of suitors, corresponding to the attorney and the solicitor of the ordinary tribunals. From an early day a body of men were attached to these ecclesiastical and admiralty courts who had the exclusive authority to appear therein, and to bring or defend all causes in the same manner that actions at law and suits in equity are brought and managed by attorneys and solicitors. Admission to the body was obtained, after a long clerkship, by means of a commission issued in the name of the Archbishop of Canterbury. The class of professional men who actually tried or argued the causes, or performed other duties, before the court itself —whose functions, in other words, were similar to those of the barristers or counsel—were termed "advocates." The title of proctor is still used, but the distinction between proctors and the other members of the legal profession has been abolished. The jurisdiction of the ecclesiastical courts in matrimonial and testamentary causes having been taken away (see Courts), compensation to the proctors, whose practice was in these courts, was made by admitting them to practice not only in the probate and divorce courts, but in the courts of equity and common law also. (See 20 and 21 Vict., c. 77, §§ 43, 105, 106, and c. 85, § 69; 21 and 22 Vict., c. 95, § 9, and c. 108, § 13; also 23 and 24 Vict., c. 27.) By the Solicitors' Act of 1877 (40 and 41 Vict., c. 25, § 17) solicitors are allowed to practice as proctors, and the Legal Practitioners' Act of 1876 (39 and 40 Vict., c. 66) allows solicitors to appear in the provincial courts of Canterbury and York.

There are no proctors, as a separate order or class, in the legal profession of the U. S., although the designation is often assumed by attorneys in admiralty cases, or when practicing before surrogates or courts of probate.

"Proctors of the clergy" in the English ecclesiastical law are the delegates or representatives of cathedral and other collegiate churches, and also of the common clergy in every diocese, appointed to sit in the convocation of the Church, that is, the assembly of the clergy held during the session of parliament, but which has long since ceased to exercise any legislative powers. Revised by F. Sturges Allen.

Proctor, Redfield: U. S. Senator; b. at Proctorsville, Vt., in 1831; graduated at Dartmouth College in 1851; studied at the Albany Law School; when the civil war broke out was practicing law. He enlisted in 1861 in the Third Vermont Regiment; became major of the Fifth, and afterward colonel of the Fifteenth Vermont, but returned home, after the battle of Gettysburg, in broken health; served in Vermont Senate and as Lieutenant-Governor; was Governor 1878–80; chairman of the Vermont delegation in the Republican National Convention of 1888, and became Secretary of War in 1889; resigned in 1891 and was appointed U. S. Senator to fill the vacancy caused by the resignation of Senator Edmunds, and in 1893 and 1899 was elected.

Proctor, Richard Anthony: writer on astronomy; b. in London, England, Mar. 23, 1837; entered King's College, London, in 1855, and St. John's College, Cambridge, in 1857, and graduated in 1860. His first literary effort was an article on *Double Stars* in *The Cornhill Magazine* for Dec., 1863. In 1865 he published his first book, *Saturn and its System*, which was soon followed by his *Gnomonic Star Atlas*, and in 1866 by his *Handbook of the Stars*. In 1867 he published *Constellation Seasons*; in 1868, *Half Hours with the Telescope*: in 1869, *Half Hours with the Stars*; in 1870, his most celebrated work, *Other Worlds than Ours, The Plurality of Worlds Studied under the Light of Recent Scientific Researches*; in 1871, *The Sun, Elementary Lessons in Astronomy*, and the first series of *Light Science for Leisure Hours*; in 1872, *The School Atlas of Astronomy, Essays on Astronomy, Orbs around Us*, and *Elementary Lessons on Physical Geography*; in 1873, *Light and Science, The Moon, The Border-land of Science, The Expanse of Heaven, The Universe and the Coming Transits*; in 1874, *Transits of Venus* (3d ed. 1878); in 1878, *A Treatise on the Cycloid and all Forms of Cycloid Curves, and on the Use of Cycloid Curves in dealing with the Motions of Planets, Comets, etc., and of Matter projected from the Sun*; in 1887, *Easy Lessons in Differential Calculus*; in 1888–90, *Old and New Astronomy*. In 1881 he founded the science periodical *Knowledge*. He several times visited the U. S., and lectured in the larger cities. He also lectured in Australasia. D. in New York, Sept. 12, 1888. Revised by S. Newcomb.

Procura'tor: the designation of a Roman administrative officer, charged with the management of the revenues and business affairs of a province. Although not of military rank troops were assigned to him for the administration of his office, and he was recognized as second in authority to the governor. He might therefore, in the absence of his superior, or during temporary vacancy of the governorship, assume entire charge of a province, or he might be put at the head of a whole district in a province too large to be governed by one person. G. L. Hendrickson.

Procyon'idæ [Mod. Lat., deriv. of *Procyon*, the typical genus; Lat. *Procyon* = Gr. προκύων, a constellation rising before the Dog Star, πρό, before + κύων, dog. The word has been, however, falsely used here, as if signifying "instead of or like a dog"]: a family of carnivorous mammals represented by the raccoons and the coatis. The teeth are in number 40 (M. $\frac{2}{2}$, P. M. $\frac{4}{4}$, C. $\frac{1}{1}$, I. $\frac{3}{3} \times 2$); the last molar of the upper jaw is more or less transverse and compressed forward; of the two molars in the lower jaw, the first is broadest; the last premolar of the upper jaw and the first molar of the lower are tubercular. The snout is more or less slender; the feet elongated, and with separated digits capable of grasping in a hand-like manner. The family includes two sub-families: (1) *Procyoninæ*, with the genus *Procyon*, or the raccoons, and (2) *Nasuinæ*, with the genus *Nasua*, or the coatis. They are peculiar to America, and naturally to the warmer regions, although a species of raccoon ascends far to the northward in the U. S. See Coati and Raccoon.
Revised by F. A. Lucas.

Profert: See Oyer.

Profit à Prendre: See Hereditaments.

Profits [Fr., from Lat. *proficio, profectus*, to progress]: an excess of earnings above expenses. In order to ascertain the real profit of an enterprise, we must take care to count *depreciation* of capital as an expense. Thus if the gross earnings of a business are $10,000 a year, and the current expenses $6,000, the apparent profit is $4,000, but if the invested capital is worth $1,000 less at the end of the year than it was at the beginning, the real profit is only $3,000. It is a disputed question whether taxes should be deducted from earnings before estimating profits. There is another and narrower sense of the word under which interest is deducted before estimating profits. Thus, in the case supposed, if the capital invested is $20,000 and the current rate of interest 5 per cent., there is an interest account, actual or nominal, of $1,000 a year, and the net profit on this basis of reckoning is only $2,000 instead of $3,000. Profits in this sense represent the earnings of management as distinct from those of capital, and will vary according to the business ability of the man in control. It is hard to make an accurate distinction between profits and rent. In general, the former term is applied to income from personal property and the latter to income from real estate. See Political Economy and Hereditaments (*Incorporeal*).
A. T. Hadley.

Profit-sharing: the name generally given to a modification of the wages system under which a share in the realized profits of the year's business is given to the employee, in addition to his wages already received. This bonus may be definitely determined at the beginning of the year, as when a firm promises to give 10 per cent. of its net profits to its men, or the percentage may be left to be determined at the end of the twelve months. The essential features of any such scheme are that the firm shall make known its intention at the beginning of the period, and that the sum allotted to each employee, usually on the basis of his wages, shall not be trifling. The principle of the admission of the workmen to this species of partnership (strictly limited, according to the wishes of the employer, who, in fact, has the whole matter in his own hands) is the application to modern conditions of the product-sharing common in agriculture and the fisheries. Its advocates claim for it that it tends to advance "the prosperity of an establishment by increasing the quantity of the product, by improving its quality, by promoting care of implements and economy of materials, and by diminishing labor difficulties and the cost of superintendence." In a very large majority of cases where the system has been thoroughly applied and time given for its educating effects, one or more of these results have followed, with no diminution of the employer's average profits.

In comparison with plans of co-operative production proper, profit-sharing, often styled "industrial partnership" in England, has had a much larger percentage of success in practice, as well as the general indorsement of the economists from Mill and Fawcett to Marshall and Walker. It is obviously most applicable to occupations such as handicrafts, where the extra interest naturally awakened in the workmen by the prospect of a bonus can produce an immediate and visible effect, and less adapted to manufactures where labor bears a lower proportion to the cost of material and plant. Nevertheless, some of the most prosperous trials of profit-sharing have been made in cotton and woolen mills in France and the U. S. "The father of profit-sharing" was the well-known Edme Jean Leclaire, the Parisian house-painter and decorator, whom J. S. Mill first brought to the notice of English readers. He introduced the system in 1842, and the celebrated Maison Leclaire has since been the standard example of "participation"; in the years 1870–86 the number of its employees varied from 710 to 1,129, and the ratio of bonus to wages from 12 to 24 per cent. The Laroche-Joubert paper-works at Angoulême, the noted Bon Marché, and the Maison Chaix, a very large printing-house at Paris, are other prominent instances of long and successful application of the principle of profit-sharing in France. That country counts over 100 establishments successfully conducted on this system. In England the abandonment of the Briggs Colliery Industrial Partnership in 1875 caused a cessation of effort in this direction for several years, but there has since been a notable revival of interest and faith in the plan, and there are (1894) over 100 instances of British profit-sharing firms. In the U. S. fully 100 business houses in a great variety of occupations practice the system.

Profit-sharing is not put forth by its wiser advocates as a panacea for industrial troubles, but as a modification of the wages system, applicable in many quarters with good results to both parties to the labor contract. The details of its application to any special occupation require care, but it is based on human nature and the wages system as they are; and the larger part of the failures in practice have been due to insufficient preparation and haste for results.

There are two societies devoted to the extension of profit-sharing. The French society, the head of which is Charles Robert, is composed entirely of men of business who practice the system; the American association has for its president the U. S. commissioner of labor. Both societies issue quarterly periodicals devoted to the cause.

The standard work on the subject in English is *Profit Sharing between Employer and Employee*, by N. P. Gilman (Boston, 1889; 3d ed. 1891; translated and adapted into German by L. Katscher). Later information may be found in two chapters of another work by the same writer, *Socialism and the American Spirit* (Boston, 1892). See also the *Report* to the Board of Trade by D. F. Schloss (London, 1894) and his *Methods of Industrial Remuneration* (London, 1892).
Nicholas P. Gilman.

Prognathism [from Gr. πρό, before + γνάθος, jaw]: the condition of having projecting jaws or a large craniofacial angle, as in Negroes. See Face.

Progression [from Lat. *progres'sio*, a going forward, progress, progression, deriv. of *pro'gredi*, go forward; *pro*, forward + *gra'di*, step, go]: in mathematics, a series in which each term is derived from the preceding by a uniform law.

An *arithmetical progression* is a series in which each term is formed from the preceding one by the addition of a constant quantity called the *common difference*. If the common difference is *positive*, each term is greater than the preceding one, and the progression is said to be *increasing*; if the common difference is *negative*, each term is less than the preceding one, and the progression is said to be *decreasing*. From these definitions we see that every increasing progression when taken in a reverse order becomes a decreasing progression, and that every decreasing progression when taken in a reverse order becomes an increasing progression. An arithmetical progression is said to be *given* when we know one term and the common difference: thus if one term is 9 and the common difference 5, we have, by the continued addition of 5, the series 9, 14, 19, 24, etc.; in like manner, by the continued subtraction of 5, we have the series 9, 4, − 1, − 6, etc. These two series written in proper order form a single progression, as follows:

$$\ldots, -6, -1, 4, 9, 14, 19, 24, \ldots$$

If the series has a beginning and end it is called limited; otherwise it is infinite or *unlimited*. Any term of a limited arithmetical progression, whether increasing or decreasing, is equal to the first term plus the product of the common difference by the number of terms that precede the term in question. The sum of all the terms of such a progression is equal to half the sum of its extremes multiplied by the number of terms.

A *geometrical progression* is a series in which each term is equal to the preceding term multiplied by a constant quantity called the *ratio of the progression*. If the ratio is *positive* and greater than 1, each term is greater than the preceding one, and the progression is said to be *increasing*; if the ratio is *positive* and less than 1, each term is less than the preceding one, and the progression is said to be *decreasing*; if the ratio is negative, the terms of the progression are alternately positive and negative. In all cases if two consecutive terms are given, we can find the ratio by dividing the second by the first. The following series, extending to an infinite number of terms in both directions, is an example of a geometrical progression:

$$\ldots, \frac{1}{4}, \frac{1}{2}, 1, 2, 4, 8, 16, \ldots$$

In this progression the ratio is 2, and this being given, together with any term of the series, the progression may be extended to any desired limit. If we consider a finite number of terms as constituting a limited geometrical progression, the nth term of the series, n being any positive whole number, is equal to the first term multiplied by the $(n-1)$th power of the ratio; the sum of all the terms is equal to $\frac{lr-a}{r-1}$, in which l is the last term, a the first term, and r the ratio.

An *harmonical progression* is a series such that of any three consecutive terms the first is to the third as the difference between the first and second is to the difference between the second and third. The reciprocals of the terms of an arithmetical progression form an harmonical progression; thus from the arithmetical progression, 2, 4, 6, 8, etc., we form the harmonical progression—

$$\ldots, \frac{1}{2}, \frac{1}{4}, \frac{1}{6}, \frac{1}{8}, \ldots$$

Taking the first three terms, we see that

$$\frac{1}{2} : \frac{1}{6} :: \frac{1}{2} - \frac{1}{4} : \frac{1}{4} - \frac{1}{6}, \text{ or } \frac{1}{2} : \frac{1}{6} :: \frac{1}{4} : \frac{1}{12}.$$

Revised by S. Newcomb.

Prohibition: the suppression, by law, of the manufacture, importation, and sale, for beverage purposes, of all alcoholic liquors.

Principles.—The advocates of prohibition base their demands on the following facts: (1) Scientific. Science has demonstrated that alcohol is a deadly poison, not a food, and neither necessary nor beneficial, but positively injurious, to healthy persons. Its sale for beverage purposes should therefore be entirely prohibited, and for other purposes should be regulated by the strict laws governing the sale of other poisons, such as strychnine, arsenic, opium, etc. (2) Social. Alcoholic liquors affect not only the drinker, but transmit to his descendants the seeds of epilepsy, insanity, and the worst diseases that afflict mankind. The use of alcoholic liquors breaks down moral restraints, excites the basest passions, and instigates to crimes through which the innocent are sufferers. The effect is not only to destroy social order, disrupt families, and ruin the home life, but to deteriorate the race and mortgage future generations. (3) Economic. The raw material consumed, the labor performed, and the money spent in the manufacture and purchase of alcoholic liquor as a beverage constitute a waste of wealth. Furthermore, the public expense incurred in caring for the pauper, insane, diseased, and criminal products of the alcoholic habit comprises a very large part of the government expenditure, and is an unnecessary and unjust public burden. (4) Political. The deterioration and degradation of the citizen is a national injury, and the organized liquor-trade has become an active and damaging factor in government, defying legal restraint, thwarting justice, dominating politics, and corrupting elections and officials.

Legality.—Legally, the prohibitive principle is the basis of all restrictive legislation: but liquor license falls short of the logical procedure just to the extent that partial permission falls short of absolute prohibition. The constitutionality of liquor license is denied by many able jurists, but the constitutionality of prohibition has been established by the highest courts of the U. S. and Great Britain. "There is no inherent right in a citizen to sell intoxicating liquors by retail; it is not a privilege of a citizen of a State, nor of a citizen of the United States." (137 U. S. 86.) "No Legislature can bargain away the public health or the public morals; the people themselves can not do it, much less their servants." (101 U. S. 816, reaffirmed in decision in Kansas cases.) "We can not shut out of view . . . the fact, established by statistics accessible to every one, that the idleness, disorder, pauperism, and crime existing in this country, in some degree at least, are traceable to the evil. . . . That legislation by a State prohibiting the manufacture within her limits of intoxicating liquors, to be sold or bartered for general use as a beverage, does not necessarily infringe any right, privilege, or immunity secured by the Constitution of the United States, is made clear by the decisions of this court rendered before and after the adoption of the Fourteenth Amendment." (123 U. S. 623.) The court has declared in fact that the constitutionality of prohibition is no longer an open question.

The Prohibition Movement.—The agitation for prohibition began with the republic. The first Colonial Congress in 1774 passed the following: "*Resolved*, That it be recommended to the several legislatures of the united colonies immediately to pass laws the more effectually to put a stop to the pernicious practice of distilling, by which the most extensive evils are likely to be derived if not quickly prevented." From 1829 the movement was pushed, and some local prohibition laws were enacted, but between 1850 and 1860 a number of State laws were secured, beginning with the "Maine law," enacted in 1851.

The civil war (1861–65) interfered with the movement, and gave the liquor-trade an opportunity to organize a powerful financial and political opposition which secured the repeal of prohibition in many States. With the woman's crusade, 1873–74, and the organization of its successor the Women's Christian Temperance Union, 1874–75, the agitation took on a wider and more systematic sweep, and not satisfied with evanescent and perfunctorily enforced statutory prohibition, constitutional amendments were demanded, and since the year 1881 the States of Kansas, Maine, Rhode Island, North Dakota, and South Dakota have adopted constitutional prohibition, though Rhode Island within two years rescinded her action. Many cities, towns, and counties in all parts of the U. S. are under prohibition by virtue of local laws.

The prohibition movement is worldwide, is spreading rapidly into Australasia, and gaining adherents in Europe and the East. It has a strong press and platform propaganda, and many organizations are committed to prohibition, among them the Women's Christian Temperance Union, the British Women's Temperance Association, the Good Templars, Sons of Temperance, United Kingdom Alliance, Prohibition party, etc. The evangelical churches generally in English-speaking countries have declared themselves in sympathy with the prohibition cause, and most of the leaders of the movement are members of religious bodies.

Frances E. Willard.

PROJECTILES.

Prohibition Party: a political party organized in the U. S., pledged to the election of officers committed to certain political reforms, among which prohibition of the alcoholic drink traffic is an essential element.

Soon after the adoption of prohibition laws in many States it became apparent to some that such laws were in danger of non-enforcement by the officers of the law. As early as 1857 the Independent Order of Good Templars, an organization committed to prohibition, declared it to be one of its cardinal purposes to secure the election of good, honorable men to administer the laws. During the civil war in the U. S. the liquor-trade organized for the expressed purpose of preventing the enforcement and securing the repeal of existing prohibition laws, and preventing further prohibitory legislation. In 1867 the seventh beer-brewers' congress declared that they would "sustain no candidate, of whatever party, in any election, who is in any way disposed toward the total abstinence cause." This was more than two years before the Prohibition party was organized.

During the session of the Right Worthy Grand Lodge of the Independent Order of Good Templars at Oswego, N. Y., May 27, 1869, a meeting of those favoring independent political party action was held, and a committee named to issue a call for a national convention for the purpose of organizing a National Prohibition party. Pursuant to this call nearly 500 delegates from twenty States met in Farwell Hall, Chicago, Sept. 1, 1869, adopted a platform, and assumed the name of the National Prohibition party.

The first national nominating convention of the party was held in Columbus, O., Feb. 22, 1872. The platform adopted strongly arraigned the liquor-traffic and the complicity of the Republican and Democratic parties therewith, and declared for entire prohibition. There were also emphatic declarations on the questions of public service, finance, interstate commerce, tariff, labor, education, immigration, and favoring equal suffrage for women. Hon. James Black was nominated for President, and Rev. John Russell for Vice-President. Electoral tickets were nominated in only six States, and received 5,607 votes. The second national nominating convention was held in Cleveland, O., May 17, 1876. Hon. Green Clay Smith, of Kentucky, was nominated for President, and Hon. Gideon T. Stewart, of Ohio, for Vice-President, and at the ensuing election they received 9,737 votes in eighteen States. At the third national convention, held in Cleveland, June 17, 1880, Hon. Neal Dow, of Maine, and Rev. H. A. Thompson, of Ohio, were nominated for President and Vice-President, respectively, and received 10,366 votes in eighteen States.

Since 1882, when a convention was held in Farwell Hall, Chicago, and a reorganization effected, the National Prohibition party has been actively engaged in the work of organizing. The national committee, of which Hon. Gideon T. Stewart was chairman and Rev. A. J. Jutkins secretary, issued an open call for a national convention, which met in Pittsburg, July 23, 1884. There were present 465 delegates from thirty-one States and Territories. A platform of political principles, advocating prohibition, equal suffrage, and reforms in finance, tariff, civil service, etc., was adopted, and Hon. John P. St. John, of Kansas, to whom, as Governor of that State, was largely due the adoption of State constitutional prohibition, was nominated for President, and Hon. William Daniel, of Maryland, for Vice-President. Hon. John B. Finch, of Nebraska, head of the Order of Good Templars, was made chairman of the national committee, and a vigorous organizing campaign was conducted. At the presidential election in 1888 the National Prohibition party ticket received 150,626 votes in thirty-four States. Immediately after the election the national committee issued an address which was widely circulated.

The party work was strengthened by a national lecture bureau, organized by W. Jennings Demorest and Horace Waters, of New York. The convention of 1888 was held in Indianapolis, and Hon. Clinton B. Fisk, of New Jersey, and Rev. John A. Brooks, of Missouri, were nominated for President and Vice-President, respectively. They received 249,945 votes. In 1892 the national convention was held in Cincinnati, June 30, and Gen. John Bidwell, of California, and Rev. James B. Cranfill, of Texas, were nominated. The vote cast for them at the ensuing election was 270,813. The National Prohibition party is (1894) organized in every State, nominates tickets at all elections, has elected members of the Legislature in a number of States, has several good newspaper organs, and is indorsed by many temperance organizations, notably by the Women's Christian Temperance Union. Its chairman is Prof. Samuel Dickie, of Michigan, and its leading journal *The Voice*, published weekly in New York.

FRANCES E. WILLARD.

Projectiles [from Lat. *proji'cere* (*proi'cere*), *projec'tum*, hurl forth or forward; *pro*, forth, forward + *ja'cere*, throw, hurl]: bodies projected forward by a force. Generally speaking, they are missiles to be used in warfare, and to be fired from a gun by means of an explosive substance. They are divided into two classes—spherical and oblong. The former are used in smooth-bore guns, and are obsolete; oblong projectiles are used in rifled guns. In each class are found three varieties—solid shot, shell, and case-shot. Other varieties, now also obsolete, were formerly used in smooth-bore guns. These were: *Chain-shot*, two projectiles connected by a short chain; *bar-shot*, two projectiles connected by a bar; *carcass*, a shell filled with an inflammable composition used for incendiary purposes; *light ball*, a combustible shell used to illuminate an enemy's works. A *hand-grenade* is a shell intended to be thrown by hand at an assaulting party.

FIG. 1.—Stand of grape.

Spherical projectiles were the first projectiles used, and were made of stone, lead, wrought and cast iron. *Solid spherical shot* was used against masonry and armored vessels. A *shell* is a hollow projectile containing a bursting charge which at some point of its flight is ignited by means of a fuze. Its effect is therefore not as local as is that of a solid shot. A shell is used against earthworks, unarmored vessels, and against such armor as it can penetrate. *Case-shot* is used against animate objects on account of the greater number of fragments resulting from the separation of its cluster. Case-shot comprise grape-shot, canister, and shrapnel. *Grape-shot* (Fig. 1) consists usually of nine spherical shot arranged in three tiers of three balls each, all being held together by two rings and a top and bottom plate connected by a central bolt. *Canister* (Fig. 2) consists of a number of small balls inclosed in a tin or malleable iron case. The shock of discharge of the piece causes grape-shot and canister to break up at the muzzle of the piece; they are used for firing at short ranges. *Shrapnel* consists of an envelope containing a number of small balls and a bursting charge, which, by means of a fuze, is exploded at any desired distance from the muzzle of the gun. During the U. S. civil war a form of shrapnel known as *spherical case-shot* was used. It consisted of a shell (Fig. 3) filled with lead balls, between the interstices of which was poured a matrix of melted rosin or sulphur; when the matrix had hardened a cylindrical hole was bored through the center to hold the bursting charge. To the side of the shot diametrically opposite the fuze-hole was strapped a wooden sabot. This sabot is used with all spherical fuzed shot to keep the fuze away from the powder charge.

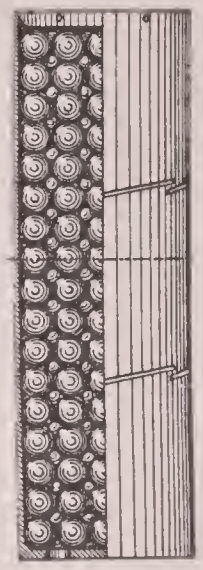


FIG. 2.—Sawyer canister.

Oblong projectiles possess many advantages over spherical projectiles, among which may be mentioned greater ranges for equal muzzle velocities, greater penetrations for equal striking velocities, capacity for a given caliber, and greater accuracy. In order to cause an oblong projectile to travel with its longest axis in the direction of its motion it is necessary to impart to the projectile a motion of rotation about its longest axis sufficient to overcome the tendency of the projectile to revolve about its shortest axis, or, technically speaking, to "tumble." Many attempts have been made to fire oblong projectiles from smooth-bore guns by means of wings or spiral channels intended to give rotation to the projectiles, but none of the attempts have proved successful. The use of oblong projectiles is therefore confined to rifled guns. In order to cause an oblong projectile to take the rifling it must be fitted with a rotating device, which differs for muzzle-loading and breech-loading guns.

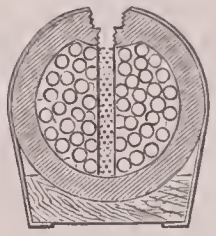


FIG. 3.—Spherical case-shot.

Muzzle-loading projectiles may be caused to rotate in two ways—by the use of studs, and by the use of some device which the pressure of the powder gas expands into the rifling. In the studded system the studs are pressed into under-cut holes on the projectile. These studs fit in the rifle grooves in the gun, and cause the projectile to rotate as it moves down the bore (Fig. 4). The Butler projectile is one of the best examples of the expansive system. The rotating device (Fig. 5) consists of a brass or copper ring screwed or cast on the projectile. The ring is divided by a deep, annular groove into an outer and inner flange or lip. On firing, the powder gas enters this groove, presses the inner lip against the projectile, thereby assisting to prevent the stripping of the ring, and forces the outer lip into the rifling. Other projectiles of this class are the Eureka, Parrott, and others. Muzzle-loading oblong projectiles are fast becoming obsolete, as all guns now made are breech-loaders.

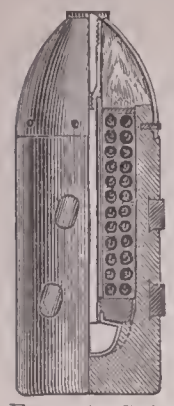


Fig. 4.—British shrapnel, muzzle-loading.

Breech-loading projectiles, since they are loaded through the breech of the piece, are fitted with a device which, being larger than the bore of the gun, is compressed into the rifling when the projectile is fired. This device at first consisted of a lead jacket cast on the body of the projectile (Fig. 6). Two copper bands were next substituted for this jacket, one band being near the head and the other near the base of the projectile. With the increasing twist of the rifling two bands were objectionable, and one band near the base was found to be all that was necessary. When one band is used the head of the projectile, where it joins the body, is slightly enlarged so as to fit the bore accurately and thus steady the projectile. The bands are made of copper or brass rings pressed into undercut grooves. The compressive system of rotation is superior to the others, as it increases the accuracy of the projectile and decreases the erosion of the bore by the rush of gases past the projectile.

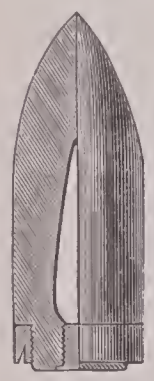


Fig. 5.—U. S. cored shot, muzzle-loading.

Oblong projectiles consist of a cylindrical body and an ogival head, the radius of the ogive being from 1½ to 2 calibers. Some armor-piercing shells have heads which start with a curve whose radius is greater than 2 calibers, and terminate with almost a hemispherical point. The solid shot used in the 12-inch U. S. breech-loading rifle (Fig. 7) is 3½ feet long and weighs 1,000 lb.; it is fired with a muzzle velocity of 2,000 feet per second. The materials used for the manufacture of oblong projectiles are steel and cast iron. Chromium is often added to the steel to increase its hardness. Steel projectiles may either be cast or forged; the latter method gives the best but also the most expensive projectiles. A new process of rolling projectiles has been extensively adopted in Europe. Among the best projectiles may be named the Holtzer, St.-Chaumont, St.-Étienne, and Firminy. The processes by which they are manufactured are kept secret. A recent test of metal from a Firminy projectile showed an elastic limit of 196,000 lb., a tensile strength of 233,000 lb., and an elongation of 7½ per cent. The manufacture of the St.-Étienne steel shell is in general as follows: A casting of steel, closed in front and presenting on the interior and exterior the general form of the projectile, is prepared by a hammer or hydraulic press. The cylindrical part is strengthened in rear by increased thickness. It is then rolled on a steel mandrel and drawn through grooves of an ordinary rolling-mill until the desired dimensions are reached. One of these shells, exhibited at the Paris Exposition of 1889, was 13·5 inches in caliber, and had been fired through a 15·7-inch iron plate without either appreciable upsetting or rupture.

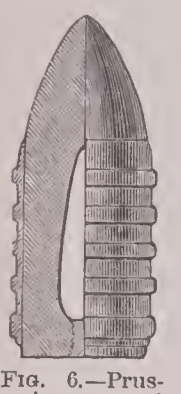


Fig. 6.—Prussian cored shot, breech-loading.

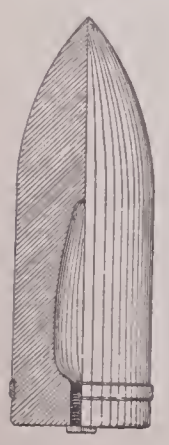


Fig. 7.—Cored shot. For U. S. 12-inch breech-loading rifle.

The tempering of a projectile is a very important step in its manufacture. At the St.-Chaumont works, in France, to temper a projectile it is first heated to a cherry red and then cooled in oil. When cold it is again heated to a cherry red and the head only is then plunged in water and allowed to remain eight or ten minutes, and then the whole projectile is plunged in oil and left until cold. In this way a very hard head and tough body are secured. In casting both solid shot and shell the point is generally cast down to secure a denser head. For armor-piercing projectiles the heads are cast in iron moulds to increase their hardness by quick cooling. Oblong solid shot have a limited use, since shells can be made which will pierce almost the same thickness of armor, and with more destructive effect.

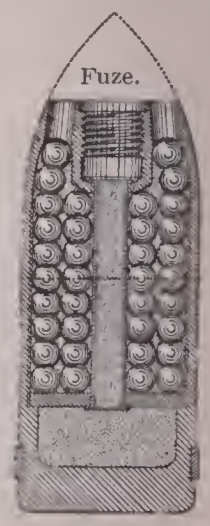


Fig. 8.—Shrapnel. For U. S. 3·2-inch breech-loading rifle.

Oblong shells are of two kinds—battering or armor-piercing shells and common shells. The first kind are made of forged steel, and the second kind are made of cast steel and cast iron. Shells are also made by Electric Welding (*q. v.*). The head and base are stamped out in dies; the body is made by rolling or drawing a tube. The three parts are then placed in a welding-machine, and a current of electricity of enormous quantity and low intensity is passed through them while they are pressed firmly together. The operation is completed in about three and a half minutes. Some of the modern shrapnel for the U. S. 3·2-inch field breech-loading rifle are manufactured in this way (Fig. 8). The base and body are welded together, then the steel diaphragm and tube are dropped in place and the head is welded on. Holes are drilled in the head connecting with the interior cavity, and through these holes the shrapnel is filled with bullets; a matrix of plaster-of-Paris is then poured in, and the holes are closed by screwing in small plugs. The bursting charge is placed in the cavity in rear through the central tube. A time-fuze is screwed in the point, and at the proper distance it ignites the charge and the cluster is swept out to the front by the diaphragm.

Oblong projectiles vary in length from 3 to 5 calibers, and are fired with a muzzle velocity which ranges from 1,800 to 2,500 feet per second; a velocity of 3,300 feet has been attained. Against earthworks very long shells are used. Some of these are 6 to 8 calibers in length.

The bursting charges used in projectiles are generally composed of gunpowder, though the high explosives are sometimes desirable, particularly in armor-piercing shells. The charges are generally ignited by means of time or impact fuzes. In the case of armor-piercing shell the heat developed in piercing the armor is usually sufficient to explode the charge. The projectiles used in the small-arms are generally made of lead, and being of a slightly larger caliber than that of the gun, the lead is forced into the rifling, thus causing the projectile to rotate. In the small-caliber rifles, which are about 0·3 inch in diameter of bore, a much more rapid twist is required for the rifling, and lead would be too soft to take the grooves, consequently the projectile is made with a lead body and covered with a jacket of a harder material, such as copper, German silver, or steel (Fig. 9). For detailed descriptions and history, see Holley, *Ordnance and Armor*; Meigs and Ingersoll, *Ordnance and Gunnery*; Morgan, *Handbook of Artillery Material*; Reports of the Chief of Ordnance; Mackinlay, *Text-book of Gunnery*; *Journal of the United States Artillery*, etc. See Gunnery, Artillery, Ballistics, etc.

Fig. 9.—0·3-inch bullet.

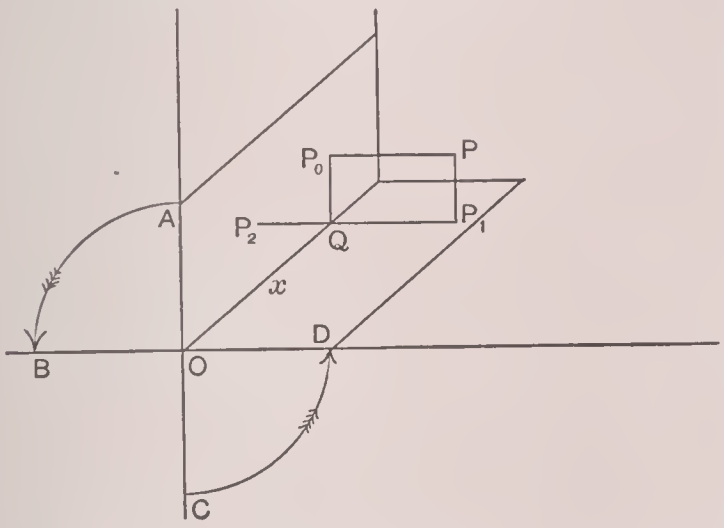
J. C. W. Brooks.

Projection [from Lat. *projec'tio*, a throwing forward, stretching out; *pro*, forward + *ja'cere*, *jac'tum*, throw, hurl]: the representation of a magnitude on a plane or other surface made in accordance with some geometrical law. In geometry, projection is restricted to the delineation of an object upon a plane surface by rays issuing from a point and intersecting the contour of the object; and this is in most cases the meaning of the word. If the point be supposed infinitely distant the rays form a system of parallels. If

their direction is perpendicular to the plane we have *orthographic* projection; if the direction is not perpendicular we have *oblique* projection; and if the point is at a finite and proper distance for ordinary vision we have *perspective* projection, or linear perspective. (See PERSPECTIVE.) Other systems of projection are used for delineating the earth's surface. In geometry the object projected is a geometrical figure; the fixed point is called the vertex, the joining lines form a cone, and the section in which the cone is cut by any plane (the plane of projection) is called the projection. This method supplies very important conclusions, according to which from a particular theorem, the general one under which it is contained, may be inferred. It is due to Poncelet, whose *Traité des Propriétés Projectives des Figures* may be regarded as marking a new era in geometry. By this method theorems concerning infinitely distant points may be extended to finite points on a right line; while theorems concerning imaginary points and lines may be extended to real points and lines. In the last we have the principle of continuity, according to which the properties of a figure are asserted to be equally true, whether any of its points or lines are real or imaginary. (See IMAGINARY QUANTITIES.) In what follows, however, orthographic projection and spherical projections alone are considered.

Orthographic Projection.—This projection is the feature of Monge's descriptive geometry, a method which was devised for the purpose of giving a representation of solids and other figures in three dimensions by means of a drawing in one plane. In this method a figure is represented by its orthographic projections on two planes, one horizontal and the other vertical. The first projection is called the plan and the second the elevation. The line of intersection of the planes is called the axis. If the drawing-paper is the surface of the plan, the plane of the elevation will be the plane perpendicular to it drawn through the axis. In order to bring the plane of elevation into the plane of the paper, we may turn it round the axis until it coincides with the horizontal plane, in which case A moves to B and C to D. This process is called rabatting.

Let P_0 P_1 be the feet of the perpendiculars from a point P on the vertical and horizontal planes, respectively; then if we turn the vertical plane toward the left round the axis until it coincides with the horizontal, P_0 will come into the position P_2, a point evidently lying on the perpendicular to the axis drawn through P_1 at a distance $P_2Q = P_0Q = PP$, from the axis. In the figure it is seen through the vertical



plane. Thus any two points, P_1, P_2, on the plane of the paper lying on a perpendicular to the axis will be the projections of some point in space, after the vertical plane has been turned round the axis so as to become horizontal. Hence we have a method of representing points in space. We take in the plane of the paper a line x as axis; then any pair of points on a perpendicular to the axis represent a point in space.

The horizontal and vertical planes divide all space into four parts, called quadrants. The first is the upper part on the right in which P lies, the second the upper part on the left, and the third and the fourth the other parts taken in rotation from right to left. Thus if P_1 is said to be below and P_2 above the axis, a point lies in the first quadrant, if the elevation is above and the plan below the axis; in the second, if elevation and plan are both above; in the third, if the elevation is below and the plan above; and in the fourth, if elevation and plan are both below the axis.

As we can represent any point thus, we have a representation of any figure in space by considering it as an assemblage of points. A plane, however, can not be represented in this way, as the projections of its separate points would entirely cover the planes of reference, and all planes would become alike. But any plane cuts the two planes in two lines meeting on the axis. These lines are called the traces of the plane. Thus a plane is determined by its traces, which are two lines intersecting on the axis; and, conversely, any two lines intersecting on the axis determine a plane. If the plane is parallel to the axis its traces are two lines parallel to the axis. One of the traces is altogether at infinity if the plane is parallel to the plane on which the trace lies. If the plane passes through the axis both traces coincide with the axis and the method of representation fails, as all planes fulfilling this condition become alike. We therefore introduce a third plane at a point O of the axis perpendicular to both the other planes. Then this plane with its trace is rabatted about the perpendicular to the axis at O, so as to become horizontal, and then the traces of the plane to be represented are the axis x and a line passing through O.

In order to represent a line we consider it either as the connector of two points which have each their appropriate representation or as the intersection of two planes with their corresponding traces. In the first case the line may be represented by its projections on the two planes. These lines are entirely arbitrary, so that any two lines represent a line in space, for when we bring the plane of elevation into its original position the perpendicular planes through the two lines must intersect in some line in space. In the second case a line is represented by its traces, namely, the two points in which it meets the vertical and horizontal planes, as these two points are not connected by any relation, and two points determine a line in space. If the traces coincide at a point on the axis this representation fails, and we must introduce a third plane or have recourse to the representation by projections.

For the further numerous problems of descriptive geometry and their solution, we must refer the reader to formal treatises upon the subject.

Spherical Projections.—In the construction of maps we have to consider the means of representing the surface of a sphere upon a plane. There is no method by which the length of lines is strictly preserved, but there is a variety of methods which have their special appropriateness, that is, produce the least amount of distortion, in particular cases. If orthographic projection is used the plane is supposed to pass through the center and the eye to be at an infinite distance perpendicular to the plane. If the plane is the equator the parallels and meridians become concentric circles and rays passing through the center, respectively. If a meridian is the plane of projection the meridians become ellipses having a common transverse axis, and the parallels a system of parallel lines perpendicular to that axis. In other cases meridians and parallels both become ellipses. In this method places near the plane of projection are crowded together, while those farthest away are fairly represented. In perspective projection the eye is supposed to be at the vertex, and the plane of projection is taken perpendicular to the line joining it to the center, and by suitably choosing the distances of the eye and plane from the center we can arrive at different systems of projection which are serviceable in representing certain portions of the earth. In general both meridians and parallels are projected into ellipses. If the point is on the sphere and the plane passes through the center the projection is called *stereographic*; and circles whose planes pass through the eye are projected into straight lines, while all other circles are projected into circles. In this method places near the plane of projection are fairly represented, and those farthest away are crowded together, but all angles remain absolutely unaltered. In *gnomonic* projection the eye is at the center and the plane of projection touches the sphere. This method gives a map of a limited portion of the sphere with little distortion. A series of star maps was constructed on this principle by R. A. Proctor; he first circumscribed the sphere by a regular dodecahedron, and then projected the entire sphere upon the several faces of the dodecahedron.

There are several other methods of representation, of which a few may be enumerated. In *conical* projection the eye is at the center of the sphere, and the projection is made on the surface of a cone touching the sphere along the parallel which most nearly divides the area to be represented,

or sometimes of a cone passing through two parallels midway between the central parallel of the area and the extreme parallels. After projection the cone is cut along a generator and opened out into a plane. The parallels here are represented by concentric circles, and the meridians by lines passing through the common center of the circles. This method is useful if the tract of country to be represented is of no great extent in latitude, but of any extent along a parallel.

In *cylindric* projection the eye is at the center of the sphere, and the projection is made on a cylinder touching the sphere along the equator. After projection the cylinder is opened out on a tangent plane. Here meridians and parallels become rectangular systems of parallel lines. This method is applicable to the case in which a map of the equatorial regions is to be made.

In *polyconic* projection each parallel of latitude is developed symmetrically from an assumed meridian by means of a cone touching the surface along the parallel. Here the parallels become arcs of circles, and the meridians may be constructed by laying off on each parallel the degrees of longitude according to their true lengths. This is the method of projection used by the U. S. Coast Survey in projecting small maps and charts. For Mercator's projection, see the article under that heading. R. A. Roberts.

Prolap'sus U'teri [Lat., falling of the womb]: the descent of the uterus below its normal position in the pelvis; in extreme cases a protrusion of part or the whole of the organ from the body. The chief causes are the enlargement of the uterus by inflammation, uterine and abdominal tumors, relaxation of the tissues which are the anatomical supports of the organ, rupture of the perineum by instrumental delivery, and sudden violence in falling or jumping.

Prome'theus (in Gr. Προμηθεύς): one of the most interesting creations of Greek mythology; a son of Iapetus and Clymene, Themis, or Asia, the brother of Atlas, Menœtius, and Epimetheus, and father of Deucalion. The myths relating to him are very variously told by Hesiod, Æschylus, and later poets and philosophers, but there are nevertheless certain fundamental traits in which all the different versions agree. They all represent Prometheus as a benefactor of the human race. According to some, he was the creator of man; according to others, he only brought to him fire and the arts depending on the use of fire. Next, they all agree that those benefits which he conferred on the human race for some reason excited the wrath of Zeus, who chained him to a rock and sent a vulture or an eagle to feed daily on his liver. From these sufferings, under which the Titan did not succumb, Hercules at last delivered him by shooting the vulture and unlocking the chains, after which Prometheus returned to Olympus. Of Æschylus's trilogy only the middle piece, *Prometheus Bound*, is extant. For Prometheus in art, see the article *Prometheus* in Baumeister's *Denkmäler*. J. R. S. Sterrett.

Promise (in law): See Contract.

Promise, Breach of: See Marriage.

Promissory Note [*promissory* is from Lat. *promis'sor*, promiser, deriv. of *promit'tere*, *promis'sum*, send forth, promise]: an unconditional promise in writing made by one person to another signed by the maker, engaging to pay, on demand or at a fixed or determinable future time, a sum certain in money, to, or to the order of, a specified person or to bearer. (British Bills of Exchange Act, 1882, § 83.) Sealed notes were unknown to the early law merchant, and as a rule the courts have held that attaching a seal to a promissory note destroys its negotiable character. This doctrine has been changed by statute in many of the U. S., and the British Bills of Exchange Act authorizes a corporation to use its seal as a signature to commercial paper. Government and corporate bonds, though under seal, have long been treated by the courts in the U. S. as negotiable, on the ground that modern commercial usage had given to them a negotiable character. *Morris Canal Co.* vs. *Fisher*, 1 Stockton (N. J.) 667.

The negotiability of promissory notes was denied by Lord Holt, but was secured by act of Parliament (3 and 4 Anne, c. 9, A. D. 1704). In the U. S. this statute or its equivalent has become a part of the law of every jurisdiction. The better view seems to be that it was declaratory only of existing law. (*Goodwin* vs. *Roberts*, Law Reports, 10 Exchequer 337; appendix to 1 Cranch 367; see *Holloway* vs. *Porter*, 46 Ind. 62, *contra*.) It should be noted that words of negotiability are not necessary to a valid promissory note. A non-negotiable note is entitled to days of grace; it imports a consideration, and the holder suing upon it need not allege or prove a consideration. (*Cornwright* vs. *Gray*, 127 N. Y. 92.) Bank-notes, certificates of deposit, and instruments which are so ambiguous that they may be construed as either notes or bills of exchange, may be sued on as promissory notes. A bank-note (that is a promissory note issued by a banker, payable to bearer on demand) differs from an ordinary note in some respects; for example, it may be reissued after payment. The maker of a note is not allowed to deny to a holder in due course the existence of the payee or the payee's capacity to indorse at the time the maker issues it. Nearly all the rules which determine the rights and liabilities of the parties to notes, and the manner in which the rights are to be exercised and the liabilities to be fixed, have been described in the article on Bill of Exchange (*q. v.*). Francis M. Burdick.

Promorphology: See Morphology, Animal.

Pronghorn: See Antilocapra.

Pronouns [*pro-* + *noun*, representing Lat. *prono'men*, a translation of Gr. ἀντωνυμία; ἀντί, instead of + ὄνομα, name, noun]: a class of words which serve the purpose of indicating objects without naming them. They do this in terms of the context or situation and of relations to the speaker. Thus when *he said* is used to replace *John said*, the pronoun *he* indicates either in relation to something said before, or in relation to what is in the speaker's presence. Nouns are name-words. Pronouns are essentially gesture-words. They act as proxies for nouns. They are not, however, mere stop-gaps or dummies, but, being universal or public proxies—i. e. capable of substitution for any noun—they are selected according to the relations borne by the object named either to context or speaker. They therefore give to language the possibility of expressing vastly more than the use of nouns alone would permit.

The so-called adjective-pronouns or pronominal adjectives, like *this*, *that*, *other*, *all*, etc., are pronominal in the sense that they express general relations to context, situation, environment, but not in the sense that they are necessarily substitutes or proxies for nouns. They may dispense with the use of the noun, but generally the apposition of the noun is found desirable; thus *get that* may require, in order to clearness, the addition of the name of the object, *get that hat*. A large class of so-called adverbs, like *here*, *there*, *then*, *thus*, are pronominal in precisely the same sense as *this*, *that*, *such*; they may be called pronominal adverbs. In the sentence *he speaks so*, the action-name *speaks* is modified by the pronominal adjunct *so*, just as, in the sentence *he uses such language*, the name language is modified by the pronominal adjunct *such*. The conjunctive adverbs *where*, *when*, *while*, *as*, etc., are pronominal in precisely the same sense as the relative pronouns *who*, *which*, etc.

Benj. Ide Wheeler.

Pronunciation [from Lat. *pronuntia'tio*, proclamation, publication, deriv. of *pronuntia're*; *pro*, forth + *nuntia're*, announce]: the act of giving the proper sounds and accent to the individual words of a language. Besides this specific meaning, pronunciation is used in general for either the right or the wrong form of the spoken word. The more distinctive term is orthoëpy (Gr. ὀρθοέπεια), which from derivation means right or correct pronunciation.

The history of English pronunciation in its general sense has been written by Alexander J. Ellis, *Early English Pronunciation* (1869–89), and by Henry Sweet, *History of English Sounds* (1888). Both of these writers trace pronunciation from the earliest times, showing the changes sounds have undergone, and the standard pronunciation in different periods. Orthoëpy, as the attempt to establish and govern pronunciation, is of comparatively recent date, but its history is interesting as showing upon what such attempts have rested and what has been their effect upon speech.

The earliest English dictionaries made no attempt to mark pronunciation, but gave their whole attention to definition and etymology. Later, as in the time of Bailey, whose *Universal Etymological Dictionary* was published in 1721, the accent of words began to be marked. Even Johnson's great dictionary, which ran through seven editions from 1755 to 1783, marked accent only, and Boswell tells us that Johnson justified this as sufficient for all purposes of speech. The first dictionary to make special mention of orthoëpy in its title is that of Benjamin Martin, published in 1749. The dictionary of William Kenrick (1773) was the first to separate words into

syllables, and to indicate the pronunciation of vowels by numbers referring to a table of English sounds. Since Kenrick's time pronunciation has had an established place in English dictionaries, as shown by those of Perry, 1775, Sheridan, 1780, Walker, 1791, as well as by those published in Great Britain and the U. S. during the nineteenth century.

In considering the pronunciation of dictionaries and orthoëpists the fundamental question is "How does the orthoëpist arrive at his standard of correctness?" Kenrick, who first marked sounds in an English dictionary, claimed to register the speech of "polished speakers in the metropolis" —that is, London. He complained especially that rules of pronunciation had hitherto been "laid down by Irishmen and Scotchmen who did not themselves know how to pronounce." Perry took a similar standard, that of "men of letters, eminent authors, and polite speakers in London." Sheridan set up the standard of Queen Anne's court, a pronunciation which he claimed to derive from his schoolmaster, a contemporary of Swift. He thus undertook to follow the pronunciation of a previous generation, which he could not have heard in its purity, and it is therefore not strange that his dictionary received much severe criticism in his own time. Walker took still a different standard, a sort of "compound ratio" of the pronunciation of the "learned, the polite, and the bulk of speakers," whatever that may mean. He also took into account in doubtful cases what he called the "analogies of language," the meaning of which is by no means clear. Of lexicographers in the U. S., Webster in 1806 gave it as his opinion that "a living language admits of no fixed state," but he clearly regarded American English rather than the "London dialect" as correct. Worcester, on the other hand, in his dictionary of 1827 followed London English as the standard for American speech.

It will thus be seen that orthoëpists themselves have variously settled the question of standard English speech. It is not strange, therefore, that as to the pronunciation of many words they should differ among themselves and sometimes from the majority of good English speakers. Moreover, orthoëpists in determining pronunciation have failed to take into account certain necessary factors. The first of these is the history of English sounds and the laws of sound-development. These laws show that certain sounds have developed differently under various phonetic influences, as of accent or different phonetic environment. For example, the reason we speak *exile* with a *ks* sound and *exist* with a *gz* sound is one of accent. So the reason we pronounce *man*, *path*, *far* with two or three different vowels is due to the different consonants following the original short *a*. Moreover, sound laws, rather than the spelling of English words, point out the true analogies of speech, and by them in doubtful cases the proper sound may be more easily determined.

Another element to be regarded by the orthoëpist is the comparatively new science of phonetics, or the doctrine of speech-sounds. This treats of the true nature of sounds, their exact relationships, and the correct classification of them. The importance of phonetics is clear when we understand that the common classifications of dictionaries are often radically wrong. For example, the long *ā* sound, as it is called, should be classed with the *e* of *men*, and not with the *a* of *hat*, *ask*, *fær*, *care*. So the *a* of *all* is not an *a* sound, but an *o* sound, and should be classed with the *o* of *not*, *strong*, and the long *ō* of *no*, *note*. The sounds of *i* are the short as in *hit*, the long as in *see*, and not at all the diphthong in *might*. It is not necessary that the minute distinctions of phoneticians should be regarded, but it is certainly important that no misleading classifications should be used. Nor can such a classification be upheld because it has been followed by orthoëpists for more than a century. Moreover, the orthoëpists have sometimes overstepped their province in trying to force a particular pronunciation, because it seemed to be in accordance with "analogy." This was particularly true of Walker, many of whose blunders might have been prevented by a knowledge of phonetics.

From the very nature of language, a single standard of pronunciation can not be followed by all the English-speaking peoples of the world. The natural divisions and the wide separation make it impossible that the usage of Great Britain, of North America, and of Australia should be exactly the same, although it is highly important that there should be as much harmony as possible. For citizens of the U. S. an American standard of spoken English is inevitable. This should be as slightly different from the spoken English of Great Britain as is warranted by the pronunciation of the better classes, while it should be equally free from servile imitation of British speech. An American standard, however, is by no means easily determined. It is at best a compromise of varying usages in different parts of the republic, since the speech of no single city or section can be regarded as standard in every particular. No city in the U. S. exercises such influence on speech as London does in England, and it is therefore absurd to set up the speech of one city as necessarily better than that of another. Still, certain general principles may be laid down for guidance in determining standard pronunciation.

The first of these principles is that present usage must always be taken instead of past or antiquated usage. Lexicographers tend to preserve the old, but it must be clear that the orthoëpists of a former generation or century are no authority in those cases in which the best present usage generally differs. Thus if the present established accent of such words as *ally*, *canine* is on the first syllable, the authority of a dozen dictionaries does not make correct the accent on the last syllable; for it is the province of the dictionary to register the best present usage, not to set up the standard of a past age, or of some supposed analogy. But past usage may assist in determining the analogies of speech, and so deciding in doubtful cases. For example, past usage shows that *wound* has had the vowel-sound of *fool* rather than of *pound*, probably because of the influence of the preceding *w*. Walker gave *wound* an alternative pronunciation rhyming with *pound*, and this has been generally followed, although Walker himself admits it was not the pronunciation of his time. The older pronunciation of *wound* is therefore better, not because it is older, but because it has been and is the best usage.

The second principle is that reputable usage indicates the standard. Reputable usage avoids the extremes of affected precision on the one hand, and ignorance or slovenliness on the other. It is neither the usage of fastidious society nor of the half-educated. It is rather that of the well-educated, who are carried away neither by the extremes of fashion in speech nor by hypercritical standards sometimes set up by orthoëpists themselves. For example, reputable usage makes no distinction between the vowel-sounds in such words as *her* and *urn*, yet the majority of orthoëpists insist on marking these sounds differently. Reputable usage implies, therefore, that careful observation of the best speakers should be compared with standards set up in books.

Lastly, national usage is to be taken as the standard rather than local or dialectal use; that is, the present reputable usage of the well educated in a whole nation is to be regarded as distinct from the usage even of the well educated of a single section. Even when this can not be determined with precision in all cases, local or dialectal use may be distinctly avoided. Thus dictionaries printed in the U. S. still recognize the pronunciation of *r* before a consonant, since it is only in the extremes of speech in the Eastern and Southern States that *r* in this position is wholly lost (as in *caad* for *card*, *faather* for *farther*). So *a* in *ask*, *path*, *far* is marked as a sound between *a* of *man* and *a* of *far*, because such a sound is a compromise between the extreme broad *a* used in some parts of the East and the extreme flat *a* of the West and South. Oliver Farrar Emerson.

Pronunciation of Botanical Names: It is a law of the science of botany that the names of species, genera, tribes, families, orders, classes, branches, etc., shall be in Latin, or where derived from words taken from other languages they shall be Latinized. The occurrence of these names in English books has led to much confusion of pronunciation, since they can not properly be treated as English words. In the absence of any formulated system of rules there has been little uniformity in practice. In a general way the pronunciation of these Latin or Latinized names, as practiced by English-speaking botanists, approximates that of the so-called "English pronunciation" of Latin in vogue twenty or more years ago, but long since discarded.

There is a growing feeling among botanists that the pronunciation of botanical names should conform to the usage of Latin scholars, and at least one attempt has been made to accomplish this end. The editors of Nicholson's *Dictionary of Gardening* (1884–88), after consultation with eminent English-speaking botanists, adopted for their work the so-called Roman system of pronunciation. Accordingly, the long sound of *a* is as heard in psālmist; short *a* as in ăpart; long *e* as in vēined; short *e* as in slĕnder; long *i* as in machīnist; short *i* as in thĭn; long *o* as in vōter; short *o* as in rŏtten; long *u* as in rūler; short *u* as in powerfŭl; *c*,

g, and *ch* always hard, as in muscular, *g*ood, and *Ch*ristian; *s* always hard, as in this; *t* always with its proper sound, as in Latin. We have then Ac'-er (*ăk'-er*, not *ā'-ser*), Cer'-as-us (*ker'-* not *ser'-*, much less *sē-rā'-sus*), Chel-o'-ne (*kel'-*, not *chel'-*, nor *shel'*), Gen-ti-a'-na (*g* hard, not *jen-shĭ-ā'-na*), etc. The only exeeption to this rule is that in the ease of words derived from the names of persons, in whieh the Latin ending only comes under the rule, the preeeding part being pronounced like the original name. This is unfortunate, since it gives us Jones'-i-a (instead of *Jo-nēs'-i-a*), Stokes'-i-a (instead of *Sto-kē'-si-a*), etc., pronunciations whieh could not be followed by any non-English botanists.

Charles E. Bessey.

Pronunciation of Foreign Names: The purpose of this artiele is to afford some help for the pronuneiation of the many foreign geographieal and personal names met in reading. The eommoner geographical names whieh have been thoroughly Anglieized in pronuneiation are not included, and those names whieh eome from the most remote and least-known languages, and in general those not originally written in Roman letters, are respelt by English writers or by continental Europeans who use the Roman alphabet. The main diffieulties in their pronuneiation come from the different orthographieal usages of the best-known languages of Europe, and the resulting doubt whether a Russian or Oriental name, for example, is spelt for English readers aecording to English, Freneh, or German usage. For geographieal names not originally written in Roman letters much of this uneertainty would be removed if the system of spelling devised by the Royal Geographieal Soeiety in London in 1885, and substantially adopted by the U. S. Government, were in exelusive use in English-speaking countries. (See *Proceedings of the Royal Geographical Society*, vii., 535–536; xiv., 116–119, 770–777; and for a eomparison with similar Freneh and German systems, *Phonetische Studien*, vi., 322–334.) Aeeording to this system vowels are pronouneed as in Italian, and eonsonants generally as in English. The vowels are accordingly as in *father*, *fête*, *machine*, *note*, *rude*, and *ai* is about like *i* in *ice*, *au* like *ou* in *out*, etc., *aw*, however, being added with the sound it has in *law*. The sound of *k* is always written *k* (never *c*), and *s* is preferred for the sound of *s* in *mason*, *ch* is always as in *church*, *g* always as in *go*, *get*, *j* is always used for the sound of *g* in *gem*, *j* in *joke*, *hw* is written for the sound of *wh* in *what*, *ng* is as in *finger* or as in *singer*, *ph* is as in *loophole*, never like *f*, *kw* is written for the sound of *qu* in *quite*, *sh* is as in *shire*, *th* as in *thin*, or, less often, as in *this*, *y* is always a eonsonant as in *yard*, *zh* is like *s* in *pleasure* or *z* in *azure*, while *kh* and *gh* are used for Oriental guttural sounds. Unfortunately, older spellings, like *Foochow* (instead of *Fuchau*) are frequent, and often ause embarrassment. In general, these older spellings are to be pronouneed aecording to the analogies of ordinary English spelling. The system just deseribed aims only at an approximate indieation of the native pronunciation. For the numerous other foreign geographical and personal names, that is, those belonging originally to European languages (including those spoken in Ameriea and elsewhere) always or often written with Roman letters, the list of letters and letter-groups below, with indieation of the pronuneiation, has been prepared. It also covers to a considerable extent modern Greek names and Slavic names originally written with the Russian alphabet. It is not intended to give an exaet or eomplete description of native pronuneiations, but to furnish a guide to the eommonest orthographie usages of the most important European languages. Some sounds not existing in English are entirely ignored, or are described as resembling eertain English sounds. Since there are, espeeially in proper names, many individual eases and exceptions, reeourse must often be had to pronouncing gazetteers or other lists of names with indieation of pronunciation. The following general prineiples, though not entirely free from exeeptions, will be useful:

1. The number of syllables is generally determined by that of the vowels (or diphthongs) written, exeept that doubled vowels are generally equivalent to the simple vowels pronounced long. See, however, *e*, *ie*, and other vowel combinations below.

2. Unaeeented syllables are pronouneed more distinctly than in English.

3. In German, Duteh, Danish, Swedish, Norwegian, Icelandic, Hungarian, and Bohemian the aeeent is usually on the first syllable. In Freneh, in whieh language it is very weak, it is always on the last syllable, unless this contains the so-called "mute *e*" (see *e* below) as its only vowel, in which case it is on the preeeding syllable. In Italian it is most often on the penult; so also in Spanish and Portuguese if the word ends in a vowel preeeded immediately by one or more eonsonants; in Spanish it is most often on the last syllable if the name ends in a consonant. The plaee of the aecent is sometimes marked in Spanish with the acute aceent, in Italian with the grave. In Polish the aecent is commonly on the penult. For Latin names the well-known rule is that the accent is on the penult if that syllable is long, otherwise on the antepenult, and elassic Greek names are usually given in Latinized forms and pronounced aeeording to Latin rules.

4. A written aeute accent indicates a long vowel in Hungarian and Bohemian.

5. In elassic Greek, Latiñ, and Hebrew names vowels and consonants are usually pronounced aeeording to English analogies, *ch*, however, having the value of *k*. In other names the vowels have commonly the Italian values as indicated above.

6. In German, Dutch, and the Slavic languages (as Russian, Polish, and Bohemian) the sounds of English *b*, *d*, *g* (whether in *go* or in *gem*), *v*, *z* (whether in *zone* or in *azure*), ean not oeeur at the end of a word; if the letters for these sounds are written in that position in one of these languages they are sounded respectively like *p*, *t*, *k* (or *ch* in *church* instead of *g* in *gem*), *f*, *s* (instead of *z* in *zone*), *sh* in *she* (instead of *z* in *azure*). See, however, *g* below.

7. Doubled eonsonants are pronounced long or doubled (e. g. *tt* as in *that time*) in Italian, Swedish, and Hungarian.

Alphabetical List of Noteworthy Letters and Combinations.

a is generally as in *father*. In Hungarian a is nearly equivalent to *o* in *hot*, and á as *a* in *father*.—â in Roumanian is like Roumanian *î* (see below).—ä in German and Swedish is like *e* in *net* or *there*; in German ae is sometimes written for *ä* (see *ae*).—ă in Roumanian approaches *u* in *hut* or *hurt*.—ã in Portuguese is nasal *a* (see *ãe*, *ão*, below).—ą in Polish is like *o* in *nor*, pronouneed through the nose.—å in Swedish and aa in Danish and Norwegian are like *aw* in *law*.—ae or æ in German, Danish, and Norwegian is like *e* in *net* or *there*; in Latin names ae is like English *e*; in Welsh it resembles *i* in *ride*.—ãe in Portuguese resembles *i* in *ride*, pronouneed through the nose.—ai is generally like *i* in *ride*, but in French it is like Freneh *é* or *è* (see below, but also *ail*, *aill*, *aim*, *ain*), and in modern Greek spelling ai (αι) approaches *e* in *red*.—ail in Freneh, when final, and aill in Freneh: see *il*, *ill*, below.—aim, ain in Freneh, if final or followed by any eonsonant except another *m* or *n*, are similar to *a* in *fag*, pronounced through the nose.—aj is in Danish like *i* in *ride*; in Hungarian like *oi* in *boil*, but Hungarian áj approaches *i* in *ride*.—am, an, under the conditions given above for *aim*, *ain*, represent in Freneh and Portuguese nasal vowels resembling *a* in *part*, pronounced through the nose.—ão in Portuguese is similar to *ou* in *loud*, pronounced through the nose.—au is usually like *ou* in *loud*, but in French it is like *o* in *note*. In modern Greek *au* (αυ) is equivalent to *av* before vowels and voiced eonsonants (as *b*, *d*, *g*), and to *af* before voieeless consonants (as *p*, *t*, *k*).—äu in German is like *oi* in *boil*.—auw in Duteh is like *ow* in *now*.—av in Danish before a consonant is generally like *ou* in *loud* (see *v*).—aw is generally like *a* in *father* followed by *v*, but in Welsh it is like *ou* in *loud* (see *w*).—ay is generally like *ai* above; in Freneh it is like French *ai*, but if a pronouneed vowel immediately follows, it has this sound (or sometimes that of *a* in *father*) followed by *y* as in *ye*.

b is in general as in English; but if final in German and some other languages (see 6 above) it is like *p*. Between two vowels *b* in Spanish approaches the English *v*, and the same pronuneiation is the usual one of *b* (β) in all positions in modern Greek. The sound may be described as a *v* formed with the lips alone, instead of with the lower lips and upper teeth.—bh is sometimes used in Sanskrit or East Indian names to express *b* followed by an aspiration. It need not be distinguished from *b*.

c is equivalent to *k* in most European languages except when it stands before *e* or *i*. In Welsh and Gaelic it is always like *k*. In Polish, Bohemian, and Hungarian, *c* always means *ts* (see also *ch*, *cs*, *cz*). Before *e* and *i* (or *y*) in Freneh, Portuguese, and Catalan it is like *s*; as also in English and in Latin names, in which last it has the same sound also before *ae* and *oe*. In German *c* (little used) before *e*, *i*, *ä* (*ae*) is like *ts*. In Italian and Roumanian *c* before *e* or *i* is like *ch* in

chin (but before *î* in Roumanian it is like *k*; see also *sc*), and in Spanish before the same letters like *th* in *thin*. In names from Sanskrit *c* is sometimes used, and has the sound of *ch* in *chin*, but *ch* is also used in sueh words. See also *ch*.—ç is like *s* in *mason*; in names from Sanskrit many pronounce it like *sh* in *she*.—č in Bohemian is like *ch* in *chin*.—ć in Polish is between *ts* and *ch* in *chin*.—ec, ech, ees. In Italian and Hungarian *c* before another *c* only indicates a lengthening of the consonantal sound.—eh is pronounced *k* in Latin, classic Greek, Hebrew, Italian, Catalan, and Roumanian names. In Freneh and Portuguese it is like *sh* in *she*, in Spanish like *ch* in *chin*. In German it has two sounds, one somewhat resembling the hawking sound heard in clearing the throat, a strong aspiration in the back of the mouth, heard after *a*, *o*, *u* (this sound is also written *ch* in Welsh and Gaelie), the other pronounced farther forward in the mouth (a voiceless German *j*), after *e*, *ä*, *i*, *ö*, *ü*. The same two sounds occur in modern Greek for *ch* (representing χ), the former before *a*, *o* (not *oi*), *ou*, the latter before the sounds *e* and *i* (however written). In some Slavic words (as Polish and Bohemian) *ch* is used as in German, but the Russian letter corresponding in sound is often indieated in Roman letters by *kh*, and *ch* in names from Russian oftener means *ch* in *chin*. In Sanskrit and East Indian names *ch* is like *ch* in *chin*, and *chh* need not be distinguished from this. (See also *sch* below.)—es in Hungarian is like *ch* in *chin*.—cu in Spanish, when a vowel follows and the *u* is not aecented, is like *kw*, or *qu* in *quite*.—cz in Polish is like *ch* in *chin* (so also in the word *Czech*). In Hungarian cz is like *ts*.

d is generally as in *did*. If final in German and some other languages (see 6 above) it is like *t*. If final, it is usually silent in French, and like *th* in *thin* in Spanish. In modern Greek *d* (δ) is usually like *th* in *that*, and it may have this sound in Spanish when between vowels.—dd in Welsh is like *th* in *that*.—dh is sometimes used in Sanskrit or East Indian names to express *d* followed by an aspiration. It need not be distinguished from *d*.—ds is in Hungarian like *j* in *joke*, and dseh is oeeasionally found in imitation of German spellings for the same sound.—dt is like *t*.—dż (Polish) and dž (in some Slavic names) are like *j* in *joke*.

e is usually nearly like *a* in *fate* or *e* in *pet* or *there*; but when final in French it is regularly silent (mute *e*), unless written with an accent (*é*). It is usually also silent in Freneh (or very short, like *e* in *battery*) if in the middle of a word and not followed by a eonsonant in the same syllable, unless it has an accent (*é*, *è*, *ê*). In German e in final syllables is similar to *e* in *battery*. In modern Greek e, if representing ε, is like *e* in *pet*; if it represent η, like *i* in *machine*. In Slavic words *e* is often pronouneed like *ye* in *yet*. (See also *ae*, *ei*, *ej*, *em*, *en*, *er*, *es*, *et*, *eu*, *ey*, *ez*, *ie*, *oe*, *ue*.)—é, è in French are pronounced, the former nearly like *a* in *fate*, the latter nearly like *e* in *pet*.—ê in French is similar to *e* in *red* or *there*. In Roumanian ê is like Roumanian î (see *î*).—ę in Polish is nearly like *e* in *red*, pronounced through the nose.—eau in French is like *o* in *note*.—eeu, eeuw in Dutch are long *e* (*a* in *fate*) followed by *u* (in *rule*) in the same syllable, not like Dutch *eu*.—ei is in French like French *è* (see above); in German, Dutch, and Welsh similar to *i* in *ice*; in modern Greek *ei* (ει) is like *i* in *machine*; in other cases it is generally *e* followed by *i* in the same syllable, that is, nearly like *ey* in *they*.—eil, eill in French: see *il*, *ill*.—ein in French is like French *ain* in the same position (see above).—ej in Danish approaches *i* in *ride*; in Hungarian it is similar to *ey* in *they* (that is, *e* followed by *i* in the same syllable).—em, en in French represent a nasal vowel under the conditions described above for French *aim*, *ain*, *am*, *an*, and the sound is the same as that described for French *am*, *an*, but final *em* (not common) is sometimes like *em* in *hem*. In Portuguese, under the same conditions, *en* (and *em* before *p* or *b*) is like *a* in *fate*, pronounced through the nose, and *em* is generally like Portuguese *ãe* (see above), or (in Brazil) like *ey* in *they*, pronounced through the nose. (See also *ien* below.)—er when final in French is generally like French *é* (see above).—es when final in French is generally silent unless the *e* is accented (*é*, *è*), in which case *s* is generally silent.—et when final in French is generally like French *è* (see above).—eu in French and Dutch is nearly like *u* in *hurt*; more exactly, it is like *a* in *fate* or *e* in *pet*, with the lips rounded as for *o* in *note* or *nor*. (See also *eeu*.) In German eu is like *oi* in *boil*. In modern Greek eu (ευ) is pronounced *ev* or *ef*, according to the rule given above for *au* in that language. In other languages both e and u have their usual sounds, one following the other in the same syllable.—ey is, in general, like *ei*, but in Freneh it is followed by a distinet *y* (as in *ye*) when a pronouneed vowel comes after the *y*; that is, it is then French *è* followed by *y*.—ez final in French is like French *é* (see above).

f in Welsh is pronounced *v*, and ff in Welsh is like *f*.—fv in Swedish is pronouneed *v*.

g is generally as in *go*, *get*. When *e*, *i*, or *y* follows, it is in Freneh and Portuguese like *z* in *azure*; in Italian, Roumanian, Latin, and classic Greek names like *g* in *gem*; in Spanish like a strong *h*. In Norwegian and Swedish g before *i* is similar to in *ye*, and is silent before *j*. Final g in German and Dutch is pronounced like German *ch* (see above), or in German by some like *k* (see 6 above). In modern Greek and in Dutch g is in all positions regularly a spirant, with the voieed sounds of *ch* as deseribed above for those languages.—gh in Italian and Roumanian is like *g* in *get*. In Irish it is nearly like *ch* in Welsh and German. In Sanskrit and modern East Indian names it is sometimes used to express *g* (as in *go*, *get*) followed by an aspiration which need not be imitated. In some Oriental names it represents a peeuliar guttural sound.—gli in Italian is similar to *lli* in *million*; if no vowel follows, the sound is the same followed by *i* as in *machine*.—gn in French and Italian is nearly equivalent to *ni* in *union*.—gu in French, when followed by *e*, *i*, or *y*, is generally like *g* in *get*, but like *gu* with French *u* if a eonsonant or *ë* follows the *u*. In Spanish gu before *e* or *i* is like *g* in *get* unless the *u* is marked with the diæresis (*ü*), in whieh case, as before other vowels, gu is like *gu* in *languid*, and this last is the regular value of gu in Italian before a vowel.—gy in Hungarian is somewhat like *dy* (with *y* as in *ye*).

h is silent entirely in French, Italian, Spanish, and Portuguese; see, however, *ch*, *gh*, *lh*, *nh*, *sch*. In German it is heard when initial, but is generally silent when preceded by a vowel and followed by simple *e* (not *ei*, before which it is heard), and when final it is generally silent in German and other languages. In Roumanian, however, h regularly has the first sound deseribed above for German *ch*. In Seandinavian names h is silent in initial *hj* (= *y* in *ye*) and *hv*.

i is as in *machine*, or sometimes as in *pit*, and î is like *i* in *machine*, except in Roumanian, where it is like Polish *y*, or somewhat like *i* in *pit* (see *y*).—ie in German and Dutch is like *i* in *machine*; in other languages it is oftener like *ye* in *yet* (for French, see *e* above).—ieuw in Duteh is like *i* in *machine* followed by *u* as in *rule* in the same syllable.—ien in Freneh, when final or before a consonant (except another *n*), is like *y* (in *ye*, *you*) or a short *i* followed by the Freneh nasal vowel written *in* (see *in*).—ij in Duteh is similar to *i* in *ice*.—il in Freneh when final and ill in French mean usually, after a consonant or silent *u* (see *gu*, *qu*), the sound of *i* in *machine* followed by a strongly consonantal *y* as in *ye*; after a pronounced vowel they indicate the latter sound (*y*) alone, the preceding vowels having their usual French sounds (written *e* = French *è*).—In French im, in, under the conditions described above for *aim*, *ain*, have the sound there described, nearly like *a* in *fag*, pronounced through the nose. In Portuguese, under the same conditions, im, in are about like *i* in *machine*, pronounced through the nose.

j is generally like *y* in *ye*, *you*. In French, Portuguese, and Roumanian it is like *z* in *azure*, and for the Russian letter with this sound j has sometimes been used (see *zh*). In Spanish it is a strongly aspirated *h*. When in Scandinavian or Hungarian names it stands before a consonant and after a vowel it combines with that vowel to form a diphthong as *i* would do (see *aj*, *ej*, *oj*). In Italian j sometimes is a vowel, with the long sound of *i* in *machine*. In names from Sanskrit or modern East Indian tongues j is as in *joke*, as is also *jh* (properly the same followed by an aspiration).

k is generally as in English; but in Swedish before *e*, *i*, *ö*, *y* it resembles *ch* in *chin*, and in Norwegian before *i* and *y* it has the second sound of *ch* in German (voiceless *y*).—kh is sometimes used for a Russian letter sounded like German *ch* (see above); also for an Oriental guttural sound. In Sanskrit and modern East Indian names it is nearly as in *inkhorn*.—kj in Swedish and Norwegian respectively has the sound of Swedish or that of Norwegian *k* before *i* described above.

l is generally as in English.—ł in Polish is an *l* with guttural quality, resembling somewhat the *l* of some Englishmen in *hill*.—lh, ll are used, the former in Portuguese, the latter in Spanish, for a sound similar to *lli* in *million*, and *ll* in Welsh is voiceless *l*.—ly in Hungarian represents for

some speakers the sound of *lh* just described, but it is now oftener pronounced as *y* in *ye*.

m, n in French and Portuguese, when final or before a consonant (except another *m* or *n*), serve only to mark that the preceding vowel is nasalized. (See *aim*, *ain*, *am*, *an*, *em*, *en*, *ien*, *im*, *in*, *om*, *on*, *um*, *un*).—mp (μπ) in modern Greek is like *b*, but it may also mean *mb* if not initial.—ñ in Spanish is similar to *ni* in *union*, and ń in Polish and ň in Bohemian have the same value.—ng in German, Dutch, and Scandinavian is generally like *ng* in *singer*.—nh in Portuguese is about like *ni* in *union*.—nt (ντ) in modern Greek is like *d*, but it may also mean *nd* if not initial.—ny in Hungarian and Catalan represents the same sound as the preceding (*nh*).

o is like *o* in *note* or *nor*.—ô in French is like *o* in *note*.—ö in German, Danish, Swedish, Norwegian, and Hungarian is like French *eu* or nearly like *u* in *hurt*, and ø in Danish has the same sound.—õ in Portuguese is like *o* in *note*, pronounced through the nose (see *õe* below).—oe or œ is sometimes written in German or Scandinavian names; it is pronounced like *ö* above. In Dutch oe is like *u* in *rule*, *oo* in *fool*. In Latin names oe is pronounced like English *e*, in Welsh it is similar to *oi* in *boil*.—õe in Portuguese is similar to *oi* in *boil* pronounced through the nose.—oei in Dutch is Dutch *oe* (= *u* in *rule*), followed in the same syllable by *i* as in *machine*.—œu in French is like French *eu*.—oi is as in *boil*, except that in French it is nearly like English *w* followed by *a* as in *father*, and in modern Greek οι (οι) is like *i* in *machine*.—oin in French, if final or followed by a consonant other than *n*, is similar to English *w* followed by the French nasal vowel written *in* or *ain* (see these above).—oj, öj in Danish are like *oi* in *boil*.—oo is like *o* in *note*.—ou in French and modern Greek (ου) is like *u* in *rule* or *oo* in *fool*; it is often used for this sound in other names. In Portuguese ou is nearly like *o* in *note*, and in Dutch like *ou* in *out*.—ouw in Dutch is like *ou* in *out*, *ow* in *now*.—oy is generally like *oi*; in French, if a pronounced vowel follows, it is like French *oi* followed by *y* as in *ye*.

ph is generally like *f*, except in Sanskrit and some East Indian names, where it is like *ph* in *loophole*.

q is like *k*.—qu in French is generally like *k*, so too before *e* and *i* in Spanish and Portuguese. In other words it may be pronounced as in *quite*, though in German it is more like *kv*.—qv in Swedish is like *kv*.

r may be pronounced as in *red*; it should not be omitted (see, however, *er* above).—ř in Bohemian is like *r* followed by *z* as in *azure*.—rh, if both letters are in the same syllable, is as in *Rhine*.—rz in Polish is generally like *z* in *azure*.

s is generally as in *mason*, but in French, German, Italian (generally), and Portuguese a single *s* between vowels is like *z* in *zone*, and initial *s* in German before a vowel may be pronounced as *z*. In German initial *s* in *sp*, *st* may be pronounced like *sh* in *she*. In Hungarian *s* (see also *ss* below) is like *sh* in *she*. In French final s is generally silent; in Portuguese final s or s before a voiceless consonant, except another *s* (*p*, *t*, *f*, etc.), is like *sh* in *she*, and s before a voiced consonant (*b*, *d*, *v*, etc.) is like *z* in *azure*. (See also *sc*, *sch*, *sk*, *skj*, *stj*, *sz* below.)—š is written in some Slavic languages, as Bohemian, for the sound of *sh* in *she*, and ş in Roumanian has the same sound; also ş is sometimes used in names from Sanskrit with the same value.—ś in Polish is a palatalized *s*, between *s* in *see* and *sh* in *she*.—sc before *e* or *i* is like *sh* in *she* in Italian; in Roumanian it is like the same sound followed by *t*.—sch in German is like *sh* in *she*, and this German spelling is sometimes found in names not properly German. In Dutch it is like *s* followed by Dutch *ch* (see *ch*); in Italian and Roumanian like *sk*.—sh is like *s* followed by *h*; but in Russian names it is as in *she*.—sj in Dutch, Danish, Norwegian, and Swedish is nearly like *sh* in *she*.—sk is generally as in *skin*, but in Swedish before *e*, *i*, or *y* it is like *sh* in *she*, as also in Norwegian before *i* or *y*, and skj in Swedish and Norwegian has the same sound.—ss is generally like *s* (sometimes lengthened; see 7 above); in Hungarian it is like *sh* in *she* lengthened.—stj in Swedish is like *sh* in *she*.—sz in Polish is like *sh* in *she* (see also *cz*); in Hungarian sz is like *s* in *mason*, and *ssz* is a long *s*.

t is generally as in *state*. If final in French it is usually silent.—ţ in Roumanian means *ts*.—th is generally like *t*; but in modern Greek (θ), Icelandic (representing þ), and Welsh it is as in *thin*.—tsch in German is like *ch* in *church*; it is sometimes found in names not properly German with the same sound.—tsh in Slavic names is like *ch* in *church*.—ty in Hungarian is similar to *ty* with consonantal *y*.—tz is like *ts*.

u is generally as in *rule* or as *oo* in *fool*; but in French (see, however, *um*, *un*) it has a sound not existing in English, produced by pronouncing *i* as in *machine* with the lips rounded as for *u* in *rule*. In Dutch it has the same sound when it ends a syllable (see also *uu*); if a consonant follows in the same syllable Dutch u is nearly like *u* in *cut* or *hurt*. In Welsh u is generally like *i* in *machine*. Written u is sometimes silent (see *gu*, *qu*).—ü in German and Hungarian is like French *u*.—ue is sometimes written instead of *ü*; except in German both vowels are usually heard; see, however, *gu*, *qu*.—ui in French is French *u* followed by *i* in *machine* in the same syllable, but the *u* is sometimes silent (see *gu*, *qu*). In Dutch ui is somewhat like *oi* in *boil*.—um, un often represent in French and Portuguese nasal vowels (see *m*, *n* above), though French final *um* is sometimes pronounced *om* (somewhat like *om* in *Tom* or *um* in *hum*). The French nasal sound is French *eu* nasalized, much like *u* in *hut*, pronounced through the nose; the Portuguese one is *u* in *rule* or *oo* in *fool*, pronounced through the nose.—uu in Dutch is like long French *u*.—uy is in French like French *ui*, but, if a pronounced vowel stands after *y*, the *ui* is followed by *y* as in *ye*. Dutch uy is like Dutch *ui*.

v is generally as in English; but in German initial v is like *f*, and in Danish v is written instead of *u* as the last vowel of some diphthongs. See also *w* and see 6 above.

w is in general like *v*. In a few German names in *-ow* the final w is silent (see also *auw*, *eeuw*, *ieuw*). In Welsh w is generally a vowel, like *u* in *rule*. The Russian letter sounded like *v* is sometimes written *w* in Roman letters, and sometimes *v*, or when final *ff* (see 6 above).

x is generally like *ks* as in English; but in Portuguese and Catalan *x* is like *sh* in *she*, and in some Spanish names *x* is occasionally found for the sound of a strong *h*, where the usual modern spelling has *j* or *g*.

y is generally like *i* in *machine*. Before a vowel it is like *y* in *ye* in Spanish and French (see also *ay*, *ey*, *oy*, *uy*). In Danish, Swedish, and Norwegian it is like French *u*. In older Dutch spelling it was like *i* in *ice*, as in Flemish; Dutch now writes *ij* instead. In Polish, and when it represents a certain Russian letter, it is a kind of retracted *i*, somewhat resembling *i* in *pit*. In Welsh it is sometimes like *i* in *sir*, and sometimes resembles *i* in *pit*.—(See also *gy*, *ly*, *ny*.)—ym, yn in French are like French *im*, *in*.

z is often as in English; but in German it is always like *ts*; in Italian it is like *ts* or sometimes, especially when initial, like *dz*, and in Spanish it is like *th* in *thin*. Final z in Portuguese is like *sh* in *she*.—ż (in Polish), ž (common in Bohemian), zh (sometimes representing a certain Russian letter), and zs (in Hungarian) are all like *z* in *azure*.—ź in Polish is a palatalized *z*, between *z* in *zone* and *z* in *azure*.—zz in Italian is generally like *ts*.

Some letters with diacritic marks, as dots or other signs, not included above, are mentioned in the list of PECULIAR PHONETIC SYMBOLS at the beginning of this volume; see also the KEY TO THE PRONUNCIATION. For fuller information as to the sounds and the orthography of the languages concerned, see the articles on FRENCH, GREEK, LATIN, and other languages, and various grammars; also PHONETICS, and the works there referred to, especially *Phonetische Studien* and the bibliographical list in Sievers's *Grundzüge der Phonetik*.

E. S. SHELDON.

Pronunciation of Greek: the prevailing methods of pronouncing the ancient classical Greek. Though characterized by minor diversities, these may be grouped in general under three heads: (1) The English method, which gives to the symbols the value common to them in English, and accents according to Latin rules, disregarding the written accents. This method has been almost entirely discontinued in the U. S., but is still widely used in Great Britain and Canada. Among the different nations of continental Europe analogous methods are in vogue—i. e. the letters are sounded according to the general analogies of the native tongue, though the written accent is observed. This does not, however, necessitate, in general, so wide a departure from the original pronunciation as the English method. (2) The modern Greek method. This assigns to the letters the values they have in modern Greek; see under GREEK LANGUAGE (*Modern Greek*). Though this method has many advocates, it is unlikely of adoption, because it sadly confuses the original vowel-sounds, and departs widely from the clearly ascertained facts of the ancient pronunciation. The application of the modern English pronunciation to the reading of Chaucer would be a fair parallel. (3) The ancient

Greek method. The present tendency is strongly toward the adoption of what can, with reasonable certainty, be determined to have been the Attic pronunciation of the fourth century B. C. Its chief characteristics are approximately indicated in the following table:

Vowels.	Consonants.
α as *a* in Eng. *father*.	γ as *g* in Eng. *go*.
ε as *é* (close) in Fr. *blé*.	γ before κ, γ, χ, ξ, as *n* in Eng. *ink*.
η as *e* (open) in Eng. *there*.	ζ either as *zd* or *dz*.
ι as *i* in Eng. *machine*.	θ, ϑ as *th* in Eng. *hothouse*.
ο as *o* (close) in Fr. *mot*.	ξ as *x* (*ks*) in Eng. *box*.
ω as *o* (open) in Fr. *encore*, and nearly as *o* in Eng. *orb*.	σ, ς as *s* (sharp) in Eng. *siss*.
υ as *u* in Fr. *ruse*, or Germ. *ü* in *für*.	τ always as *t* in *tip* or *cat*.
	φ as *ph* in Eng. *uphill*.
	χ as *kh* in Eng. *blockhead*.
	ψ as *ps* in Eng. *autopsy*.

Diphthongs.
αι as *ai* in Eng. *aisle*.
αυ as *ou* in Eng. *out*.
ει as *ei* in Eng. *vein*.
ευ as ε followed by *u* of Eng. *rude*.
οι as *oi* in Eng. *boil*.
ου as *ou* in Eng. *you*.
υι as *u* of Eng. *rude* followed by ι.

Other consonants have the ordinary sounds of their equivalents in English. Rho (ρ) should always be given its own distinct sound, and not be dropped at the end of words after a vowel, as is common in English. The vowels ε and ο were close and short, and have no equivalents in English; η and ω were, however, open and long. The long vowels corresponding to the shorts ε and ο were, at least until the middle of the fourth century, when ου became *ū*, the pseudo-diphthongs ει and ου. In direct contrast with the Greek it is to be noted that in Latin *ĕ* and *ŏ* are open and *ē* and *ō* are close. See F. Blass's *Pronunciation of Ancient Greek* (trans. from the 3d German ed., 1890); K. Zacher, *Die Aussprache des Griechischen* (1888). Benj. Ide Wheeler.

Pronunciation of Latin: The pronunciation of the Romans themselves at the height of their civilization (i. e. in the Augustan age and the time of the early empire) was substantially as follows:

A. *Vowels.*—*ā* as in father, *ă* as in the first syllable of *ahá*; *ē* as in *they*, *ĕ* as in *met*; *ī* as in *machine*, *ĭ* as in *pin*; *ū* as in *rude*, *ŭ* as in *put*; *y* like French *u*, German *ü*.

B. *Diphthongs.*—*æ* like *ai* in *aisle*; *œ* like *oi* in *oil*; *au* like *ow* in *how*; *eu* with its two elements pronounced in rapid succession.

C. *Consonants.*—*b*, *d*, *f*, *h*, *k*, *l*, *m*, *n*, *p*, *qu* were pronounced as in English; *bs* and *bt* had the sound of *ps* and *pt*; *c* always as *k*; *t* always a plain *t*, never with the sound of *sh* as in English *oration*; *g* always as in *get*, except that when *ngu* precedes a vowel *gu* has the sound of *gw*, as *anguis*, *languidus*; *j* like *y*; *r* slightly trilled; *s* always voiceless as in *sin*, but in *suadeo*, *suavis*, *suesco*, and in compounds and derivatives of these words *su* has the sound of *sw*; *v* like *w*; *x* always like *ks*, never like English *gz* or *z*; *z* like English *zd* or *dz*. The aspirates *ph*, *ch*, *th* were pronounced like English *ph*, *ch*, *th* in such compound words as *loop-hole*, *block-house*, *hot-house*. Geminated consonants (e. g. *ll*, *mm*, *tt*) were pronounced with each member of the combination distinctly articulated.

For Latin scientific names the following pronunciation (often called English) is usually followed; but a strong tendency is now manifesting itself among scientists to adopt the Roman pronunciation:

A. *Vowels.*—These have their long English sounds (*a* in *make*, *e* in *me*, *i* in *kite*, *o* in *go*, *u* in *rude*, *y* in *lyre*) when final; before another vowel; in penultimate (next to the last) and unaccented syllables, not final, before a single consonant or before a mute followed by *l* or *r*. Vowels have their short English sounds (*a* as in *bat*, *e* as in *met*, *i* as in *pin*, *o* as in *not*, *u* as in *run*, *y* as in *myth*) in final syllables ending in a consonant; in all syllables before *x* or any two consonants, except a mute followed by *l* or *r*; in all accented syllables, not penultimate, before one or more consonants.

B. *Diphthongs.*—*æ* and *œ* like *e* in the same situation; *au* as in *author*; *eu* as in *neuter*.

C. *Consonants.*—These are pronounced in general as in English, but *c*, *s*, *t*, when preceded by an accented syllable and followed by *i* and another vowel, have the sound of *sh*; *x*, under the same circumstances, is pronounced as *ksh*; *ch* is always hard, as in English *echo*.

See Seelman, *Die Aussprache des Latein* (1885); Lord, *The Roman Pronunciation of Latin* (1894).

Charles E. Bennett.

Propagan'da [abbrev. from Lat. *Congrega'tio de Propagan'da Fi'de*, the Lat. name, liter., association for spreading the faith]: a congregation of cardinals at Rome, first fully established in 1622 by Gregory XV., for furthering the spread of the Roman Catholic religion among the heathen; also, the great college (Collegium Urbanum) for training missionaries sustained by this body.

Proper'tius, Sextus: elegiac poet of Rome; b. in Umbria, near the frontier of Etruria, probably at Assisi; lost while still a youth most of his property by confiscation, and lived in Rome on a small competence; devoted himself to poetry; attracted the attention of Mæcenas, and resided on the Esquiline in familiar intercourse, as it seems, with Mæcenas, Vergil, and Ovid. The exact dates of his birth and death are unknown, but he was probably born about 49 and died about 15 B. C. His *Elegies* (in five books), which appear to have been much appreciated in antiquity, have come down only in a very corrupt text, and are in a way less enjoyable than the similar productions of Tibullus and Ovid on account of their style, which is cumbersome and obscure. These defects are offset by his strength of imagination, and vivid power of description, the genuine fervor of his passion, and his delicate sense of beauty. There are editions by W. Hertzberg (Halle, 1843–45, 3 vols.), Keil (Leipzig, 1850), Haupt (revised by Vahlen, Leipzig, 1885), A. Palmer (Dublin, 1880); a translation into English verse by Charles Robert Moore (Oxford, 1870); and an excellent edition of selections, with introduction and notes, by Postgate (London, 1881). See also W. Y. Sellar, *Horace and the Elegiac Poets* (Oxford, 1892). Revised by M. Warren.

Property [from O. Fr. *proprete* < Lat. *propri'etas*, property, liter., ownness, deriv. of *pro'prius*, own, proper]: in the broadest sense, all private rights of economic value. In this sense the term covers (*a*) real rights—i. e. rights over corporeal objects; (*b*) obligations—i. e. rights of demanding from particular persons that they do or refrain from doing particular things; (*c*) rights of a monopolistic nature (patents, copyrights, etc.), which confer an exclusive power of making and selling certain things. As here treated the word property is confined to rights over corporeal things.

Roman and European Law.

Roman Law.—Many provisions of the Roman law are applicable only to immovables, and many other provisions only to movables; but in general the same body of rules governs both classes of property, both as regards relations *inter vivos* and as regards inheritance.

Rights over things are either general or partial. The general right is ownership (*dominium*, *proprietas*). This includes all rights over the thing not expressly withheld by the law or granted by the owner to other persons. Ownership is acquired either from a former owner, so that the title of the new owner depends upon that of his predecessor (*auctor*), or by the operation of some rule of law which vests in the new owner an independent title. In the former case the acquisition is "derivative"; in the latter case it is "original." The most important modes of derivative acquisition recognized at Roman law were (*a*) conveyance, which implies an agreement between the conveyor and the conveyee and the delivery of possession (*traditio*), and (*b*) inheritance or legacy. (See Succession.) The modes of original acquisition were occupation, accession, specification, and prescription. (*a*) Occupation signifies, literally, taking possession. If the thing occupied has no owner (*res nullius*), the assumption of possession with the intention of assuming ownership creates ownership. Among *res nullius*, capable of occupation, the Romans classed wild animals; shells, stones, etc., on the seashore; and things derelict. Dereliction is the opposite of occupation; it consists in the abandonment of possession with the intention of abandoning ownership. Things lost are not derelict, and the finder does not acquire ownership; but treasure-trove (*thesaurus*) is regarded as *res nullius* when the articles found have been so long hidden that the owner can not be discovered. In such case half the treasure goes to the finder, the other half to the owner of the soil. (*b*) Accession signifies that what was previously an independent thing has become a part of some other thing, and has thereby passed into the ownership of him who owns the principal thing. An example of accession is the planting of a tree. No separate ownership is possible in the tree; it goes with the land. The same rule properly applies to a building erected on another man's land, and to the materials employed in its construction; but here the original ownership of the materials is not deemed to be extinguished, but simply suspended. Other cases of accession

are *alluvio*, or the gradual deposit of soil by the action of running water; and *avulsio*, or the sudden deposit of soil torn from another's land by a freshet or a landslide. Accession is also possible in the case of movables; so when a leg is fitted into a chair, a blade inserted in a knife, etc. (*c*) Specification takes place when a thing is converted by labor into a new and different thing (*nova species*). Cases of specification range from the conversion of wine into vinegar to the manufacture of watch-springs out of a bar of metal, and from these purely mechanical transformations to such as are effected by the artistic skill of a sculptor or painter. In all these cases the maker of the new thing becomes owner, although the material was not previously his, provided he has acted in good faith; provided also (by a positive rule of Justinian's) the new thing can no longer be reduced to its previous condition.

Partial rights (*jura in re*) were divided by the Roman jurists into rights of use and rights of pledge or mortgage. Rights of use were (*a*) servitudes; (*b*) hereditary leaseholds. The ordinary lease was a purely contractual relation, and created no *jus in re*; but where unimproved land was leased for long terms a very liberal measure of "tenant right" was accorded to the lessee. Such leaseholds were termed *emphyteusis* when the land was used for agricultural purposes, *superficies* when it was used for the erection of buildings.

Mediæval Developments.—Teutonic custom drew a much sharper distinction between realty and movables than was drawn at Roman law. The feudal system, which associated political powers with the ownership of land and public or quasi-public duties with its possession, accentuated the distinction; so that mediæval law developed quite different rules for realty and personalty, both as regarded relations *inter vivos* and as regarded inheritance.

Rights in immovables could be acquired as a rule only by inheritance or by some public form of "investiture" or conveyance. Transfer of realty was generally restricted: partly in the interest of the ruling classes by the system of feudal tenures, and partly in the interest of the family by the system of family community. As regarded movable property, delivery of possession regularly passed title. Except in the case of lost and stolen things, and except as between bailor and bailee, Teutonic custom treated possession as equivalent to title. Transfer of movables was regularly unrestricted.

In neither field of property rights was the distinction between ownership and the lesser rights so sharply formulated as in the Roman law. As regarded realty the confusion was increased in the course of the Middle Ages by the systems of feudal and of peasant tenures. The feudal system gave to one person, the lord, general residuary rights in the land, and in particular a more or less effective reversionary right; to another person, the vassal, it gave rights of possession and use which everywhere tended to become hereditary and alienable. When Roman legal theories began to dominate mediæval thought the jurists found some difficulty in deciding whether the lord or the vassal really owned the land; and they solved the problem by attributing to the former a higher or superior ownership (*dominium eminens* or *directum*), and to the latter "practical ownership" (*dominium utile*). Similar difficulties were encountered in dealing with peasant tenures, especially in Germany. In many parts of Germany the private or property rights of the manorial lord (as distinguished from his jurisdictional rights) were limited to the receipt of customary rents and services, the peasants having perpetual and hereditary leases (*Erbpacht*). Here again, with the reception of the Roman law, the jurists worked out the un-Roman distinction of superior and inferior ownership (*Obereigenthum* and *Untereigenthum*). With the decay of the feudal system and the disappearance of the reversionary rights of the feudal lord, the inferior rights of the vassal developed into the full right of ownership, while the eminent domain of the lord gradually lost the character of a property right and became simply governmental power. Peasant rights also have usually been converted by modern legislation into full proprietorship. In all modern European states the confused system of the Middle Ages is rapidly disappearing, and ownership in the Roman sense is sharply distinguished on the one hand from political power and on the other from lesser and partial rights in the land.

The feudal system has nevertheless left permanent traces in the modern law of property, both as regards inheritance of realty (see Succession) and as regards other modes of acquisition. The effort of the feudal princes to reserve control over forests, hunting, and fishing, paved the way for the modern governmental control of all these matters. Early in the Middle Ages animals *feræ naturæ*, if regarded as objects of sport, ceased to be open to occupation except by him who had the right to take them. The efforts of the feudal princes to increase their revenues led also to an assertion of exclusive governmental right over other things which the Romans regarded as *res nullius* (e. g. things washed up by the sea, abandoned land, enemy's goods; in some territories *thesaurus*, or treasure-trove). The same efforts gave rise to the theory that mining privileges belonged to the feudal lord, and could be exercised only by his license, which was regularly issued to the first finder. The owner of the soil could demand only compensation for damage done to the surface, and in some territories a share in the venture. The right to minerals was thus separated from the right to the surface. Nearly all these "royalties" (*regalia*) have passed into modern European law as rights of the state or "fiscus."

Modern Legislation.—Some of the older codes confuse rights over things with property rights in the broader sense, and speak of an "ownership" of obligations, etc.: but in the more recent codes rights over things are sharply distinguished from rights *in personam*. Immovables and movables are subjected to very different rules, but the distinction is obscured by a formal unity of treatment.

Ownership (*domaine, propriété, Eigenthum*) is the general right in the Roman sense. As regards original acquisition, the list of *res nullius* has been limited and the field of occupation narrowed by the development of fiscal rights. The Code Napoléon declares that all property without an owner belongs to the state, but it makes an exception in the case of treasure-trove (*trésor*) and applies the Roman rule. Some of the existing German codes give a share of treasure-trove to the state or the commune, but the draft code for the whole empire proposes to re-establish the Roman rule. As regards accession, the Roman rules are generally accepted. The law of specification is substantially Roman; but the Saxon code and the German draft code discard the distinction between the honest and the dishonest maker, and all the modern codes reject the distinction between a new thing that can be reduced to its original form and one that can not be so reduced. In determining the ownership of the new thing many codes lay stress on the relative value of the material and the labor.

As regards conveyance, the French law breaks with the Roman law by declaring that title passes with the conclusion of the contract and without delivery of possession; but while this rule governs the relations between the conveyor and the conveyee it does not operate against third persons.

The most sweeping changes that have been introduced in the modern law of property are due, in the case of movable property, to the protection given to the honest possessor (see Possession), and in the case of immovable property to the registration laws. See Recording etc. Munroe Smith.

English and American Law.

The English law of property, from which that of the U. S. is derived, followed an independent line of development. Whereas, to the Roman law, land and goods were only differing forms of property, accidentally discriminated by the physical differences between them, but both of them subject to ownership in the same sense of that term and for the most part governed by the same rules of law, in the English system this physical difference became fundamental, and resulted in two distinct bodies of law—the law of "real property" and the law of "personal property." This result was due to the peculiar and exceptional character impressed upon land as the subject of property by the feudal system. As explained in the articles on Estate and Landlord and Tenant, that system was wholly based on the conception of land, not as subject to ownership, as chattels are owned, but as subject to a qualified interest or estate, limited in duration, and exacting of the holder, or "tenant," the performance of feudal services as the condition of his tenure. Nor was the "lord," of whom the land was held, in any better situation; he in his turn held the land as tenant of some superior lord, and so the feudal hierarchy ascended until it reached the king as lord paramount. So while goods and chattels continued to be subject to that absolute control which we call ownership, lands were merely "held" by a variety of tenures or estates, the ultimate ownership being vested in the crown or state.

It would be a mistake, however, to assume that the distinction between real and personal property coincides with

that between land and goods, or between the "movables" and "immovables" of the Roman law. Here, as so often in the history of the common law, the inflexible methods of procedure by which rights were enforced gave rise to an artificial distinction, based, indeed, on the fundamental difference between movables and immovables, but not following the natural line of cleavage between them. The terms "real" and "personal," now employed to describe different classes of rights over things, originally described only different forms of action. The *real* action was a proceeding for the recovery of the *res*, the very thing of which the party complaining had been deprived; the *personal* action, on the other hand, was an action against a certain person for the infringement of a right, but it sought to recover, not the property itself, but damages for its detention or destruction. By reason of the permanent, indestructible character of lands, the real action was especially appropriate for recovering possession of them. Hence lands were called *real* property. But goods and chattels, being easily susceptible of destruction, or loss, or concealment, and being, moreover, infinitely less important to feudal society than freehold interests in land, could not be pursued and recovered by a real action. The only remedy provided by law for the unlawful destruction or detention of a chattel was the personal action for damages. Hence goods, or chattels, came to be known as *personal* property.

Not all interests in land, however, could be recovered by a real action. All estates of freehold—fees simple, fees tail, life-estates—were considered worthy of recovery by this solemn form of procedure; but leases for years, which were not properly estates at all, which existed by virtue of contract merely, and which were deemed unworthy of freemen, were not recoverable by real action. In other words, the tenant for years, if he was unjustly dispossessed, whether by his lord or by a stranger, had originally no remedy but a personal action for damages. Accordingly, terms of years came to be regarded as personal property, notwithstanding the fact that the right to recover possession of his leasehold by ejectment was conferred upon the tenant for years at a very early period. By virtue of this right to maintain ejectment for its recovery, the term of years became a true estate or interest in lands, but it has never lost the anomalous character which its humble origin impressed upon it. A leasehold of 1,000 years is still, in the U. S. as well as in England, regarded as personal property, whereas an estate for life is a freehold, and has all of the incidents of real property. In Massachusetts and a few other States, however, leaseholds of great length are assimilated to real property.

Personal property, then, includes not only goods or chattels, but also such interests in lands as the early common law did not deem worthy of protection by a real action. The legal conceptions to which the feudal system gave rise were responsible for another anomalous extension of the notion of personal property. All property rights are in their nature rights of control over material objects—called rights *in rem*—and are opposed to those legal rights which do not directly concern things, but persons, which are known as rights *in personam*. A large body of rights of this latter class—i. e. rights of action, such as claims, demands, etc., called *choses in action*—were brought into the classification of personal property. To these must be added those other intangible rights recognized by modern law, such as trademarks, patent rights, copyright, etc.

Real property, on the other hand, comprehends much besides those estates or interests in land, called freehold interests, which were anciently deemed worthy of protection by real action. The term includes also all those rights of use or enjoyment in the lands of others which, under the description of easements, profits and rents, fill so large a space in the modern as well as in the ancient law of property, together with all those movables which, by becoming attached to the soil, have acquired the character of FIXTURES (*q. v.*). On the other hand, certain things which are usually regarded as real property, may, because of special circumstances or as between particular persons, fall into the category of personal property. This is true of such growing crops as have acquired the character of "emblements," of trees standing or cut, of stones which have been quarried but not removed, etc. In all such cases, however, the special circumstances must be shown in order to rebut the presumption arising from the apparent connection of the articles in question with the land.

The complicated system of feudal tenures above referred to has long since been swept away. The freehold tenant no longer holds his land as the fee of a lord, excepting in a few manors which still survive in England. But the tenure of lands, in the U. S. as well as in England, continues to exhibit the feudal form. In some of the States it is expressly provided by statute that all lands shall be held by "allodial"—that is, absolute—titles; but, notwithstanding that declaration, there is no such thing as absolute ownership of lands. The state is lord paramount, and the landowners hold their fees in subordination to its paramount title.

The popular notion of *ownership* is, for most purposes, a sufficiently accurate definition of the extent of the right of property; it indicates in general either a present or an ultimate right of possession, coupled with the control of the thing and the power of transferring this ownership in whole or in part to another. Of course, the actual physical possession may be in another than the owner, and even the right of possession may be temporarily vested in another person—as in a tenant of lands or a bailee of goods—but there can be no property without actual or constructive possession, or the right to resume or control the possession at some time in the future. Indeed, so important is the fact of possession even without right, and the right of possession without ownership, that they have in law many of the attributes of actual property rights. Attention is called in the article on LIMITATION OF ACTIONS to the extraordinary consequences of a disseisin, whereby a disseisor, by dispossessing the rightful owner of lands and installing himself in his place, acquires the lawful seisin, the "property" of the former owner, and becomes a new root of descent. But it is also true that the disseisor has by his act acquired a right of possession and a title against the whole world besides the rightful owner: and if he is, in his turn, disseised, he can recover the lands by process of law. So, in the law of personal property, one, not the owner, who has the temporary right of possession of chattels (as a pledgee, for example), is said to have "a qualified property" in the goods, giving him certain rights of control and disposition, which could not be lawfully exercised by one who had no proprietary interest. The term "seisin" was originally identical in meaning with "possession," and was applied indifferently to real property and to chattels, but it was ultimately appropriated exclusively to describe the possession of freehold interests in land, the term possession being reserved for chattels and chattel interests. Accordingly, if X, a tenant in fee simple, leases his lands to Y for a term of years and the latter enters and occupies them, there is a double possession; Y is *possessed* of the premises as tenant for years, and X is at the same time *seised* of them by virtue of his freehold.

The two classes of property under consideration differ greatly in the extent and kind of use and enjoyment which are the attributes of ownership of them respectively; but this difference is wholly due to the nature of the subject-matter in each case. As has been said before, the right of property in chattels is in its highest estate absolute and untrammeled. A man may do what he will with his own. But while the right of property in land is unlimited in extent—extending to an indefinite distance below and above the surface—it is nevertheless strictly limited and circumscribed by the physical and social conditions which prevail.

Land, as the seat of man's habitation, is so bound together with and related to all other adjoining land, that to admit an absolute right of property in one man would be to devote his neighbor's property rights to destruction. Hence we have the principle that a man may make only such use of his land as is compatible with the due and reasonable enjoyment by his neighbor of *his* land. In order to enforce this obligation of mutual forbearance the law recognizes three so-called "natural rights" of property: I have a right to require of my neighbor that he shall not by excavations on his own land withdraw the natural support of my land; that he shall not vitiate the air which visits my premises with noxious or disagreeable substances, odors, or noises; that he shall not unreasonably interfere with the watercourse which passes over my land. These are fluctuating rights, however, and vary in degree according to the conditions of life and industry which prevail in the locality, the test of infringement of the property right in each case being the reasonableness or unreasonableness of the act complained of in view of all the circumstances.

In addition to these original and natural limitations on dominion, the absolute right of property is further extensively limited by that numerous class of rights over the land of others known as easements, profits, etc. While these rights are in themselves, as has been explained above,

a species of real property, they are from the point of view of the person over whose land the rights exist, serious limitations on his enjoyment of his own lands.

The principal remaining differences between the two classes of property under consideration display themselves in the mode of conveyance requisite to transfer them, respectively, and in the disposition which the law makes of them upon the death of the former owner intestate. Personal property is still transferred by delivery, so far, at least, as it is susceptible of manual delivery; where this is not possible the transfer is effected by delivery of some evidence of the property or by some writing. The transfer of real property, which passed at common law only by "livery of seisin" (a symbolical delivery of possession), or, in the case of incorporeal hereditaments (see HEREDITAMENTS) by grant, or instrument under seal, is now effected by deed, sealed and delivered. (See DEED.) For the alienation of goods by SALE and GIFT, see those titles.

By the laws of descent and distribution, upon the death of a property-owner intestate his real estate passes at once to his heir, and his personal property into the jurisdiction of a probate or surrogate's court, where its distribution to creditors and next of kin is supervised and effected. This process of distribution is known as the "administration" of the estate, and is carried out through the medium of an administrator appointed by the court. If the decedent leaves a will his lands go directly to the devisee, but the personal property to the executor for distribution according to the terms of the will. See DESCENT and WILL.

The principal modes of acquiring property are considered elsewhere, and need only be referred to here. Under the head of "original acquisition" are included the taking of title to chattels by occupancy or finding, by capture (of wild animals), by confusion and accession, and the acquisition of title to new lands by accretion. The acquisition of title by disseisin and lapse of time is discussed in the articles on LIMITATION OF ACTIONS and PRESCRIPTION. Conveyances, by deed or otherwise, include gifts. Gifts *causa mortis* are a kind of informal will which has been much favored by the courts. (See WILL.) At the present time both real and personal property may be freely alienated by will, though the right to devise real property did not exist at common law. It was created by the Statute of Wills (32 Hen. VIII., ch. i., A. D. 1540). The subjects of descent and distribution are now wholly regulated by statute.

The law of property as above outlined prevails over the whole of North America, except in the State of Louisiana, the Province of Quebec, and the republic of Mexico, where modifications of the Roman or civil law are in force. The states of Central and South America are also governed by codes which are mainly derived from the civil law.

See also articles on FEUDAL SYSTEM, CHATTEL, and REMAINDER. Consult Leake, *Digest of Law of Land*; Washburne, *Real Property*; Schouler, *Personal Property*; Pollock and Wright on *Possession*; and Raleigh's *Outline of the Law of Property*. GEORGE W. KIRCHWEY.

Prophet [from Gr. προφήτης, interpreter, one who declares and explains clearly (πρό). The word is, however, also used to translate the Hebrew *nābi* with its sense of one who has insight into God's mind and reveals it]: he who speaks for another, *proclaimer*, preacher; or one who predicts future events. In the records of all nations from the most remote antiquity there are accounts of men who claimed, and were believed to have, special and immediate intercourse with the Deity. The most remarkable and familiar instances of these phenomena appear in the nations of the East, more particularly among the Hebrews. In the Old Testament they are called נביא, speaker, interpreter—i. e. revealer—of the divine will to man (in no case does it mean predicter of future events), Ex. iv. 16; vii. 1. Comp. חזה, ראֶה, seer. In the earlier ages they appear chiefly as seers (ראה, 1 Sam. ix. 9), leading a contemplative life apart from the world. Apparently about the time of Samuel, with whom the prophetic age begins, they were organized into communities, known as בני אלהים (comp. *Darwîs* of the present day), established in various places under the charge of old and experienced prophets, devoting their time to the study of the sacred writings and ecstatical religious exercises. After the exile all trace of these organizations is lost; the prophets appear separately and at intervals, and from Malachi to John the Baptist there arose no prophet in Israel. The prophets led in the main an ascetic life, supported by the contributions of the charitable (2 Kings iv. 42), by the gifts of those who sought counsel from them (1 Sam. ix. 7; 1 Kings xiv. 3; 2 Kings v. 15, 16 ff.; *ib.* viii. 8), or by fruits herbs, etc., gathered by themselves (2 Kings iv. 39; Matt. iii. 4). Their costume was a mantle of skin (Zech. xiii. 4; 1 Kings xix. 13) girded around the loins (2 Kings i. 8; Matt. iii. 4).

The call to the prophetic office was an inward one from God, but those so called were not at all times in a state of inspiration, nor was this under control of their will. The divine revelations were not received in a state of ecstasy, but in visions or in an elevated though entirely rational condition. The form in which the prophecies were communicated to the people depended entirely on the age and the individuality of the prophet, whether by verbal communication, symbolic actions, which were mostly unreal, or by writings (Isa. xl. ff., and some of the later prophets). The prophets had mainly in view the reformation and elevation of the people, but announced future calamity or deliverance of their own or neighboring peoples as an aid to present guidance. Revised by S. M. JACKSON.

Propion'ic Acid [*propionic* is from Gr. πρῶτος, first + πίων, fat; so called because it is the first member of the series of fatty acids that has oily or fatty properties]: the third member of the series of fatty acids. Its composition is $C_3H_6O_2$. It occurs in the fruit of *Gingko biloba*, in sweat, and in wood-vinegar. Gottlieb, its discoverer, obtained it by oxidizing metacetone, and therefore called it metacetonic acid. It can be made in the laboratory by a number of methods, the most satisfactory being the oxidation of propyl alcohol, to which it bears the same relation that acetic acid bears to ordinary or ethyl alcohol, and formic acid to methyl alcohol. It is a liquid that mixes with water in all proportions. It boils at 140·9° C. IRA REMSEN.

Prop'olis [= Lat. = Gr. πρόπολις; πρό, before + πόλις, city, so called because it is used to close small approaches to the hive]: a resin which the honey-bee collects upon its posterior tibiæ and carries to the hive, where it is used in filling crevices, finishing combs, and the like. In the U. S. it is mainly collected from the buds of the birch, the horse-chestnut, and the balsam-poplar.

Proportion: in mathematics, an equality of ratios, a ratio being the relation, expressed by division, which one quantity bears to another. Four quantities are said to be in proportion when the ratio of the first to the second is equal to the ratio of the third to the fourth. A proportion may be written in either of two ways; thus if the ratio of a to b is equal to the ratio of c to d, the equality may be indicated by either of the following expressions:

$$\frac{b}{a}=\frac{d}{c}, \text{ or } a:b::c:d.$$

Either of them may be read *a is to b as c is to d*. The first and third terms are *antecedents*; the second and fourth terms are *consequents*; the first and fourth are *extremes*; the second and third are *means*. The first ratio is called the *first couplet*, and the second ratio is called the *second couplet*. Two varying quantities are said to be directly proportional when their ratio is constant; inversely, or reciprocally, proportional when their product is constant. But this distinction of proportion does not seem to serve any useful purpose. A continued proportion is an expression of continued equality between three or more ratios; thus

$$\frac{b}{a}=\frac{d}{c}=\frac{f}{e}, \text{ etc., or } a:b::c:d::e:f\ldots, \text{ etc.,}$$

is a continued proportion. The terms of a geometrical progression form a continued proportion.

The following are some of the ways in which proportions may be transformed: (1) The antecedents may be made consequents, and the consequents antecedents; the proportion is then said to be transformed *by inversion*. (2) Antecedent may be compared with anteeedent, and consequent with consequent; the proportion is then said to be transformed *by alternation*. (3) The sum of the antecedent and consequent of each couplet may be compared with either the antecedent or consequent of the corresponding couplet; the proportion is then said to be transformed *by composition*. (4) The difference of the antecedent and consequent of each couplet may be compared with either the antecedent or consequent of the corresponding couplet; the proportion is then said to be transformed *by division*.

The most important principles of proportions are the following: (1) If four quantities are in proportion, the product of the means is equal to the product of the extremes; *con-*

versely, if the product of two quantities is equal to the product of two other quantities, the first two may be made the means and the other two the extremes of a proportion. (2) If a couplet in each of two proportions is the same, the remaining couplets will form a proportion. (3) If four quantities are in proportion, they will also be in proportion by inversion, by alternation, by composition, or by division. (4) Equimultiples of two quantities are proportional to the quantities themselves. (5) In a continued proportion the sum of all the antecedents is to the sum of all the consequents as any antecedent is to the corresponding consequent. (6) If the corresponding terms of two or more proportions are multiplied together, the products will be in proportion; consequently, like powers or like roots of all the terms of a proportion are in proportion. Revised by R. A. ROBERTS.

Proportional Representation: See REPRESENTATION.

Proposition: See LOGIC.

Propylite [Gr. *πρόπυλον*, or *τὰ προπύλαια*, gateway]: a name given in 1867 by von Richthofen to certain altered forms of andesites and allied volcanic rocks (formerly called greenstone trachytes), which are greatly developed in the silver districts of Hungary and the Comstock lode (Nevada). The name was selected under the impression that these rocks constituted a distinctive type which ushered in a renewed period of volcanic activity at the beginning of the Tertiary period, after long-continued inactivity in Mesozoic times. These rocks have since been shown by Wadsworth, Becker, and others to be only normal and widely distributed igneous varieties, whose ferromagnesian constituents have been extensively altered to fibrous hornblende, epidote, chlorite, and similar secondary minerals. The name propylite can not, therefore, be regarded as having any petrographic significance except to denote a certain phase of alteration, which may be closely connected with the deposit of silver ores in the regions above named. See Monograph III. and Bulletin No. 17 of the U. S. Geological Survey.

GEORGE H. WILLIAMS.

Prosecutor: in law, one who institutes and carries on a criminal proceeding against another in the name of the government.

In most countries the duty of making a preliminary investigation into the circumstances of an offense, collecting the evidence for trial, and managing the trial of the case is imposed upon public officers. This is the case throughout the continent of Europe. In Scotland there are officers (procurators-fiscal) charged with the duty of instituting criminal proceedings, obtaining evidence, securing the accused, etc.; and in Ireland (where in general the same laws, with slight variations only, prevail as in England) criminal prosecutions are conducted principally by solicitors and counsel who represent the crown.

In England, and in some English colonies, the prosecution of persons for public offenses is left entirely to private persons, or to public officers who act in their private capacity and have hardly any legal powers not possessed by private individuals. Every private person has exactly the same right to institute any criminal action as the attorney-general or any one else, and a private person may prosecute for high treason, a seditious conspiracy, or a libel upon a third person in which he has no sort of interest. Formerly there was no public official whose duty it was to inquire into cases of supposed criminal offenses; but as a matter of fact the duty was undertaken by the police, who in cases of any importance were usually authorized by the superior officers to instruct a solicitor, who in some cases instructed counsel to appear and prosecute. Now, by act of Parliament (47 and 48 Vict., c. 54), the chief officer of every police district is bound to give information to the director of public prosecutions of indictable offenses alleged to have been committed in his district.

When a private person has instituted a prosecution he is usually bound over to prosecute, and when a bill has been sent to the grand jury the matter must take its course (unless the proper court sanctions the withdrawal, or unless the attorney-general enters a NOLLE PROSEQUI, *q. v.*), and the injured party must pay all the costs of the prosecution, unless the court allows him costs, which it may now do in all cases of felony and in all common cases of misdemeanor. This system of prosecution by private individuals, which is the result of historical causes and not of design, while apparently liable to great abuses, in practice is found to work well and to afford a very effectual guarantee of the due observance of the laws.

In the U. S. the system of prosecution by public officers is followed, and private prosecutions, except for petty offenses and in the lowest courts, are almost unknown. DISTRICT ATTORNEYS (*q. v.*) or prosecuting attorneys are appointed by the Federal and State governments to take exclusive charge of prosecutions, oversee the finding of indictments, and conduct the trial for the state. The injured person can do no more than lodge a complaint before the committing magistrate or the grand jury, and thus secure the arrest of the accused for examination and indictment. The public officer may employ private counsel in some instances or surrender the case to them, but they act as his delegates. This is the course of proceedings that generally prevails throughout the U. S. See Stephen's *History of the Criminal Law of England* and Bishop's *Law of Criminal Procedure*.

F. STURGES ALLEN.

Pros'elytes [via O. Fr. and Lat. from Gr. *προσήλυτος*, convert, proselyte, liter., one who has come to (a party); deriv. of *προσελθεῖν*, come to; *πρός*, to, toward + *ἐλθεῖν*, come]: among the post-exilic Jews, Gentiles who conformed to Judaism. The rabbins speak of "proselytes of the gate," who simply observed the seven precepts of Noah; and "proselytes of the covenant," or of "righteousness," who were circumcised, baptized, and allowed all the privileges of the Jews; but Lardner recognized only the latter.

Prosencephalon: See BRAIN.

Proserpina: See PERSEPHONE.

Prosim'iæ [Mod. Lat.; Lat. *pro*, before + *si'mia*, ape, monkey]: a division, usually considered as a sub-order, of the order *Primates*, containing the lemurs, aye-aye, and tarsius. These animals agree with the apes and monkeys in many particulars, but have a considerable portion of the cerebellum not covered by the cerebrum, the lachrymal opening in the cheek outside the orbit, and the orbit open behind. The ears are more or less pointed and turned outward, and without a lobule. The female has a two-horned uterus, and the clitoris perforated by the urethra.

F. A. LUCAS.

Prosobranchia'ta: an order of gasteropod molluscs in which the gills are in front of the heart. It includes the majority of the sea-snails, as well as some of those occurring in fresh water or on the land. See GASTEROPODA.

Prosody [from Lat. *proso'dia* = Gr. *προσῳδία*, what accompanies the song, marks of accent, punctuation, breathings, quantity, etc.; *πρός*, in addition + *ᾠδή*, *ἀοιδή*, song, deriv. of *ἀείδειν*, sing]: a term properly meaning "accent," but including ACCENT, QUANTITY (*qq. v.*), and versification. Here the general principles of versification are treated, the special verses being given under METRES (*q. v.*). This branch of prosody relates to the reduction of speech to rhythmical form. See RHYTHM.

Speech is composed of syllables that are either short, or long, or doubtful. In versification the long is made equal to two short syllables, and the doubtful or "common" may be used either as short or as long. In the treatment of syllables to produce rhythm some special processes arise. In the classic languages hiatus ("yawning" or "gasping" resulting from the concurrence of two vowels) between two words is not allowed except in special cases. It is prevented by elision, or crasis, or shortening (partial elision) of a long vowel or diphthong, or by synizesis (slurring) of two long vowels. Also within a word a short vowel may be slurred with a following vowel. Rarely in Latin *i* receives the sound of y, as *arjete* = – ⏑ ⏑, for *ariete* = ⏑ ⏑ ⏑ ⏑, and *u* rarely receives that of *w*, as *tenvia* (– ⏑ ⏑) for *tenuia* (⏑ ⏑ ⏑ ⏑). Sometimes syllables are lengthened or shortened seemingly for metrical reasons, that is, to make an indispensable word suit the verse; but generally the quantity thus created was in use, though perhaps rare or obsolescent.

Elements of Verse.—As in speech there are syllables, words, clauses, etc., and in music notes, bars, or measures, etc., so in metre there are syllables, feet or measures, cola (clauses or sentences), periods. To the *χρόνος πρῶτος* of rhythm corresponds the mora or short syllable of verse, as the unit of measure. From its name *σημεῖον*, or *σῆμα*, syllables are called monoseme, diseme, triseme, etc., when the number of moræ they contain is one, two, three, etc. Sometimes a syllable was prolonged (by *παρέκτασις*, now usually, but inappropriately, called syncope) to the length of three or more short syllables. Again, a long in certain feet may, as an irrational, serve as a short. Moreover, two short syllables may be used as one irrational, thus having the metrical

value of one short, and a long and a short may have the time of a long. Rests or pauses also occur in catalexis, i. e. at the end of cola or periods. Hence we have the following elements of metre, with their rhythmical analogues (the *χρόνος πρῶτος* being conventionally represented by the one-eighth note or quaver):

Note.	Syllable.	Length.
𝅘𝅥𝅯	⏑	1 mora, monoseme.
𝅘𝅥	–	2 moræ, diseme.
𝅘𝅥.	⏖	3 moræ, triseme.
𝄽	⏓	4 moræ, tetraseme.

Even a pentaseme is mentioned by some. The greater pauses are indicated by the caret (∧) with quantity marks over it, but the monoseme pause by the simple caret. The irrational is indicated by >, two short syllables equivalent to one by ⏑, and a short and a long, equivalent to one long, by –⏑.

By resolution in some metres two short syllables may replace one long, and by contraction one long may replace two short ones.

Feet.—In rhythm the units of time must be marked. In English the accent serves as a mark, while in Latin and Greek the mark is the stress or loudness of long syllables as compared with short. Hence every fundamental foot must contain at least one long and one short syllable. The strong part of a foot was called thesis (*θέσις*, down-beat), and the weak part arsis (*ἄρσις*, up-beat); but some, following Roman grammarians, now interchange these terms.

Feet may be classified (1) according to the ratios between thesis and arsis (*γένος ἴσον*, *γένος διπλάσιον*, *γένος ἡμιόλιον*, etc., for the respective ratios 1, 2, 1½, etc.); or (2) according to the number of syllables they contain; or (3) according to their length as measured by moræ. Adopting the last method there are:

1. *Triseme Feet.*—(*a*) Descending: the trochee ⏑ and its substitutes, the tribrach ⏑⏑⏑, the irrational choree >, ⏑>, the triseme syllable or syncopated trochee ⏖, the catalectic trochee –∧, the cyclic and trochaic dactyls –⏑⏑, –⏑. (*b*) Ascending: the iambus ⏑ and its substitutes, the tribrach ⏑⏑⏑, the irrational iambus > , the irrational choree >⏑⏑, and the cyclic anapæst (perhaps ⏑–, or sometimes ⏑⏑>).

2. *Tetraseme Feet.*—(*a*) Descending: the dactyl ⏑⏑ and its substitutes, the spondee –, the tetraseme trochee ⏖⏑ (?), the tetraseme syllable or syncopated dactyl ⏓, the catalectic dactyl –⏑∧. – . (*b*) Ascending: the anapæst ⏑⏑ and its substitutes, the spondee – and the dactyl –⏑⏑. The proceleus-maticus ⏑⏑⏑⏑, ⏑⏑⏑⏑, is rare, and generally due to corruption.

3. *Pentaseme Feet.*—(*a*) The cretic ⏑ and its equivalents, the first and fourth pæons, ⏑⏑⏑⏑, ⏑⏑⏑. (*b*) The bacchius and anti-bacchius, ⏑, ⏑⏑.

4. *Hexaseme Feet.*—(*a*) Ionicus a minori ⏑⏑, ionicus a majori ⏑⏑⏑⏑, with resolutions ⏑⏑⏑⏑–, etc.; by contraction the molossus –––, and by anaclăsis (*ἀνάκλασις*, breaking up) ⏑⏑ for ––⏑⏑. Otherwise the ditrochæus and the diiambus, –⏑–⏑, ⏑–⏑–, are dipodies. (*b*) The choriambus = trochee or choree + iambus, ⏑⏑. The antispast ⏑⏑⏑ has only apparent existence.

5. *Heptaseme Foot.*—The epitrite (*ἐπίτριτος*, 3 : 4), ⏑⏑–, probably two feet with change of tempo making –⏑ = ––, but usually read either ⏖⏑–– or –⏑–>.

6. *Octaseme Foot.*—The dochmius ⏑⏑⏑, which through irrational syllables and resolutions assumes many forms.

Two short syllables, ⏑⏑, though not a foot, receive the name pyrrhic. Sometimes, in logaœdic verse, a polyschematic (many-formed) foot—the so-called basis—consists of two syllables, either long or short, ⏑ ⏑, or three short syllables.

Measure.—In iambic and trochaic verse, where one ictus or stress is stronger than the other, and in anapæstic verse used in the march, a dipody or pair of feet is the measure, so that a dimeter, for instance, has four feet; in other metres the single foot is the measure.

Colon (*κῶλον*, member), called also clause or sentence.—When a verse contains more than eighteen moræ it is divided into members, each marked by an ictus stronger than that of the ordinary foot. Verses of less than eighteen moræ consist of a single colon, which, however, may be divided into commata (*κόμμα*, section) by cæsura or diæresis.

Period (*περίοδος*, circuit).—Either a single colon or several cola may form a fully rounded rhythmical unit, or period. Such a period is usually a verse, but may exceed the limits of a legitimate verse.

Verse (Lat. *versus*, a turning).—A verse is a period of rhythmical speech, sufficiently short to be perceived as a whole by the rhythmical sense. The ancients limited it to thirty or thirty-two moræ. *Versus* and *στίχος* (line) were both used of lines in prose as well as poetry. When a continuous rhythmical series or period exceeds thirty-two moræ it is usually divided into cola written as separate verses. A true verse is distinguished by its end, which (1) must not divide a word; (2) may end with a vowel when the next begins with a vowel; (3) does not usually allow elision; (4) admits the *syllaba anceps*, that is, a short where the rhythm calls for a long, and *vice versa*; in other words, a verse allows at its end a slight pause not included in the rhythm. Exceptions to the requirements stated are rare, such as the division of a compound proper name (*Ἀριστο | γείτων*) between a hexameter and a pentameter, and elision at the end of an iambic trimeter (*εἶδος Σοφόκλειον*) in Greek, and a dactylic hexameter in Latin.

Cæsura, Diæresis.—When a word ends in a foot the cutting of the foot is called cæsura (*τομή*). It is masculine when it follows the ictus, feminine when it divides the weak part of a foot, ⏑⏑, ⏑ ⏑. When a word ends with a foot there is diæresis (*διαίρεσις*, pulling asunder) or "incision" between the foot and the next one, –⏑⏑–⏑⏑. Every verse of more than one colon has either a "main cæsura" or "verse-cæsura," or else a diæresis between the cola. Both the main cæsura and the diæresis are called simply "the cæsura."

In the following examples (:) denotes masculine cæsura, (;) feminine cæsura, (‖) main cæsura or diæresis, (,) diæresis.

Membranam poscas, scriptorum quæque retexens.
⏑– | ⏑ : – | ⏑ ‖ – | ⏑–, | ⏑⏑ ; ⏑ | ⏑–

Εἰς ὅσον κλύδωνα δεινῆς συμφορᾶς ἐλήλυθεν.
–:⏑ | –:⏑ | –⏑, | – > ‖ –⏑ | –:⏑ | –⏑– ∧

Catalexis (*κατάληξις*, an ending).—A verse whose last foot is incomplete is catalectic; if the last foot is complete the verse is acatalectic. See the verses just cited.

Compound Verses.—Verses may consist of cola in different rhythms. For examples, see METRES.

Combinations of Verses.—Most recited poems of the ancients were stichic, that is, composed by the line. For hypermeters or systems, exceeding the length of a normal verse, see METRES. In elegiac and melic poetry larger units than the single verse were employed, as follows:

1. *Distich.*—The oldest couplet is probably the hexameter and pentameter of elegy. Later distichs are found in Epodes.

2. *Stanza.*—The Lesbian poets introduced four-lined logaœdic stanzas in songs. These were imitated and modified by Roman poets. The most famous are the Alcaic and Sapphic. Stanzas were, and sometimes still are, included under the name strophe. They usually, though not always, contain two or three different forms of cola.

3. *Strophe.*—In choric poetry a group of lyric cola, usually more complex in form than the stanza, was followed by an exactly similar group, the former being a strophe, the latter an antistrophe. (See STROPHE.) Finally, a strophe as an epode was added, so that the great unit became the triad, AA′B, which may be used once, or any number of times, as in Pindar. Sometimes in the drama a still more complex form is presented, the second strophe and antistrophe being unlike the first, the third unlike the second, and so on, thus: AA′, BB′, CC′, etc.; and to such a series may be added an epode.

M. W. HUMPHREYS.

Prosopyg'ii [Mod. Lat., from Gr. *πρόσω*, in front + *πυγή*, buttocks]: a class of worms, embracing the POLYZOA, BRACHIOPODA, and SIPUNCULACEA (*qq. v.*), in which the body may be either long or short, the mouth is surrounded by a circle of tentacles, the alimentary canal doubled upon itself so that the vent is far in front, the body without evident segmentation, and provided with at most but two pairs of excretory organs (nephridia). With the exception of a few freshwater polyzoans all are marine.

J. S. K.

Prosper of Aquitaine: saint; commemorated June 25; b. in the southwest part of Gaul about 400; d. about 463. Little is known of his personal history, but he was certainly only a layman. He visited Rome during the pontificate of Celestine (in 431), and spent perhaps the latter part of his life there in the service of Leo the Great. The earlier part of his life appears to have been spent in Marseilles, where he came in contact with Semi-Pelagianism, and wrote those tracts against it on which his fame now principally rests.

His *Carmen de Ingratis* against the Semi-Pelagians, written about 430 in defense of Augustine, shows him to have been a poet of considerable technical merit. A book of epigrams, over 100 in number, contains theological dicta of Augustine done into elegiacs. He was author also of a *Chronicon Consulare*, in continuation of Jerome, reaching down to 455. The standard edition of his works is by the Benedictines Le Brun de Marette and Mangeaut (Paris, 1711; Rome, 1758); Migne, *Patrol.*, vol. li.

Revised by M. WARREN.

Prossnitz: town; in the province of Moravia, Austria; on the Rumsa; 13 miles by rail S. W. of Olmütz (see map of Austria-Hungary, ref. 4–F). It manufactures brandy, linen, and woolen fabrics, and has a large trade in grain, flax, cattle, and geese. Pop. (1890) 21,192.

Prostate Gland [*pros'tate* is from Gr. *προστάτης*, liter., standing before; *πρό*, before + *ἱστάναι*, stand]: a glandular mass which surrounds the neck of the bladder and urethra in the male.

Pro'tagon [possibly first introduced as an abbreviation of *protagonist*, one who plays the leading part; Gr. *πρῶτος*, first + *ἀγών*, contest, drama]: a fatty compound which, according to Liebreich, its discoverer, forms the chief constituent of nervous tissue. It is prepared from brain-substance, first washed with water and ether, by the action of warm alcohol, in which it is soluble. At the temperature of melting ice the protagon is precipitated from the alcoholic solution, and may be obtained crystallized by further purification and resolution. The composition assigned is $C_{160}H_{308}N_5PO_{35}$. See NEURINE.

IRA REMSEN.

Protag'oras: philosopher; b. about 480 B. C. at Abdera; was instructed by Democritus; lived afterward at Athens, where he was the first who taught philosophy and rhetoric for money, and assumed the title of *sophist*, teacher of wisdom, but was banished on account of his frivolous statements concerning the existence of the gods, and died in exile 411 B. C. His impeachment was, indeed, founded on his book on the gods which began thus: "Concerning the gods, I am unable to say whether they exist or not" (*Diog. Laert.*, ix., 51). None of his works is extant.

Protection: a term in political economy correlative with free trade, referring especially to the relation of legislation to the movement of industry. Free-traders are those who hold that legislation should offer no inducement to capital to take any direction which it would not assume in the absence of such legislation. (See FREE TRADE.) Protectionists hold that situations arise in which the general interest may be best served by offering such inducements. They regard the legislative authority as possessing the right and responsibility of co-ordinating in a general way the industrial growth of the country, and as exercising this rightly to bring up the home production of necessary articles to the home demand.

The issue between the two parties is, therefore, a part of the larger controversy as to the sphere and duties of government. At one time the free-trade policy was advocated on grounds which practically reduced civil government to the functions of the policeman. The reaction against this *laissez-faire* theory in politics has taken the point from many arguments once alleged for the free-trade policy, and it is now defended on grounds chiefly of its economic expediency.

The same division of opinion has appeared in the politics of France, Belgium, Germany, Sweden, Russia, Italy, and Spain. In France the protectionist policy introduced by Henry IV., extended and systematized by Colbert, was exaggerated to caricature by Napoleon in his Continental System, although even that proved of great benefit to the continental industries, especially those of France, Saxony, and Switzerland. The congress of Vienna, by an inevitable reaction, tended toward the free-trade policy, but a few years' experience of it forced a return to protection. The Bourbons restored the policy of Colbert; Germany, under the lead of Prussia, organized the Zollverein, whose moderately protective tariff caused the British to work, through their hold on Hanover, for its dissolution.

The antagonism between the two policies first came into view in the closing quarter of the seventeenth century. In earlier times the protective policy had been accepted by governments generally. Even the Roman empire levied protective duties on imports at its frontier towns. In the Middle Ages, however, the practice was generally the other way, because the dominant interest was agriculture, and the value of manufactures to a country's prosperity was not understood. The contemplation of the wealth of the Low Countries, and its contrast to the poverty of his own kingdom, led Edward III. to take vigorous steps to naturalize the woolen industry in England. He forbade the export of English wool to Flanders, and thus forced the Flemings to bring their industry to his dominions; and he enacted that every Englishman should be the owner of at least one suit of English-made woolen. The striking success of these measures, which laid the foundation of England's manufacturing system, led to the prohibition of a list of imports which was enlarged in successive reigns. It was in Queen Elizabeth's time that these prohibitions were converted into duties on imports, and thus became a source of national revenue. Henry IV. of France, Gustavus Adolphus, and Cromwell made notable and successful use of the same methods, which grew in favor with the rise of national feeling in their time.

The discovery of America exercised a profound influence on the economic condition of Europe through the rapid inflow of gold and silver from the Spanish possessions. Since the reign of Augustus there had been no substantial addition to the supply of these metals in European circulation, and industry of every kind felt the constriction produced by a growing scarcity of the instrument of association and of exchange. Within the four centuries after Columbus the European supply was increased thirty-fold (Humboldt), and the effect was even greater than that of European colonization upon America. Harbors were constructed, rivers bridged, great exploits of engineering were executed, the cities filled with splendid structures, the country better tilled, and manufactures took an impetus of growth never seen before. These results led to economic study into their cause, and the best means of extending them. Hence the rise of the mercantile school of economists, of which Colbert, John Locke, the Abbé Galiani, Sir James Steuart, and the banker-statesman Necker are the best representatives. (For the principles of this school, see the article POLITICAL ECONOMY.) They saw palpable evidence that the possession of an abundance of money was one of the surest means of national prosperity, and they planned, by means wise and otherwise, to secure its inflow and prevent its outflow. Some advocated the free-trade policy as the best and surest means to this. Most, however, held that the protection of manufactures by making a country independent of others for necessary articles, and furnishing it with those it could sell its neighbors, was the surest way of bringing in money and keeping it at home. This policy was often called Colbertism, after the great French statesman.

In France in the first half of the eighteenth century the school of economists known as Physiocrats, whose leading representative was Quesnay, asserted that agriculture is the only source of wealth, and therefore opposed the protectionist policy. Adam Smith, in his *Inquiry into the Nature and Causes of the Wealth of Nations* (1776), gives evidence of having studied in this school and of having gone beyond it. He enunciated for the first time the free-trade doctrine in its modern shape as a principle of "natural liberty." He holds that when every man is left "free to do what he will with his own," he will do that which will be most beneficial to society. An assertion so broad as this could not, of course, be derived from observation. Dr. Smith bases it on what he regards as an axiom of natural religion, viz., that the highest social well-being must result from the freest exercise of that principle of self-interest which our Maker has implanted in each of us.

The teachings of the *Wealth of Nations* were gradually absorbed by the educated classes of Europe and America, although they did not pass unchallenged. Hence the rise of free-trade parties on both sides of the ocean, especially in England, where the industrial situation favored an experiment of this kind. The destruction of the small farmer class, the comparative neglect of agriculture, and the immense development of manufactures, prepared the way for a combined and successful attack on the corn-laws as tending to keep up the cost of factory labor without enabling the country to feed its own people. Since their repeal in 1846 England has been the leading champion of the free-trade policy, but only after having pursued the other successfully for more than five centuries.

For the first thirty years after the adoption of the U. S. Constitution there was substantial agreement among public men in the support of protection. The colonies from

the outset had tried to establish all the industries known to the mother country. Their own circumstances, but especially the repressive enactments of the British Parliament, had prevented their manufacturing extensively. Yet they observed that in the case of articles which could not be imported cheaply, such as stoves and hollow-ware, farming was greatly benefited by the neighborhood of these home industries. This was re-enforced by the experiences of the war for independence, when the country, and especially the army, suffered dreadfully through the cessation of the supplies of goods from Europe. The industries which sprang up to meet this need were crushed after the peace, because the national Government had no power to protect them. It was this more than any other circumstance which forced the adoption in 1789 of a more perfect form of government "to provide for the common defense and promote the general welfare." President Washington and Alexander Hamilton, as Secretary of the Treasury, pressed the policy upon Congress, which legislated expressly for this purpose, keeping in view the need of manufactures as an element in national defense. It was not until the failure of the well-meant but fatally defective tariff of 1816 that the antagonism over this question became an element in U. S. politics. The Southern States had owed to the protective policy the establishment and development of their cotton-growing. They supported that policy so long as they cherished the hope of becoming a manufacturing region, or found in the Northern cotton-mills the only open market for their staple, which Great Britain taxed in the interest of her East and West Indian cotton-growers. When their hope of manufacturing proved futile, and Great Britain in 1832 repealed the import duty on U. S. cotton, the South changed front. Then came the great alliance of the U. S. cotton-grower with the British cotton-spinner, which supported the free-trade policy in both countries. The first free-trade tariff, that of 1835, had such effects as to provoke a protectionist reaction, which resulted in the tariff of 1842. Four years later the repeal of the British corn-laws re-enforced the cotton-planter interest by the support of the Western wheat-grower. The result was the mongrel tariff of 1847, carried by the casting vote of Vice-President Dallas, and further reduced in 1857.

The withdrawal of Congressmen from the Southern States in 1861 left Congress in the control of representatives and Senators from States interested in manufactures. The Morrill tariff of that year, signed by President Buchanan, marked a return to the earlier policy of the republic, and was framed as much in compliance with the demands of national defense as of economic theory. It was feared that the war for the Union would involve the U. S. in war with Europe, where the South had many friends. To leave the republic dependent on Europe, therefore, for staple commodities of any kind would be to invite attack, and the increased duties would bring a larger revenue so long as commerce was uninterrupted. The policy thus adopted has now (1894) continued for over thirty years, with the result of placing the U. S. among the foremost of industrial nations, a chief producer, and by far the greatest consumer of great staples like cotton and woolen goods, iron and steel, with a *per capita* average of national wealth surpassed only by Great Britain.

In the middle of the nineteenth century, Great Britain—in the words of *The Saturday Review*—became the propagandist of "a new religion, made up of free trade and the pleasanter parts of Christianity." The commercial treaty negotiated with Napoleon III. by Richard Cobden came quickly after the reduction of the U. S. tariff to almost a free-trade footing, and Cavour's free-trade experiment in Italy. Germany in 1864 made reductions in her Zollverein tariff which carried her in the same direction. Only the reaction in the U. S. darkened the prospect of universal free trade; but the example of the U. S. and still more experience at home have carried all these countries back to their former policy, which has come into favor also with the autonomous colonies of the British empire. The French Republic hastened to denounce the Cobden Treaty, which Napoleon never had dared to submit to the judgment of his Corps Législatif. Bismarck in 1879 carried Germany back to the earlier policy of the Zollverein, alleging the astonishing success of the U. S. under protection as his justification. Canada the same year became protectionist by a popular reaction, following the example of Victoria, and to be followed in its turn by other colonies. As *The Times* has said, a wave of protectionist sentiment seemed "sweeping round the world," and in Great Britain itself a small party demands a return to protection in the interest of agriculture.

As in so many other cases, the practice of protection to home industry antedates the theory, and the theory itself has taken different forms according to the environment of the thinkers who have elaborated it. These forms, which may be distinguished as four, are not antagonistic, but mutually corroborative.

I. The mercantile school generally defended the protectionist policy in view of the industrial use and the international circulation of money. Seeing that the increased supply of this instrument of industrial association had resulted in a rapid and great development of productive industry, furnishing employment to idle people, bringing neglected resources into use, raising the standard of comfort, and making the collection of an adequate revenue an easy thing, they insisted that a "favorable balance of trade" was an object of national policy. No country could safely import to a larger extent than it exported, and if its imports fell below its exports, so that it drew upon its neighbors' reserve of coin in payment of the difference, so much the better. To this end the development of manufactures and the checking of imports by duties (or even prohibitions) were desirable means. The former enabled the country to sell more; the latter insured its buying less.

It was also found that it was hard, if not impossible, for a country to maintain a favorable balance, unless it were possessed of a body of shipping to carry on its own commerce. The surplus of exports would be swallowed up in paying freight to foreigners. Hence the navigation laws enacted under Oliver Cromwell, re-enacted by the first Stuart parliament, copied by the U. S. in Washington's first administration, and maintained by Great Britain until 1850. These laws confined the ships of foreign countries to bringing in the produce of those countries and their colonies and dependencies, and levied tonnage taxes on these ships in British harbors. Thus the British destroyed the monopoly of the carrying trade previously enjoyed by the Dutch; and thus the foundations were laid first of the British, and then of the U. S. mercantile marine.

This theory of protection rested entirely upon observed facts as to the use and functions of money, made during a period particularly favorable for such observation. It was in a different period that Hume and Turgot put forward a theory of money calculated to undermine it. In their view, money is merely a standard of value and an instrument of exchange, and exerts no definite and permanent influence upon production. An addition to a nation's supply of money could be of no lasting benefit to its industries; and the diminution of that supply could not harm them. The only real effect of an increase must be to raise prices; of a decrease, to lower them. The drain of money from a country would thus make it "a good place to buy in, and a bad place to sell in," as prices would fall. An influx of money would make it "a bad place to buy in, but a good place to sell in," as prices would rise. In the former case foreigners would bring coin and take away goods; in the latter, bring goods and take away coin. In each case the balance would be restored, "all things would find their level." In fact, the wiser point of view was to regard money as "a commodity like any other," and to treat its export or import as a matter of indifference to the nation. If it went abroad, it must be to secure in exchange commodities for which the country had greater demand, and adapted to meet human needs more directly.

This theory, which obtained the support of Adam Smith's school and holds its own even in the school which has displaced his, did not rest on observed facts. No case has ever occurred which conforms even remotely to its diagnosis of the results of an export or import of money. Nowhere do we find this lowering of prices as a result of the diminution of a country's supply of coin, or this beneficent reaction which restores the supply. The case of Portugal under the operations of the Methuen Treaty (1703), and of Japan under the treaties of 1868, signally refute the notion that "things find their level" in this easy way. Tooke and Newmarch, in their elaborate and irrefutable *History of Prices*, have proved that in Great Britain itself the fluctuation of prices has not corresponded to the fluctuation of the currency in this mechanical fashion. The common sense of the business world also has rejected the notion that "gold is a commodity like any other." Every great emporium of trade watches the export of it as a calamity, and uses all the means available to check it and to set the current moving in the opposite direction.

Prof. Stanley Jevons complains that the money articles of the London newspapers are "steeped in the mercantile theory."

The theory that money is merely an instrument of exchange and a commodity like any other failed as a diagnosis of the industrial movement because it was defective fundamentally. Money has a far more important function as the instrument of industrial association. It was this fact of which the mercantile school were conscious. In his *Growth of English Industry and Commerce* (London, 1894) Dr. W. Cunningham gives a much juster view of their aims and achievements than has been current. Under their guidance, one of his English reviewers says, "English statesmen strove to build up shipping, industry, and agriculture. They succeeded in their aims, and made England mistress of the sea and the workshop of the world."

II. The nationalist school of protectionists arose in the new awakening of national feeling in the revolt against the imperialism of Napoleon. Its first and most extreme representative was the philosopher J. G. Fichte, who proposed to confine foreign commerce strictly to the exchange of the products of different climates. Friedrich List, the founder of the German Zollverein, is its best representative, but it was substantially the point of view occupied by the earlier American statesmen. In this view nations are industrial no less than political units, and national boundary lines are economic boundaries also. Industrial power and independence are essential to political power and independence. National industry is one of the forms of national wealth, and is as much entitled to protection as is any other. This principle is implied in all the relations of peoples to their governments. They demand of their rulers not only an efficient police, which shall keep men's hands out of their neighbors' tills or pockets; they also hold them responsible, though less directly, for the general welfare of the country.

The duty thus imposed upon government is discharged only by promoting a full and balanced development of the industries needed for the largest industrial life each people is capable of, and securing the employment of all the resources offered by national character and natural environment. Experience, however, shows that the countries already in possession of profitable foreign markets for their products have the means and the will to resist the establishment in other countries of industries which would deprive them of these markets. This they do by selling for a time at cost, or even below it, often making great sacrifices to crush out incipient competition, and then recouping their losses by higher charges when they have the market to themselves. John Stuart Mill points out that under these circumstances it can not be expected that individuals should, "at their own risk, or rather to their certain loss, introduce a new manufacture and bear the burden of carrying it on until the producers have been educated up to the level of those with whom the processes have become traditional." By enacting a protective duty on the import, the nation assures the undertaker of a new industry against unfair competition, and enables him to overcome the grave initial disadvantages of such enterprises. By this means the people are lifted out of that uniformity of occupation which always keeps them poor and frequently exposes them to famine. Living in this uniformity they have few of the interchanges of commerce with each other. The great lines of commercial intercourse run all to the seaboard or the frontier to meet the foreign trader and his agents. So before the civil war the great railway lines of the U. S. ran to the Atlantic seaboard. They were the warp without the woof of a great national system. In Germany, the removal of all custom-house lines to the frontier and the establishment of free trade within and protection without the Zollverein is recognized to have been one of the great promoters of German unification. Hence the eagerness of Austria to obtain admission, and the successful efforts of Prussia to exclude her.

The second public interest is national defense. A country which can not supply from its own industrial resources the outfit of an army, and can not thus meet the needs of its people during the suspension of foreign commerce commonly attendant on war, is in a position to invite attack from those which are better situated. The war for independence found the British colonies in North America at a great disadvantage in this respect. They had a poor supply of arms and gunpowder, without the materials needed for tents, clothing, and shoes. The blood which marked the tracks of the men on the wintry roads, the terrible suffering from nakedness and frost in the Valley Forge encampment, were the fruit of the nation's industrial dependence and gave point to Washington's exhortations to Congress to put the country in a position to defend itself by cherishing its own manufactures. Yet the war of 1812–15 found the republic nearly as ill-fitted for a great war, there being neither tents nor gunpowder nor blankets in any adequate quantity. The sufferings of the soldiers and even their defeat in the first years of the struggle were due to this in large measure. (See Horace Bushnell's article in *Hours at Home*, July, 1870). In the civil war the Southern States were at a great disadvantage in this respect, as their dependence on slave labor had resulted in their securing hardly any manufacturing industry as the outcome of the protective tariffs of the U. S. Jefferson Davis congratulated the Confederate Congress on the growth of a few manufactures, and if the Confederacy had achieved its independence, it probably would not have been able to abide by the free-trade provisions of its constitution.

It is notable that whatever tends to awaken a strong sense of nationality tends also to the protectionist feeling about national industry. All the periods of strong national feelings have been periods in which the policy of promoting home industry by collective action has been popular. On the other hand, periods of decay in this feeling have been the free-trader's best opportunity. Richard Cobden was quite right, from his standpoint, in regarding nations as necessary evils, and wishing all boundary-lines effaced from the map of Europe.

III. What may be called the biological school of economists was founded by Henry C. Carey, of Philadelphia. He points out that at the starting-point of economic development man is isolated and feeble, his first need being association with his fellows for the conquest of nature. Until he attains this he is occupied with a struggle for bare existence. With the growth of numbers and of association this struggle becomes easier, and sets some free to provide for less primary but not less real wants. Hence the rise first of the artisan or manufacturing class, and afterward of classes which serve the intellectual needs. At each step onward production grows faster than numbers, nature rewards more largely the toils of her conqueror, and the share of each individual in the joint product increases. At the same time the industrial order passes from its primitive simplicity to one of constantly increasing complexity through the growth of association. In the earlier stages in the development, when population is still scanty and the different classes of producers are separated by distance, a check to the freedom and the profit of their exchanges is offered by the power of the trader, who is able to levy a heavy tax on production. With the increase of population in density the artisan and the farmer naturally come into closer neighborhood, so that they can exchange their products directly, if necessary, and thus dispense with his services. Wherever this result is not attained, and commerce in the necessaries of existence continues to be transacted at long distances, the trader still reaps a high profit at the expense of the producers. Especially the farmers and other producers of raw materials suffer from the necessity of having to pay the cost of carrying their bulky products to distant markets; and farming suffers in quality through the forced monotony of its cropping, and the loss of opportunities to make returns to the soil, which the neighborhood of manufactures offers. The farmer so situated is constantly injuring a valuable instrument instead of improving it. This, however, must be the result of some obstacle to the operation of natural law, interposed by the selfishness of peoples or of individuals, or by the currency of false theories. To remove obstacles of the former class is the work of the statesman; of the latter class that of the economist. The power of highly developed nations to check the industrial growth of those less advanced than themselves he was obliged by the evidence of facts to recognize. That power he would check by legislation to lay duties on imports, not in order to contravene natural law or find a substitute for it, but to remove an obstacle to its operation. He thus held strongly to the conception of natural economic law, which the current reaction against the abuses of that conception has thrown out of vogue for a time.

IV. Among protectionists there has been a tendency to treat the development of domestic industry in this way as a branch of the great social problem, which presses upon us from all quarters. The policy is defended as securing juster and more adequate remuneration to the laboring classes of the U. S. George Gunton and Erastus B. Bigelow might be regarded as representatives of this view. It can not be as-

serted, of course, that a protective tariff works directly to raise wages. It contains no specifications to that effect. Where it secures the producer a fairer price for his product it does not provide that part of the difference between this and the lower price he would have got under free trade shall go to raise the wages of his workmen; but its indirect operation does raise wages, and has done so in America, France, and Germany. One reason of this is that the demand for labor more nearly approaches the supply in countries of diversified industry than in those where there is but one kind of employment. Another reason is seen in the fact that agriculture calls for little else than unintelligent and ill-paid labor, while manufactures demand intelligence and skill, and must pay for them.

It has been rightly indicated by Francis A. Walker that the public opinion of a country plays a great part in determining the rate of wages. In aristocratic countries this works to the disadvantage of the working classes, as requiring that they shall "know their place," and be content with such a standard of living as social tradition permits them. In democratic countries, like the U. S., the same social force works to elevate the standard of comfort for the working classes, requiring that all citizens shall be housed, clothed, and fed in a manner becoming their place as a part of the sovereign people. This, however, would be impossible in the absence of all restrictions on international commerce, as the products of depressed labor, if freely admitted to the markets, would make it impossible to pay home labor at a properly American rate. The difference between the rates of the U. S. and those of Great Britain is shown by a report of the Massachusetts Bureau of Labor Statistics for 1884, which also proves that the tariff does not "take from labor with one hand"—in prices—"what it gives with the other"—in wages. In the industries pursued both in Great Britain and Massachusetts the average of wages was 62 per cent. higher in the latter, while the cost of living was but 17 per cent. higher, and of this 11 per cent. was due to the higher outlay for housing, leaving 6 per cent. for the higher cost of food, clothing, etc. The standard of living, the report shows, was 50 per cent. higher in Massachusetts. If the U. S. workman chose to live as the British workman does, he could save three-eighths of his income, while the British workman can save but 2 per cent. That this difference is not due to the abundance of land open to settlement, or other local advantages peculiar to North America, is seen from the wretched condition of laborers in the U. S. in the earlier decades of the history of the nation, as Prof. Macmaster describes this in the first and second volumes of his *History of the People of the United States*, and Matthew Carey in his *Letters on the Charities of Philadelphia* (1829). It is rather due to the more favorable conditions for the operation of public opinion which the protective policy has created, especially during the last thirty years. The census of 1880 showed that the average wages of the skilled workman in the U. S. had risen in twenty years from $460 to $720 a year, while the price of all the staple articles he buys had fallen at a rate varying from 26 to 46 per cent. In fact, the wages of 1880 had about twice the purchasing power that the wages of 1860 had, and the census of 1890 showed that this advance had been sustained, both in the rise of wages and the cheapening of commodities.

It is not necessary, however, to the vindication of the protective policy to show that in no case is the price of an article higher to the workman than it would be under free trade. To "buy in the cheapest market and sell in the dearest" is good policy only when you are sure of having a good market to sell in. It is not a question, especially for the workingman, merely of the price at which he is to buy what he needs, but of the relation of that price to his wages. The immense immigration of European workmen to share what free-traders call the "burdens of protection" is a practical comment on the workings of the system.

The protective policy finds an exact parallel in the laws to prevent the importation of coolie and contract labor into the U. S. There would, however, be no justice in excluding such laborers if the products of their labor were admitted freely. It would be grossly unfair to compel the American employer to hire his labor in a close market and sell his product in an open one. The abandonment of the protective principle would carry with it, as in Great Britain, the removal of all restrictions on the importation of labor.

Objections brought by the Free-trade School against Protection.—1. The first is that "protection is an artificial system, like the forcing of plants in a hothouse. It creates a mushroom growth of industries, which are unable to stand the free open air of competition, and which, by their constantly increasing demand for higher duties, show that they become weaker instead of stronger with the lapse of years. Free trade stands for the principle that a thing shall keep its place by the vitality it possesses, and not by governmental support or bolstering of any sort."

Protection is artificial in the sense in which clearing away the forests, inclosing and reclaiming farms, building houses, constructing roads, canals, and railroads, and educating the young are artificial, but in no other. To seek the establishment of industries for which the abilities of the people, the resources of the country, and the climatic conditions are all favorable, is to move on the lines of natural law.

That industries thus established by the aid of protective legislation will not attain the vigor which secures their permanence is an assumption contradicted by nearly every page of the world's industrial history. The silk-manufacture of France, the woolen, iron, and cotton industries of Great Britain, the linen industry of Ulster, the cotton-growing of the U. S., are striking instances of well-established industries which owe their very existence to protection. It would be difficult, indeed, to point out a single great manufacture which is now competing for the markets of the world that did not make its beginning in the same way.

That protected industries demand ever higher rates of duty is not the truth. It is true that in some cases such industries have made a start under a protection, which experience proves to be inadequate, and which has to be increased. It is true also that the facilities for cheap transportation in other cases have so altered the conditions of trade as to make the earlier duties ineffective; but in every case there is reason to expect a gradual reduction of protective duties, and finally their abolition with the consent of the manufacturers themselves. The former is illustrated by the successive reductions of the duty of the U. S. imposed on Bessemer steel and other articles; the latter by Great Britain's adoption of free trade after a long course of protection.

2. It is objected that "protection is an anti-social policy, seeking the good of classes at the expense of the people at large. It aims at making certain commodities dearer for the benefit of their producers, who constitute only a class in a community, while the interest of the consumer is always in cheapness, and the consumers are the whole community." The object of protection is not dearness, but to bring up the home production of some important staple to the measure of the national demand. In no case is the increase in price a permanent one, unless the conditions are such as to forbid the development of that line of production up to the national demand, as in the case of the duties on sugar imported into the U. S. In such cases the application of a protective duty is a questionable measure. Moreover, the interest of "the consumer" is not separable from that of "the producer." An illustration of this is the condition of the consumer in "hard times." Abstractly considered, he is well off, but the actual human beings who consume find those times not at all to their liking. It is not necessary that every form of production should be protected in order that all may share in its benefits. It is the freedom of the laboring men to choose between the protected and unprotected industries that puts up the wages paid them.

3. To much the same effect, protection is challenged as "a scheme of taxation" which enables the producer to levy a tax on the whole community for his private benefit. So much of a protective duty as falls upon the imported article goes into the public treasury; but a tax of the same rate is levied also upon the home-made equivalent by its maker, and goes into his pocket. The duty is added to the price, and the tariff is a tax.

A tariff duty generally secures its end by offering a special inducement to capitalists to turn their capital into that line of production. It offers them a chance of profits above the average, and a certain security in possession of their market. In the earlier stages of the manufacture these hopes are fulfilled; but profits above the average rapidly attract other capital, and domestic competition for the market pulls down prices to the level which permits of an average profit. At no stage can the home producer "add the duty to the price" simply. To do so would be to forego the advantage the duty offers, and keep the market open to his foreign competitor. Besides this, the foreigner commonly prefers to forego a part of his former profits rather than lose his hold.

on the imperiled market. The profits of the home manufacturer therefore are limited both by the amount of this sacrifice of profits by the foreigner and the margin needed to give his own product an advantage in price. Even this, after a time, is cut down by the rise of domestic competition, as McCulloch and other free-traders admit: for in no line of production that is not guaranteed by a patent or some similar monopoly can profits remain above the average for any length of time. It is noteworthy that very few of the great fortunes in the U. S. have been made in manufacturing. On the other hand, as Mill points out, the transfer of an industry to an entirely new set of conditions is generally attended by great improvements of method, which tend to reduce the cost of that product to the country and ultimately the whole world. This was seen in the establishment of the cotton-manufacture in Great Britain and of cotton-growing in the U. S. In the same way protection in the U. S. has led to the improvements which have cheapened cutlery, silks, earthenware, Bessemer steel, cottons, nails, and many other staples to all consumers.

4. It is objected that "protection is a wasteful use of a country's capital, since it diverts it from the more profitable into less profitable lines of production." No country can produce more than it has the capital to undertake; but no country has attained the amount of production that it has the capital for. The establishment of new industries by protection is effected not so much by a diversion of active capital into new channels as by awakening dormant capital to flow in them. It is not safe to assume it is always worth while for some individual to do whatever it is the common interest to have done. This assumption of the absolute identity of private and public interest is untrue in many matters. The destruction of the forests of the U. S. is illustration sufficient. So a country may have need of new industries which no person would find profitable to initiate.

5. It is objected that "protection is hostile to commerce. It seeks to destroy that division of labor among the nations by which each produces what it can to the best advantage, and exchanges this with what the others produce in similar circumstances. It aims at making every nation self-contained and self-sufficing, by fostering on its soil even those kinds of production for which it has less fitness, and refuses to allow it to benefit by the natural advantages of the rest. It is typified by the great Chinese wall, built to restrict intercourse to the utmost with all the neighboring states. If it were consistent, Bryant once objected, instead of digging harbors it would fill them up, would grow tea, coffee, and spices under glass, and make imports to cease altogether."

Commerce, as protectionists understand the word, is the interchange of services and productions between persons of different industrial function, whether these are of the same or of different countries. The protectionist policy certainly aims chiefly at the development of domestic commerce. To this end it seeks to secure the greatest possible diversification of industrial function at home. Protectionists hold, with Adam Smith, that this home commerce, "the trade between town and country," is by far the most profitable to the country. They see in its extent and prosperity the truest test of national well-being. They deplore the wretchedness of those countries in which uniformity of occupation prevents this commerce, as in Ireland, India, and Japan since the treaties of 1868. Their people are thus unfitted to render industrial services to each other. Foreign trade flourishes at the expense of commerce at home.

Protection not only favors the freest development of trade at home, but cherishes the freest trade with foreign countries in those products which can not be produced at home. It forbids such duties on tea, coffee, spices, and the like, as make up the schedules of the tariff of free-trade countries like Great Britain and Norway. It thus favors the commerce which moves along the meridians, exchanging the products of different climates. On the same principle it fosters the commerce which grows out of different industrial capacity. By its preference for specific duties—a preference also shown by Great Britain, but not by the free-traders of the U. S.—it favors the exchange of the more valuable and highly elaborate products, which represent the best-trained productive capacities of sister nations. At the same time the policy fits the country to supply its less developed neighbors with manufactures they are not capable of making for themselves, as well as farm products not produced in their climates. In this way the tariff law of 1892 secured the U. S. twenty-four reciprocity treaties which gave special advantages to its commerce in return for the free admission of sugar and other tropical or semi-tropical products, an advantage which was abandoned by levying a revenue duty on sugar in the much less protective tariff of 1894. The fields the protectionist policy thus leaves open to foreign commerce are so extensive that the progress of the U. S. has been as rapid in this department as that of any of its rivals since 1864.

Bryant's illustration suggests the question whether, on his principles, government should create or maintain harbors. If it has nothing to do with industrial development, as free-traders contend, why should it concern itself about commerce any more than manufactures? He once admitted his inability to justify the construction of the Erie Canal by the State of New York, instead of leaving such work to private enterprise; why not leave the harbors of New York and Liverpool to the private enterprise of the ship-owners and commercial firms, and trust to the identity of private and social interest in this matter, as in the growth of manufactures?

6. "The protectionist policy has driven the U. S. flag from the ocean by making it costly to build ships in U. S. dockyards and by refusing leave to the people of the U. S. to buy them from the ship-builders of other countries." Statements of this kind are still current, but the only fragment of truth in them is that the higher wages paid under protection makes it costlier to build ships in the U. S. The decline of ship-building in the U. S. began under the tariffs of 1847 and 1857. It was begun by the withdrawal of subsidies to steamship lines in 1855, at a time when all rival countries were paying them. It was accelerated by the civil war, which cost the loss of many vessels, caused the transfer of others to foreign registration, and checked the building of merchant ships. To remove all complaints on that score, protectionists enacted the admission of ship-building materials free of duty, but without any marked result. They did not place shipping inside the protective system, as was done in Washington's time with the best result. They left the merchant marine absolutely to the chances of free trade, charging foreign vessels with neither tonnage dues nor lighthouse dues, nor discriminating duties on their cargoes, while they left them free to bring in the produce of all the world. Citizens of the U. S. are free to buy and own ships of foreign build to any extent they please, as they are refused nothing but U. S. registration, and are exempted from the specially severe requirements of the laws of the U. S. as to the care to be taken of its seamen. If ship-building and ship-owning have declined in the U. S., this has been chargeable not to protection, but to free trade.

7. Protection is charged with being "a selfish policy, in that it leaves out of account the well-being of all countries but one, and teaches its people indifference to the depressions of trade and loss of markets which it may inflict upon other peoples."

Protection is distinctly a less selfish policy than is free trade, which teaches each individual to regard simply his own self-interest as a consumer and to practice entire indifference to welfare of the producing classes. Protection is a declaration of national interest in the welfare of the laboring classes, while free trade tells them they must shift for themselves. As *The Spectator*, a strongly free-trade paper, said in 1884, "Protection appeals to men on the side of their duties, free trade on that of their interests." As to the injury done to other countries by a shift of markets, that is not chargeable to the protective policy. A market which can exist only so long as other countries fail to produce that article for themselves must result from a bad economic management in the country affected, and the total of the injuries thus inflicted is trifling compared with those inflicted by free trade on Ireland, India, China, Japan, and in the U. S. in 1783, 1817, 1837, and 1857. (On this point, see Kirkup's *Study of Socialism*.) The ultimate object of the protective policy is the maximum of national life throughout the world, through each nation attaining the largest measure possible to it. Besides, the best the U. S. can do for the working classes of other countries is to establish and maintain the highest possible level of comfort for itself. Thus it will furnish them the best fulcrum for raising their own condition and beating down the social prejudices against them.

Of works on the protectionist's case, the most important are the Abbé Antonio Genovesi's *Lezioni di Commercio* (Naples, 1757); the Abbé Ferd. Galiani's *Dialogues sur le Commerce des Blés* (Paris, 1770); Jacques Neeker's *Sur la Législation et le Commerce des Grains* (Paris, 1775) and *Éloge*

de Colbert (Paris, 1773); Alexander Hamilton's Treasury Report for 1791; Matthew Carey's *The New Olive Branch* (Philadelphia, 1820); John Rae's *New Principles of Political Economy* (New York, 1834); Willard Phillips's *Propositions concerning Free Trade and Protection* (Boston, 1850); Henry C. Carey's *The Past, the Present, and the Future* (Philadelphia, 1848), *The Harmony of Interests* (Philadelphia, 1851), and *System of Social Science* (Philadelphia, 3 vols., 1858–59); Friedrich List's *National System of Political Economy*, with introduction by Stephen Colwell (Philadelphia, 1856); E. Peshine Smith's *Principles of Political Economy* (New York, 1853); Francis Bowen's *Political Economy applied to the Condition and Institutions of the American People* (Boston, 1884); Judge Byles's *Sophisms of Free Trade* (London, 1849; 10th ed. Philadelphia, 1872); Andrew W. Young's *National Economy: a History of the American Protective System and its Effect on the Severat Branches of American Industry* (New York, 1866); Dr. Friedrich Stoepel's *Freihandel und Schutzzoll* (Frankfurt, 1867); Sir Edward Sullivan's *Protection to Native Industry* (London and Philadelphia, 1870); David H. Mason's *How Western Farmers are benefited by Protection* (Philadelphia, 1875); Henry M. Hoyt's *Protection versus Free Trade* (New York, 1886); R. W. Thompson's *History of Protective Tariff Laws* (New York, 1888); Henry V. Poor's *Twenty-two Years of Protection* (New York, 1888); R. E. Thompson's *Elements of Political Economy* (Philadelphia, 3d ed. 1882), *Protection to Home Industry, Harvard Lectures* (New York, 1885), and *Ireland and Free Trade, an Object-Lesson in Political Economy* (Philadelphia, 1888); Albert S. Bolles's *Financial History of the United States* (3 vols., New York, 1879–83); George Basil Dixwell's *Review of Sundry Free-trade Arguments* Cambridge, 1882); Ellis H. Roberts's *Government Revenue* (New York, 1884).

ROBERT ELLIS THOMPSON.

Proteids: See ALBUMINOIDS.

Proteine [from Gr. *πρῶτος*, first]: a term applied by Mulder to a product of the metamorphosis of ALBUMINOIDS (*q. v.*), which is produced by the action of caustic potash, and which he believed to constitute the basal molecule of all the proteids, whence the name. Its formula, according to him, is $C_{36}H_{26}N_4O_{10}$. Although this theory is obsolete, the name *proteids*, being very convenient, remains still in use.

Proterozoic Era [Gr. *πρότερος*, earlier + *ζῷον*, animal]: the earliest of the great divisions of geologic time based on life. The co-ordinate succeeding divisions are Paleozoic, Mesozoic, and Cenozoic, and the Proterozoic era was theoretically preceded by an Azoic or lifeless era. No faunas and floras of this era have been discovered, and only a few traces of organic forms. The life of the Paleozoic periods is shown by fossils to have been varied and highly organized, and, in accordance with the doctrine of evolution, it is inferred that long periods were necessary for its development. It has been suggested that a full record of Proterozoic life has not survived because the animals of that period were pelagic, rather than littoral, and were not furnished with shells and other hard parts. Consult Bulletin 86 of the U. S. Geological Survey.

G. K. GILBERT.

Protest: See BILL OF EXCHANGE and NOTARY PUBLIC.

Protestantism [from Lat. *protes'tans*, pres. partic. of *protesta'ri*, declare in public, bear witness; *pro*, before, forth + *testa'ri*, to witness, deriv. of *tes'tis*, a witness]: the religious tenets of Protestants; the liberal influences and tendencies of the Protestant movement. This began with the second Diet of Spires (Speyer), when the Lutheran members of the diet, on Apr. 25, 1529, *protested* against the action of the Roman Catholic members in condemning the innovations Luther had introduced, and in forbidding, on pain of the imperial ban, any further reformation until the meeting of the general council promised for 1530 by Charles V. and the pope. (See REFORMATION.) This protest was a renewal and expansion of Luther's at Worms, Apr. 17 and 18, 1521. At the suggestion of the Landgrave of Hesse a protest was also made against the diet's repudiation of the Zwinglian doctrine of the Eucharist. (See Gieseler, *Ecclesiastical History*. The term Protestantism as used to-day, however, has the broader meaning of opposition to the Roman and Greek Catholic Churches. Protestants oppose the Roman Church chiefly because it (1) raises tradition to the level of Scripture as source of doctrine; (2) denies justification by faith alone; (3) makes the pope the spiritual ruler of the entire Christian Church. The first two counts hold against the Greek Church, but, because the Greeks reject the pope, have done less to prevent the circulation of the Scriptures, and do not insist on sacerdotal celibacy, there is more friendly feeling for them on the part of Protestants, and the Church of England and the Protestant Episcopal Church of the U. S. contain many influential members who labor for some sort of union between their communions and the Greek Catholics.

SAMUEL MACAULEY JACKSON.

Pro'teus [Mod. Lat., from Gr. *Πρωτεύς*, a sea-god fabled to assume many forms]: a genus of tailed batrachians (see URODELA). *Proteus anguinus*, the only known species, is found in the caves of Southern Europe. It is whitish, about 6 inches long, has rudimentary eyes, and large external gills. Its only relatives are the water-dogs (*Necturus*) of the U. S.

Proteus (in Gr. *Πρωτεύς*): in classic mythology, a subject, or according to some versions a son, of Poseidon, whose flocks of seals he tended on the island of PHAROS (*q. v.*), off Egypt. He was gifted with the power of foretelling the future, but, as he disliked prophesying, he used to escape from those who succeeded in catching him when he came up from the depths of the sea to sleep among the rocks, by assuming the most horrible or disgusting shapes. The conflict of MENELAUS (*q. v.*) with Proteus is narrated in Homer's *Odyssey* (4, 351, *seq.*).

Revised by J. R. S. STERRETT.

Prothallium: See FERNWORTS.

Prothero, ROWLAND EDMUND: See the Appendix.

Protista [Mod. Lat., from Gr. *πρῶτος*, first]: a term introduced by Haeckel to include the simplest forms of life, both animal and plant, since it is impossible to draw the line between these two kingdoms of nature. The division is not generally recognized.

Protococ'cus [Mod. Lat.; Gr. *πρῶτος*, first + *κόκκος*, berry]: a poorly defined genus of minute unicellular algæ, of the family *Palmellaceæ* and order *Protococcoideæ*. The cells are globose, solitary, or aggregated into loose masses; the walls are thin, and the protoplasm is stained with chlorophyll (green); and this, when old, may be replaced with red coloring-matter. Under favorable conditions the cells may divide, each into two, and these may again divide, and so on. By a subdivision of the cells zoöspores, also, are produced, which, in related genera at least, unite to give rise to new cells. About twenty species are admitted to the genus as limited, among which the best known is *P. viridis*, very common on the bark of trees and the surface of damp walls. Formerly many more species, now referred to *Pleurococcus*, *Stichococcus*, *Hæmatococcus*, etc., were included in the genus.

The name *Protococcus* is often applied in a general way to any unicellular green plant, and in this sense protococci constitute the so-called gonidia of lichens. Finally, it is probable that *Protococcus* in the narrower sense is composed of younger states of higher algæ.

CHARLES E. BESSEY.

Protogene: See GRANITE.

Protog'enes: painter; b. at Caunus, Caria, in the middle of the fourth century B. C.; lived mostly at Rhodes, and was one of the most celebrated painters of his time. When Demetrius Poliorcetes besieged Rhodes he refrained from attacking one of the weakest points because here was kept the masterpiece of Protogenes, *Ialysus*. This picture was still at Rhodes in the time of Cicero, and later it was brought to Rome. Another celebrated work of his was *The Satyr*. Nearly all that we know of him is contained in Pliny's *Natural History*. He is thought to have died about 300 B. C.

Pro'tophytes [from Mod. Lat. *Protoph'yta*; Gr. *πρῶτος*, first + *φυτόν*, plant]: the *Protophyta*, the lowest branch or division of the vegetable kingdom. The plants collected here consist of single cells, or loose chains of cells, with little, if any, differentiation of the cells. They reproduce by the division of cells and by the asexual production of spores or cysts. No sexual reproduction is known. Most of the species are of some shade of green, as blue-green, smoky green, brownish green, reddish green, etc., but never chlorophyll-green. The coloring-matter is regarded as a modification of chlorophyll, and is distinguished as phycocyanin. The parasitic and saprophytic species (*Bacteria*) are colorless.

Protophytes may be all grouped under one class—*Schizophyceæ* (or *Cyanophyceæ*), and under this two orders may be distinguished—viz., *Cystiphoræ* (or *Chroococcaceæ*) and *Nematogeneæ* (or *Nostochineæ*). See PLANTS, FOSSIL.

CHARLES E. BESSEY.

Protoplasm [Gr. *πρῶτος*, first + *πλάσμα*, anything formed or moulded, deriv. of *πλάσσειν*, form, mould]: a substance,

or, better, a group of substances, of varying chemical composition known only in connection with, and as products of, life. It is semi-fluid, will not dissolve in water, refracts light more strongly than water, and varies in appearance as minute particles—microsomata—are more or less abundant in the ground substance (hyaloplasm), which under lower powers of the microscope appears homogeneous. Much attention has been given to the minute structure, and it is now known that protoplasm is far more complex than the "drop of jelly" to which it is frequently compared. With the use of stronger and better microscopes it has been shown to consist of a small amount of firmer substance combined with more fluid matter, and that these differ in chemical as well as physical properties, but it is not yet certain as to how these parts are arranged. Passing over the hypothetical micellar theory of Nägeli, the view of Heitzmann, Fromman, and Leydig first demands attention. According to this the firmer portions are in the shape of fine fibrillæ which interlace, forming a network, in the interstices of which the fluid portions are contained. In other words, the whole might be compared to a sponge; but, as Bütschli has pointed out, the different supporters of the fibrillar or sponge theory have not all been looking at the same things. Flemming, on the other hand, thinks that protoplasm consists of extremely fine threads imbedded in a ground substance, but is not certain whether each thread is distinct throughout or whether it interlaces here and there with others. Bütschli advocates the view that the firmer portions have a foamy nature, and that they bear the same relation to the fluid parts that the comb does to the honey, a condition which would also explain the observations of others, their threads and networks being optical sections of the foam fibers. He has imitated these conditions by a foam of thickened sweet oil and carbonate of potash or salt or sugar, in which the oil lamellæ represent the firmer framework of the protoplasm, and the intersection of the lamellæ the microsomata. Especially interesting is the fact that, like its prototype, this imitation protoplasm is capable of spontaneous motion. Satisfactory as it is in some respects, this foam theory is open to certain objections. It does not allow room for the spindles of the dividing cell; and, further, the nucleus of the cell presents several conditions which are greatly unlike a foam. Last in order is the granula theory of Altmanns. According to this the elementary parts of protoplasm are minute particles—granula—imbedded in a ground substance, either isolated or arranged in rows or threads. Protoplasm therefore is a colony of these granula, bound together by indifferent substance. Altmanns's views, which go much further than we can indicate here, have attracted few supporters. He has ascribed the most important position to those parts which others regard as secondary and in some cases adventitious substances.

Concerning the chemical nature of protoplasm even less is known than of its physical structure. Here it is most clearly shown that protoplasm is at least a collection of different substances in varying proportions, so that the word must be understood as implying not a compound of fixed and definite composition, but rather as a group of compounds which exhibit certain physical properties. The analysis of these offers extreme difficulties, for all ordinary processes transform the living into non-living matter, a change which may be accompanied by chemical alterations of more or less complexity, "so that the bodies we identify as components of protoplasm may be simply alteration products, or fragments of the larger and more complex molecules resident in living matter." Of these supposed components most numerous are the phosphorus-containing nucleo-albumens; next come the globulins, lecethin and cholesterin; and certain phosphates and chlorides are always present. Some of these are substances of extreme complexity, with hundreds of atoms in the molecule. These substances are unstable, are easily broken down, and that development of energy which is one of the characteristics of protoplasm is due to the chemical action involved.

In the remaining matters to be mentioned we are on firmer ground. Protoplasm exhibits certain phenomena. As was said above it always occurs in connection with life, and all the phenomena of life are those of protoplasm. Protoplasm has the power of spontaneous motion, as shown not only in the motion (cyclosis) of the plant-cell, but in the less evident but no less real motions of all cell-contents. It is irritable and responds to stimuli of various kinds. It has powers of assimilation; it can take non-living matter and build it into a substance like itself. It grows by the operation and is capable of reproducing its kind. These various phenomena—motion, construction (anabolism), etc.—call for an expenditure of energy, and this is developed by the oxidation or breaking down of the higher compounds into lower and more stable substances. As we know it, homogeneous protoplasm does not occur in nature. It is always aggregated into individual particles or cells, and in each of these different portions—all protoplasm—may be recognized both by physical and chemical tests.

LITERATURE.—Besides the older works of Beale, Huxley, etc., see especially Altmanns, *Die Elementarorganismen und ihre Beziehung zu den Zellen* (Leipzig, 1890); Bütschli, *Investigations on Microscopic Foams and on Protoplasm* (London, 1894); Flemming, *Zellsubstanz, Kern und Zelltheilung* (Leipzig, 1882); Nägeli, *Theorie der Abstammungslehre* (Leipzig, 1884); Chittenden (Chemistry), *American Naturalist* (Feb., 1894); Wendt (Chemistry), *Jenaische Zeitschrift* (1893); Heidenhain, *Kölliker Festschrift* (1892).

J. S. KINGSLEY.

Protop'terus: one of the three living genera of the dipnoan fishes. See DIPNOI.

Prototheʹria [from Gr. *πρῶτος*, first + *θήρ*, beast, i. e. lowest or most generalized mammals]: a term used by Gill as equivalent to *Ornithodelphia* or egg-laying mammals (see MONOTREMATA), these being considered as one of two grand divisions of mammals, the other being the *Eutheria*, or viviparous mammals. By other authorities the term is employed as an equivalent of *Promammalia* to designate the supposed ancestors of the monotremes. F. A. L.

Protozoʹa [Mod. Lat., from Gr. *πρῶτος*, first + *ζῷον*, animal]: one of the grand divisions or branches of the animal kingdom which receives its name from the fact that its members are simplest in structure and therefore come first in logical order. Each protozoön consists of a single cell, or, in those cases where several-celled protozoa are found, each cell performs all the functions of life without assistance from its fellows. In other words, there is no differentiation of the cells into tissues or organs. In all (except the doubtful *Monera*) each individual consists of a mass of protoplasm, with an internal nucleus. In some no cell-wall is present; others may secrete an external or internal horny, calcareous or siliceous skeleton, frequently of wondrous beauty and complexity. In the protoplasm there are usually spaces or vacuoles, and some of these (contractile vacuoles), which rhythmically expand and contract, are supposed to be excretory in function. The protoplasm in the *Rhizopoda* is capable of protrusion in temporary lobes or pseudopodia; in the *Infusoria*, on the other hand, there may be either long, hair-like slowly vibrating outgrowths (flagella), or shorter, more numerous, quickly moving cilia. These processes serve for locomotion and for obtaining food. Food may either be taken in at any part of the body surface, or there may be specialized regions for its admission. There is no alimentary canal, but the nourishment contained in the food is extracted and metabolized by the protoplasm of each cell. There is no true sexual reproduction, but instead a propagation of the species by division of the individuals, in which all of the material of the parent persists in the second generation. There is thus, as Weismann has pointed out, no natural death in the protozoa. Accompanying the processes of reproduction is an occasional temporary union (conjugation) of individuals, in which an exchange of nuclear protoplasm takes place. The protozoa are all minute, and but few can be seen by the naked eye. They live abundantly in both fresh and salt water, and a few live in moist earth or as parasites on or in other living organisms. Notwithstanding their minute size, they play an important part in the world. Some are scavengers, some cause diseases (hay-fever is said to be caused by an infusore), while the dead skeletons of others form extensive beds of rock.

The *Protozoa* are divided into the following classes: 1. MONERA; 2. RHIZOPODA; 3. INFUSORIA; 4. SPOROZOA, which should be referred to for further accounts of these organisms. See also PALEONTOLOGY. J. S. KINGSLEY.

Protracheata: See ONYCHOPHORA.

Proudhon, proo'dōn', PIERRE JOSEPH: socialist; b. at Besançon, France, July 15, 1809; became a printer; employed all his spare time in study, and in 1838 received from the academy of Besançon a stipend of 1,500 francs yearly for three years as a reward for an essay on general grammar. He went to Paris, and in 1840 wrote *Qu'est-ce que la propriété?* In this he assumes that simply by being born into the world every man has a right to a share of what the world

contains of necessaries, comforts, and enjoyments. From this assumption he develops his famous definition of property: "La propriété, c'est le vol." The academy withdrew the stipend, and even threatened him with a prosecution, from which, however, it was restrained by Blanqui, who declared the essay to be perfectly innocent. From 1843 to 1847 Proudhon lived in Lyons, but his two large works from this time were published in Paris, *De la Création de l'Ordre dans l'Humanité* (1843), in which he gives a new theory of political organization; and *Système des Contradictions économiques, ou Philosophie de misère* (1846). When the revolution of February broke out in Paris, he immediately repaired to that city, and (Apr. 1) began the issue of a daily paper, *Le Représentant du Peuple*, in which he set forth the most radical opinions, and which in a short time made him immensely popular. He was elected a deputy to the Constituent Assembly, but he soon discovered that he could do nothing there with his ideas, as nobody would hear him when he spoke, and he consequently returned to the press, editing in succession three daily papers. He was fined for his outrageous sarcasms and personalities against his adversaries, but his readers paid the fines. He started a people's bank in which he tried to reduce his theories to practice, but the project failed and the bank was closed by the authorities. In Mar., 1849, he was sentenced to three years' imprisonment for illegal publications, and he fled to Geneva. Shortly after, however, he returned and delivered himself up to the police. During his imprisonment he wrote *Confessions d'un Révolutionnaire*, *Gratuité du Crédit*, and *La Révolution sociale démontrée par le Coup d'état*. After his liberation he went to Belgium, where he published from time to time works embodying his peculiar theories. D. in Paris, Jan. 19, 1865. Proudhon was the founder of that school of political philosophy which is known as scientific or individualistic anarchism. In *Qu'est-ce que la propriété?* he holds that while property in its existing form is the cause of all social evils, it is so closely connected with the state that the only way to prevent the evils is to destroy the state itself. To communism he was as hostile as to the state, the only proper basis of society being, in his opinion, a voluntary contract between its members. He wished to abolish money as a medium of exchange, substituting for it a sort of bank-paper based on products, in application of his theory that "services should exchange for services and products for products."

F. M. Colby.

Prout, Father: See Mahony, Francis.

Provençal (prō′vǎǹ′saal′) **Language** [*Provençal* = Fr., deriv. of *Provence* < Lat. *Provin'cia*, liter., the Province, the part of France anciently constituting a separate Roman province]: the group of dialects spoken in Southern France in the Middle Ages, which are of great literary importance, and both in the mediæval and the modern forms of high philological interest also, on account of the intermediate position they occupy among the Romance languages and for other reasons. The name Provençal is commonly and conveniently applied to these various dialects, not only covering Provence, but also other territory, as Languedoc, Auvergne, Limousin, Gascony, etc., a rough division from the French dialects being made by a line running from the mouth of the Garonne so as to leave on the S. the greater part of the departments Gironde, Dordogne, Haute-Vienne, Creuse, and also parts of Allier and Loire. E. of Lyons is a considerable territory, with Geneva about in the middle, roughly covering the departments Isère, Ain, Jura, Doubs, Savoie, Haute-Savoie, and also Western Switzerland; in this the so-called Franco-Provençal or Middle-Rhonish dialects are spoken, which agree in some respects with the French dialects, in others with Provençal. The Gascon dialects in the southwest may also be considered as a group by themselves, though they are generally included under Provençal. Another name for the language is preserved in the geographical designation Languedoc (originally "language of yes," from the Provençal word for "yes," just as the French of Northern France has been occasionally called *langue d'oïl* from the Old French word for "yes"). The number of speakers of Provençal has been estimated at about 10,000,000, but this includes, in part, the Franco-Provençal dialects, whose territory has a population of about 2,500,000. For the subject of dialect divisions and for an historical view of Old Provençal phonology and inflexions, see Suchier's article in Gröber's *Grundriss der romanischen Philologie*, i., 561 ff. (or the French translation, *Le Français et le Provençal*, by Monet, 1891), and the maps at the end of the same volume.

In several respects Provençal diverged less from late spoken Latin than was the case with French, or even with Italian or Spanish. Its most obvious distinction from French is that it retains Latin accented *a*, and (in its old form) the *a* of Latin final syllables, while French changed the former under certain conditions into *é* and the latter into *e*. In modern Provençal the older final unaccented *a* has generally become *o*. The Latin diphthong *au* remained unchanged in Provençal. The simple sounds of Provençal in the twelfth century were probably very nearly the same as those of the French of the same period, but the nasal vowels of French do not appear. The sound of *th* in *that* seems to have changed pretty early into *z*, and the palatalized *l* has in the modern dialects generally lost the *l* sound, becoming an *i* or rather *y*, as in modern standard French. The Latin pluperfect indicative was, as in very old French, retained for a time as a simple past tense, but it commonly took in old Provençal the sense of a conditional, as it has done in Spanish.

It is remarkable that we have in Provençal grammatical works on the language itself belonging to the thirteenth century. See Stengel, *Die beiden ältesten provenzalischen Grammatiken* (1878). In modern times Provençal has generally been looked upon as a group of vulgar *patois* until the nineteenth century, when a certain literary standing has again been acquired.

Besides the books mentioned already, the following, among others, are of use (see also Romance Languages):

For the older language: Raynouard, *Choix des poésies originales des troubadours* (6 vols., 1816–21) and *Lexique roman* (6 vols., 1838–44; still useful, but Raynouard's grammatical and comparative work is antiquated); E. Levy, *Provenzalisches Supplementwörterbuch* (1892, *seq.*); Mahn, *Die Werke der Troubadours* (1846–82) and *Gedichte der Troubadours* (1856–73); Bartsch, *Chrestomathie provençale* (4th ed. 1880); P. Meyer, *Recueil d'anciens textes bas-latins, provençaux et français* (1877); H. Suchier, *Denkmäler provenzalischer Literatur und Sprache* (i., 1883); V. Crescini, *Manualetto provenzale* (1892–94).

Mostly for the modern dialects: F. Mistral, *Loutresor dóu felibrige ou Dictionnaire provençal-français* (2 vols., 1879–86); Chabaneau, *Grammaire limousine* in *Revue des langues romanes*, ii.–viii.; Mushacke, *Geschichtliche Entwicklung der Mundart von Montpellier* in *Französische Studien*, iv.; Koschwitz, *Grammaire historique de la langue des félibres* (1894); also articles in the *Revue des patois gallo-romans* (1887–93), the *Revue de philologie français et provençale*, and other periodicals.

E. S. Sheldon.

Provençal Literature: the literature written in the language or dialects of the south of France; one of the most interesting, though least extensive, of the group of Romance literatures. Though born at the same time as French literature, and but little earlier than the Italian and Spanish literatures, Provençal literature is peculiar in that it has not had an uninterrupted history down to the present day. The conquest of Southern by Northern France in the thirteenth century, and the destruction of the former's political autonomy thereby, led to the entire decay of independent Provençal culture and to the decline of the Provençal tongue to the level of a mere dialect. In the nineteenth century there have been efforts toward a revival both of the languages and the literature, efforts that have engaged men of great ability and given rise to excellent literary works; but it can not be said that a new Provençal literary language, fully unified and regulated, like French, for example, has been attained. While it lasted, however, Provençal literature was accepted universally in Europe as the most refined of all. It served as a model for the first Italian, the first Spanish, and the first Portuguese lyric poets; it gave rise to one of the chief poetic schools of Northern France; and hardly any literature in Europe fails to show numerous traces of ideas and poetical forms that had their origin in this.

First Period (950–1100).—None of the first scanty monuments of Provençal verse and prose contain clear indications of the ideas that were later to become dominant in Provençal poetry, and as a consequence they are of interest chiefly to the philologist. The earliest monument of all is a fragment of a poem by some moralizing clerk, based on the story of the Roman philosopher Boethius, and showing an uncritical use of his *De consolatione philosophiæ*. This was written toward the end of the tenth or early in the eleventh century. Likewise the work of clerks are several

fragments of lives of saints and religious lyrics, whose precise dates can not be fixed, but which undoubtedly belong to this time. The earliest monument of Provençal prose is a fragment of a translation of the Gospel of John (ch. xiii.–xvii.) in the Vaudois dialect. Much more interesting to the student of literature is a fragment of 105 octosyllabic verses on the legendary Alexander the Great, written by a certain Albéric of Besançon (or Briançon) early in the eleventh century. This is based on the fabulous life of Alexander, written in the second century A. D., and known as the Pseudo-Callisthenes. It is the first monument of the extensive literature of mediæval Europe devoted to Alexander, and, if we may judge by the indications of the *Alexanderslied* of the German Pfaffe Lamprecht (twelfth century), which was partly based on it, must have been one of the most interesting.

Second Period (1100–1226).—The first name in this period introduces us to that form of poetry that is most characteristic of Provence. It is that of William VII., Count of Poitou (IX., as Duke of Aquitaine), who ruled from 1087 till 1127, and was one of the most famous persons of his time. He was the first of the troubadours (Prov. *trobaire*, acc. *trobador*), as the mediæval lyric poets of Provence called themselves. In him we have the earliest exponent of the new society, with its new ideals of conduct and of art, which had at last come to replace the Roman society that the barbarians had destroyed. This new society had doubtless for some time been forming itself at the feudal courts of Southern France, and had been elaborating its peculiar theories of life. It was an aristocratic society, and the very words by which it expressed its social conceptions are those of a rich and elegant upper class. Such are *cortesia*, or what is suitable at courts; *valor*, or the high spirit of the perfect gentleman; *mesura*, or due self-restraint in demeanor and action; *largueza*, or unbounded liberality; *jovens*, or the gayety and grace of the young in spirit; *joi*, or the glad energy of the heart intent on deeds of excellence and renown. One other conception, the most important of all, was that of *amor*, or chivalrous love, which for Provençal society was not merely the subjective passion universal in the race, but rather a form of conduct, an ideal of excellence, which was at once the source and the criterion of all other excellences. Essentially, the poetry of the troubadours deals with very little of interest besides this chivalrous love; and this was the chief contribution made by them to the poetry and the society of other countries. Indeed the whole modern conception of love has been profoundly modified by it, and that, too, despite the fact that it contains elements at first sight highly repugnant to modern feeling on the subject. Based upon an idealization of woman that was a reaction against the unhappy consequences both of the low idea of her common among the clergy and of the degradation of her caused by the necessities of feudal marriage, the love of the troubadours was avowedly antagonistic to the conventions both of society and of the Church. It was declared by them that love was impossible between husbands and wives, or between persons who might expect to enter into this relation with each other. In general, the lover must serve a lady already married to another; and it was obligatory in a lady thus served to return the love, without regard to her marital obligations. As runs one of the rules of the amorous jurist André le Chapelain, whose *De arte amandi* (*circa* 1200) embodies the theorizings of the time, *Causa conjugii non est ab amore excusatio.* Clearly love of this kind, if it remained honorable, must be a social function rather than a personal passion. Clearly, also, the danger was great that this would not always be the case; nor, in point of fact, was it. Still, it is clear that for a considerable period such relations between men and women were held to be not merely permissible, but in the highest degree ennobling to both. The essentially troubadour love of Dante for Beatrice, wife of Simone de' Bardi, and the high consequences that proceeded from it, are proof enough of this.

During the whole twelfth century the elaboration and discussion of this theory of chivalrous love went on in Southern France, and with it went on the development of the poetical art of the troubadours. The extreme variety and intricacy of the forms of this art were natural results of the essentially external and formal character of the subject-matter; yet these lyric varieties, which are too numerous even to name in a brief article, served as models for the first modern poets of the rest of Europe, and have powerfully affected the history of all modern poetical literature.

The vogue of the new poetry in and out of Provence was very great, and even kings were proud to be counted among the troubadours. The great nobles, like Richard Cœur de Lion, the Count of Poitou, and later King of England; Raymond V. and Raymond VI. of Toulouse; Alfonso II., Count of Provence; William VIII., Lord of Montpellier; Robert, Dauphin of Auvergne; Henry I., Count of Rodez; Barral, Viscount of Marseilles; Ermengarde, Countess of Narbonne; and many others, welcomed the singers to their courts and heaped them with favors. Beyond the borders of Provence they fared no less well, as at the courts of Aragon, Leon, and Castile, in Spain, and at those of the Emperor Frederick II., Marquis Boniface II. of Montferrat, and the Marquises Azzo VI. and Azzo VIII. d'Este in Italy.

The list of troubadours of the twelfth and thirteenth centuries contains no less than 412 names, of whom the great majority belong to the period we are now treating. Of many of these, however, we have but scanty remains and little biographical information. After William IX., mentioned above, there was in the first half of the twelfth century a small group of poets who were felt by the later troubadours to have belonged to an older school, but whose art is not for us markedly different from that of their successors. Chief of these were Cercamon, Marcabrun, and Jaufré Rudel, Prince of Blaya, whose romantic passion for the Countess of Tripoli was long famous. Whatever the change of style was, it seems to have taken place about the middle of the century; and the name given as that of the first really excellent troubadour is Peire d'Alvernh. Another innovator, according to tradition, was Guiraut de Bornelh, who first used the lyric form called *cansos*, or canzone. Practically contemporary, however, or little later, were all the most famous troubadours: Bernart de Ventadour, the best singer of love; Guillem de Cabestaing, whose passion ended in a tragic death; Arnaut de Maruelh, more simple in style than most, and more delicate in sentiment; Pons de Capduelh, eagerly sincere in his service of love; Peire Vidal, a fantastic spirit, but truly a poet; Peire Rotgier, in whom theory overbalances art; the flippant Rambaut III., Count of Orange, and Beatrice, Countess of Die, whose avowed passion for him has obtained for her the name of the Provençal Sappho; Folquet de Marseilles, somewhat later, whose amorous youth was followed by the stern zeal of the fanatic bishop; Rambaut de Vaqueiras, who carried his art into Italy; Peirol, the passionate crusader. Still more noted than any of these were Bertran de Born, who sang more of arms than of love, and Arnaut Daniel, whom Dante thought the best of all the troubadours (*Purg.*, xxvi., 118, *seq.*). In the latter, however, art was carried to the point of extreme artificiality, for the poet even prided himself on the unintelligibility of his difficult style (*rims cars* or *oscurs*).

In the thirteenth century a change began to come over the spirit of Provençal song. The political situation in Provence became ever more threatening. The Church had become uneasy about the heretical sects so numerous there —Albigenses, Cathari, Vaudois—while the Northern French were looking with greedy eyes upon the fair lands of the south. In 1207 the tempest burst, and for nearly forty years the Albigensian crusades continued, devastating the land, destroying the courtly life, dispersing the poets, and finally merging Provence itself in France. The culmination of the tragedy may be said to have been reached in 1226, when the last revolt in Toulouse, the center of Provençal resistance, was crushed. For the next quarter of a century the conquerors were busy with the last details of their task. The Inquisition, established for this purpose, hunted down and destroyed the few surviving heretics; and so far did the violence of the Church go that in 1245 Pope Innocent IV. issued a bull declaring the Provençal language heretical and forbidding students to use it. With the same ruthlessness the French crushed all those, whether nobles or commoners, who desired political independence.

The necessary result of these disasters was a falling off in the art of the troubadours. Though we have many names from the first quarter of the thirteenth century, they are not of the first rank. Love was sung with less of high conviction, and political passions usurped a larger place. We may name from this time Gaucelm Faidit, a man of many loves; Savario de Mauleon; Uc de Saint Circ, from whose pen several brief biographies of earlier troubadours have descended to us; Aimeric de Pegulhan; Cadenet; Perdigon. The two most characteristic poets, however, are Peire Cardinal and Guillem Figueira, the former of whom,

in grave and noble fashion, denounced the vices of his day, especially those of the clergy; while the latter, a scorner of all gentle practices, lived like a roysterer, making mock of the pretensions of noble and churchman alike.

One or two other kinds of literature, though not esteemed like the lyrics of the courtly poets, afford monuments of interest. The first of these is the historical or popular epic, like the *Chansons de Geste* of Northern France. Though it is certain that these were never produced in Provence in the profusion formerly imagined (e. g. by Fauriel), they certainly existed, especially in the region nearest France. Several specimens are extant, in whole or part, and one of these, the poem of *Girart de Rossillon*, is one of the finest epics of the Middle Ages. Here, too, should be mentioned several historical poems, of which the most important is that on the *Crusade against the Albigenses* (early thirteenth century). Probably as early as the twelfth century, also, romantic narrative poems began to be written, but our examples are chiefly from the next period. Of great interest are several didactic poems, particularly those known as *ensenhamens*, in which the ideals of conduct of the time were discussed. These, too, flourished more in the thirteenth century.

Third Period (1226–1323).—The successful termination of the crusade against the Albigenses produced almost a cessation of lyric poetry in Provence proper. A few names of unimportant troubadours of the latter part of the thirteenth century are known to us, but we have only scanty remains of their work. Chief of these poets is Guiraut Riquier, who was, however, little more than *laudator temporis acti*. The real life of the troubadour poetry was at this time to be found in Italy and the Spanish Peninsula. In the former the vogue of this poetry was so great that native Italians began to write it, and the Mantuan Sordello, the Venetian Bartolomeo Zorgi, and the Genoese Bonifacio Calvo deserve honorable mention in the list of troubadours. As is well known, this Provençal poetry served as a model for the first Italian verse. In the Spanish Peninsula, as has been mentioned above, there were several courts frequented by the troubadours during the thirteenth century; and also, especially in Catalonia, not a few poets who employed the Provençal tongue.

In Provence itself there was in this period a considerable development of literature other than lyric poetry. Romances and novels after the French style became popular, and in the *Roman de Jaufre* we have a work of some interest. The poetical novel of manners *Flamenca* gives us important information about the customs of the time. Didactic literature increased greatly in extent, and gives us several *ensenhamens* and treatises of a moral kind. We have a number of scientific or pseudo-scientific works also, and the extensive encyclopædia of Matfre Ermengaud, entitled *Breviari d'amors*, illustrates the speculations on the constitution of the universe then current. Historical poetry is cultivated to some extent. The religious literature is much larger in amount than in the preceding period, and includes legends, in both verse and prose, connected with the life of Christ and of various saints, prayers, sermons, etc. Of special interest are several versions of parts of the Bible, chiefly of heretical origin. Toward the end of this period we get the first example of the Provençal drama, the mystery entitled *L'Esposalizi de nostra dona sancta Maria verges e de Josep*.

Fourth Period (1323–1500).—By the end of the thirteenth century the aristocratic poetry of Provence had entirely come to an end; but here, as elsewhere in Europe, an attempt was made in the *bourgeoisie*, now become rich and prosperous, if not to revive it, at least to imitate it. In short, mastersong succeeded minnesong. In the year 1323 a group of *bourgeois* of Toulouse associated themselves together under the name of the Sobregaya companhia dels VII. trobadors de Tholoza, and in order to promote poetic composition appointed for May 1, 1324, a poetical contest—the first of the long series of Floral Games of Toulouse. The prize offered was a golden violet for the best canzone; and we learn that a certain Arnaut Vidal de Castelnaudari was the first to obtain it. In 1355 the contest was still further developed, and other flowers of gold or silver were offered for excellence in other forms of verse. At the same time the chancellor of the consistory (for so it was then called), Guillem Molinier, was instructed to draw up a treatise on the poetic art. He did this in his famous *Leys d'Amors*, which, though fantastic in the extreme, has great interest for the student. The most remarkable thing about this bourgeois poetry is the fact that though the forms and even phrases of the troubadours were scrupulously preserved, the old meaning had been entirely lost. It was not permitted these new troubadours to address their lyrics to real ladies; they had to write canzoni, ballades, albas, pastourelles, etc., to the Virgin Mary, and to a certain abstraction, *Clemenza* by name, who became almost a goddess. We know the names of about 100 winners in these contests, reaching down to 1498.

Beyond these lyrics this period affords little of interest, except a certain number of mysteries and miracle-plays. Some considerable body of religious literature there is, but of so slight consequence that little of it has yet been published.

Fifth Period (1500–1825).—This is really not a literary period at all, but an interregnum. Not that all versifying had ceased in Southern France, but the language had so degenerated as no longer to deserve the name of literary language, and what was written in it was merely the rude utterance of local dialects. Interest in the troubadours was indeed not entirely lost, especially after the appearance of the romantic, lying book of Jean de Nostradame, *Vies des plus celebres et anciens poetes provensaux* (1575). Others, more truly scholars, like the Italians Castelvetro and Crescimbeni, and the French La Curne de Sainte-Palaye, did much in the way of investigating the history of Provençal song. Still no permanent and fruitful restoration of the decayed tongue took place, and it rapidly sank to lower and lower depths.

Sixth Period (1825 to the present).—After the nineteenth century had well begun, two influences combined to make possible a renaissance of Provençal poetry. The first of these was interest aroused by the studies and publications of the French historian Raynouard, the German philologist Diez, and their numerous followers both in France and Germany. The other was the appearance in Provence of several dialect poets of unusual powers. Chief of these was the barber-poet of Agen, Jasmin (1798–1864), the appearance of whose *Charivari* in 1825 may well be taken as the starting-point of the movement. Contemporaries of Jasmin were Diouloufet, Cabanes, Azaïs, Morel, and, above all, Roumanille. In 1854 an important step was taken by the last named with six other poets—Mathieu, Tavan, Aubanel, Mistral, Brunet, Giera. This was nothing short of the re-establishment of the dead consistory of Toulouse, under the name, however, of the Society of Félibrige, and not limited to Toulouse, but extended to all Provence and even Catalonia. Curiously enough, the title thus assumed was one whose exact meaning was unknown to the associates, and remains even to-day without certain explanation. The poet Mistral had heard at Maillane a poem in honor of the Virgin Mary, which contained the phrase *li sèt félibre de la lèi*. The poets were seven; they proposed to be a law to the other poets of their region; the word *félibre* they were willing to accept on faith as meaning doctors or expositors. The society thus established has extended itself over the whole region in which Provençal and Catalan were once spoken, and is organized in the greatest detail. It has undoubtedly, by the poetical contests it has held, stimulated the production of much verse; but it may be doubted whether it has evoked many great poets. After all, Jasmin, Roumanille, Aubanel, and Mistral remain the chief figures of the new Provençal poetry, and the appearance of all of these antedates the society. On the other hand, the latter has undoubtedly done much for the study of Provençal literature and the Provençal tongue, not so much by its annual pronunciamento, in the form of a poetical almanac, *Armana prouvençau* (1855, *seq.*), as by fostering learned societies, like the Société pour l'étude des langues romanes, whose organ is the *Revue des langues romanes* (Montpellier, 1870, *seq.*).

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The chief collections of the works of the troubadours are: Rochegude, *Parnasse occitanien* (Toulouse, 1819); F. Raynouard, *Choix des poésies originales des troubadours* (6 vols., 1816–21) and *Lexique roman* (6 vols., 1838–44); Mahn, *Werke der Troubadours* (4 vols., 1853–86) and *Gedichte der Troubadours* (4 vols., 1856–73); P. Meyer, *Recueil d'anciens textes bas-latins, provençaux et français* (1877). The best introductory books are K. Bartsch, *Chrestomathie provençale* (4th ed., Elberfeld, 1880), and V. Crescini, *Crestomazia provenzale* (Padua, 1892). A. R. Marsh.

Provence': an old province of France; bounded E. by the Alps and S. by the Mediterranean, and now divided into the departments of Var, Bouches-du-Rhône, Basses-Alpes, and Vaucluse. It derived its name from the Latin *Provincia*, by which the Romans pre-eminently designated it. After the fall of the Roman empire Provence was overrun by the Goths and the Saracens, and during the Middle Ages it was ruled by independent counts. In the twelfth century this land, celebrated for its climate, its sky, and its fruit, produced the famous Provençal songs. In 1481 it was annexed to the French crown by Louis XI.

Proverbs [from Lat. *prover'bium*; *pro*, for + *ver'bum*, word]: popular wisdom, often expressed by "the wit of one," always concentrated in a handy sentence, and actually in use by the people. The last of these limitations is important. For example, many of the sayings of Mrs. Poyser, in George Eliot's *Adam Bede*, would be good proverbs, if they were proverbs. Metaphor and alliteration, though not essential, are common in the proverb, and show origins akin to those of the oldest poetry; for, contrary to the current ideas about didactic verse, proverbs are now regarded by critics as belonging, together with choral song (the later ballad) and popular tale (*Märchen*), to the oldest phase of primitive poetry. The proverb is a general statement which fits a number of particular cases; it is the wisdom or wit of the masses, and therefore flourishes best among unlettered folk—like the ballad and the popular tale. Like the latter, moreover, it is often imported, and is particularly at home in the Orient. These are general proverbs. Others attach to place or person, but spread far beyond original limits—as, "to go round [by] Robin Hood's barn." Proverbs often give a lively notion of the popular attitude in regard to certain classes or institutions; although historical estimates based on such evidence are, to say the least, uncertain: for example, the saws and quips about the mediæval clergy—in particular, monk and nun—or the ever-youthful jibes at medicine and law. Here, again, we have an interesting parallel with popular songs, and as we must distinguish the latter from individual lyric, so should all possible care be taken to sunder a real saying of the people from the incisive phrases of speaker or writer. Moreover, the distinction between the humorous and the didactic must always be kept in view.

Collections of proverbs were attempted even among the Greeks, but modern interest in the subject was awakened and led by Erasmus. His *Adagia* were published in 1500, and found speedy imitation in several countries. The Germans were among his most successful followers, and they have outdone all competitors for later times, with the single exception of Spain. On the other hand, for whatever reason, witty as the Celtic folk is known to be, but scant harvest of proverbs has been gleaned from Irish fields. English proverbs, however, are fairly plentiful, and proverbial poetry has always been popular with Germanic races. A peculiar form of this poetry is preserved in the so-called gnomic verses of the Anglo-Saxon. (See Grein-Wülker, *Bibliothek der Angelsächsischen Poesie*, i., 338 ff.). Other collections of the same character are found in the Old English period, but later proverbs increase in wit, terseness, and subtlety. Chaucer, like Shakspeare, had a liking for proverbs, and collectors have gathered good spoil from many old plays, sermons, pamphlets, tales, and the like.

Of the numerous collections the following may be mentioned for the general subject: Rheinsberg-Düringsfeld, *Sprichwörter der germanischen und romanischen Sprachen* (1872 ff.), and Bohn, *Polyglot of Foreign Proverbs*; for English, Bohn, *A Handbook of Proverbs*, and W. C. Hazlitt, *English Proverbs and Proverbial Phrases* (London, 1869). The Germans have an excellent work in Wunder's *Deutsches Sprichwörter-Lexicon* (5 vols., 1863–80).

Francis B. Gummere.

Proverbs, Book of: a title which comes through the Vulgate from its Greek equivalent, Παροιμίαι, in the Septuagint, and which must be taken in its widest acceptation in order to make it embrace all the varieties of expression comprised in the collection. The original Hebrew term (*mashal*) means properly a "comparison;" but as every utterance of a truth involves a comparison, we find included in the book apophthegms, maxims, enigmas ("dark sayings," in the English version of Prov., i. 6), and sometimes longer connected discourses of the same didactic nature.

It is said in 1 Kings v. 12 that Solomon spoke 3,000 proverbs, and it is probable that many of these are found in this book, as the superscription prefixed to each of their three main divisions assigns it to Solomon. The first division (chs. i.–ix.) is devoted to a description of wisdom and an exhortation to its pursuit. The second (chs. x.–xxiv.) contains individual proverbs, and in its latter part brief proverbial discourses. The third (chs. xxv.–xxix.) was a compilation by "the men of Hezekiah." In chs. xxx. and xxxi. we have three appendices. The first is by an author known to us only by the name Agur, given to him in ch. xxx. 1; the second (ch. xxxi. 1–9) contains precepts for a King Lemuel, given by his mother. *Lemuel* ("one belonging to God") is clearly only a symbolical name, and a general resemblance in style has led some to infer that this, as well as the final section (ch. xxxi. 10–31), was also written by Agur.

The Proverbs exhibit the results of reflection upon the moral and spiritual value of its precepts in the concerns of life. It is noteworthy that they do not once mention the priest nor exalt the externals of worship, nor allude to any conflict between the worship of Jehovah and that of idols. There are good commentaries in English by C. Bridges (London, n. e. 1859), W. Arnot (Edinburgh and New York, 1869), F. Delitzsch (1875), and in *The Expositor's Bible* by R. F. Horton (1891). Revised by S. M. Jackson.

Providence [viâ O. Fr. from Lat. *providen'tia*, foresight, provision, deriv. of *provide're*, foresee, provide; *pro*, for, before + *vide're*, see]: in theology, the doctrine which teaches that God upholds, preserves, and governs the entire universe which he has created. The scriptural doctrine affirms at the same time the omnipotent power of God and the liberty and responsibility of man. It is removed equally, on the one hand, from Stoicism and the rigid doctrine of Fate, and on the other from the Epicurean affirmation that it is an unworthy condescension of the Deity to concern himself about the affairs of men. (Pliny, *Hist. Nat.*, iii., 4, *seq.*) It includes the two essential ideas of preservation and of government. Modern philosophy, which is increasingly monistic, emphasizes the *immanence* of God, and tends to resolve all matter, in its ultimate essence, into a manifestation of the present agency of God. Hence preservation differs from creation only as the beginning of an agency differs from the continuance of the same agency. The scriptural affirmation is, that God upholds all things by the word of his power—that his agency is everywhere seen in the continued existence of his creatures and in the operations of nature. "By him all things consist," Col. i. 17; "In him we live and move and have our being," Acts xvii. 28. The *extent* of providence is unlimited. It includes all the creatures of God, intelligent and non-intelligent, since nothing is so high as to be above his control, nor anything so minute as to be beneath his notice. The *end* of providence is the realizing of the divine plan in the universe. The end is infinitely wise, holy, and beneficent. The *means* are such as are best adapted for the certain accomplishment of this end. Instead of chance, or necessity, or inexorable fate, to which gods and men are equally subject, the doctrine of the Scriptures substitutes the intelligent control of the omnipotent and omnipresent Jehovah, in accordance with designs as gracious as they are vast and inscrutable. The *method* of providence—*how* it is that God governs the world consistently with the liberty of rational beings—is not a subject of revelation. The employment of motives to govern human action in many cases is plain. The difficulty of the problem lies in the reconciliation of divine foreknowledge and government with human freedom.

That there are powers, unseen and supernatural, operating to sustain and control both nature and man seems to be the instinctive faith of the race, aside from the special

teaching of revelation. This imparts a deep significance to many fables of ancient mythology. The belief in a providence of some kind seems well-nigh universal. It is affirmed or implied in the writings of ancient classical poets and philosophers, although disfigured with crude and unworthy conceptions of the divine nature or character. Cicero in his dialogues, *De Nat. Deorum*, states at considerable length the speculations of the most distinguished philosophers among the Stoics and Epicureans on the existence, attributes, and providence of a Divine Being. In lib. ii., while allowing the principle of pantheism—that God is the Universe and the Universe is God—he affirms the existence of minor deities, and then argues in favor of the divine government and providence—(1) from the existence of the gods, which implies their actual control of the world; (2) from the laws of nature—nature, properly interpreted, being another name for God; and (3) from the order, harmony, beauty, and wisdom manifested in the works of creation. Although not very complete or satisfactory, the argument shows the tendency of philosophic thought unaided by revelation. See also *Tusc.*, Disp. i., 49, *et al.*

The doctrine of providence was affirmed with great unanimity by the most distinguished early Christian Fathers, and maintained with equal subtleness of discrimination and strength of argument. The objections, too, early brought against the doctrine, were nearly the same as those revived and reaffirmed in our day. By some it was held to be unnecessary, or an implication of imperfect work on the part of the Creator, rudely supplemented afterward. Others "maintained that God concerned himself only about the genus, but not about the species," distinguishing between a general and a special providence—*gubernatio generalis* and *gubernatio specialis*. Still others held it to be derogatory to the Supreme Deity to suppose that he would condescend to notice the small concerns of men. Origen represents Celsus as affirming that God interferes as little with the affairs of men as with those of monkeys and flies. The opposite and Christian view of this article of faith was eloquently maintained in the East and the West by Chrysostom and Theodoret, by Augustine and Salvian. Augustine especially objects to the comparison of God to a master-builder, whose work remains though he himself withdraws. "The world would at once cease to exist," he says, "if God were to deprive it of his presence." Nearly two centuries earlier, about A. D. 230, Minucius Felix, in his apologetic dialogue entitled *Octavius*, in a passage of singular beauty, says: "We are not only under God's eyes, but we even live in his bosom."

The doctrine of providence is not inconsistent with the idea of a government of law. The Scriptures affirm that God is the creator of the universe. He is the author of what we call the laws of nature, and can surely change or suspend or overrule them. But he does not govern the world arbitrarily, but according to a fixed plan and for a great end. The laws of nature are the ordinances of God, but a man even may use some powers of nature to control or limit other powers. So, in a far higher sense, and with a method infinitely more perfect, may the Creator control that which he has made. Nor can we deny that he may act directly upon the rational mind, as one finite mind may seek to modify another; or upon both nature and spirit by methods to us now, and perhaps always, incomprehensible.

Some theories of evolution have been used against the doctrine of providence. The laws of the development of living forms being reduced to few, and their rigid and invariable application being assumed as the process of all the modifications resulting in the existing life of the planet, it has been argued that there is no place for providence. But evidently there is no *new* problem added by a new view of the *nature* of the laws under which providence must proceed to that given by the idea of natural law in general; and this problem is simply that of the personality of God.

Some of the proofs of the doctrine are the following: (1) It is inferred from the idea of a personal God, infinite in intelligence, wisdom, goodness, and power; (2) from the evidence of intelligence and design in nature; (3) from the evidences in history of moral order and law. History would otherwise be a tangled skein without beginning or end, without significance, and incapable of harmony or intelligent interpretation. The story of races and nations, the epochs which seem to mark the movements of society and the progress of civilization, would lose their importance, and our hope for the world would vanish, if we destroy the reality and the end of providential control. (4) From the experience of individuals, which may be misinterpreted, but can not be overlooked altogether. (5) The proofs from the Holy Scriptures: (*a*) in the passages which indicate or declare the government of God over nature, over irrational animals, over men and nations; (*b*) in the lives of eminent men—e. g. Abraham, Moses, Elijah, Saul, David, Daniel, Paul; (*c*) in the Jewish history, conspicuously everywhere; (*d*) in passages which affirm the truth of prophecy; (*e*) and in those which affirm the efficacy of prayer.

The literature of this subject is voluminous. Some of the most important works which treat of the history of opinion are (*a*) in philosophy: Ritter's *History of Philosophy* (12 vols.); *History of Ancient Philosophy* (4 vols.), translated from the first volumes of the general history by A. J. W. Morrison; Ueberweg's *History of Philosophy*, translated by Prof. G. S. Morris (2 vols.). (*b*) In theology: Neander's *General Histories of the Christian Religion and Church*, translated by Prof. Torrey (5 vols.); Hagenbach's *History of Doctrines*, translated by Prof. H. B. Smith (2 vols.); Van Oosterzee, *Christian Dogmatics* (2 vols.), in Theological and Philosophical Library, edited by Prof. Smith and Prof. Schaff; Knapp's *Christian Theology*, translated by President Leonard Woods; and Rev. Dr. Charles Hodge's *Systematic Theology* (3 vols.). Revised by FRANK H. FOSTER.

Providence: city (founded in 1636); capital of Rhode Island and also the capital of Providence County; at the head of navigation on Narragansett Bay; seven railways, all controlled by the New York, New Haven and Hartford Railroad Corporation, enter the city; 30 miles N. by W. of Newport, 44 miles S. W. of Boston (for location, see map of Rhode Island, ref. 8–N). Two small rivers meeting divide it into two parts, the east and west sides. At the junction of these rivers was formerly the Cove, now filled in. With the promenade which surrounded it the space, amounting to 1,585,134 sq. feet, is devoted to the use of the railways. Of public parks the most important is the Roger Williams (102 acres). It contains a fine statue of Roger Williams (see WILLIAMS, ROGER), the founder of the city and State. The surface of the city is very uneven. Many of the best business blocks rest on "made land," while parts of the residence portions rise 200 feet above tide-water. These inequalities add much to the picturesqueness. The streets are remarkably well cared for. Those in the business portions are paved, the others macadamized. All are clean. The electric and cable railways are owned by one company. The city is noted for its large private houses. Its most important public buildings are the old State-house (1762), Providence County court-house (1877), the city-hall, built in 1879 at a cost of over $1,000,000; the Rhode Island State Normal School, and the new State Capitol. This last was finished in 1900 at a cost of $3,500,000. Among the business blocks should be noted the Arcade (1828), a three-storied structure, connecting the two principal business streets; the Butler Exchange (1872), the buildings of the Rhode Island Hospital Trust Company (1891), the Industrial Trust Company (1894), the Union Trust Company (1901), and the Banigan Building. All these buildings front on Westminster Street, the chief business thoroughfare. There are 129 churches and other places of worship. Of these the Baptists have 21; Episcopalians, 14; Congregationalists, 10; Methodists, 18; Roman Catholics, 16; Unitarians, 4; Universalists, 3; and Presbyterians, 4. The most noted is the First Baptist meeting-house, built in 1775 "for the public worship of Almighty God, and also to hold commencements in." It is of wood, and has a very beautiful spire. The largest edifice is the Roman Catholic cathedral (1885). The principal educational institution is BROWN UNIVERSITY (*q. v.*). The Rhode Island School of Design furnishes the art instruction needed in a great manufacturing community. The chief private school is the Friends Yearly Meeting Boarding-school, opened in 1818. Here is also the State Normal School. The public schools in 1893 had 18,772 pupils, 451 teachers, and 66 buildings. The most important hospitals are the Rhode Island (1868), and the Butler Hospital for the Insane (1847). The last is situated on the east bank of the Seekonk river in a park of 140 acres, and accommodates 200 patients. The Dexter Asylum for the Poor was founded in 1827; its grounds comprise 39 acres. The city is especially rich in public and private libraries. Besides that of Brown University (110,000 volumes) should be noted the Public Library, 100,000 volumes, the Athenæum Library, 70,000 volumes. The library of the late John Nicholas Brown is unequaled in its Americana. The city debt Apr. 1, 1900, was $14,008,484.14; assessors'

valuation of real and personal estate, $188,501,780; rate of taxation, $16 per $1,000. Providence is especially noted for its manufactories of cotton and woolen goods, jewelry (167 establishments), silverware, tools, locomotives, boilers, steam and electrical engines, screws, files, sewing-machines, etc. The census of 1890 showed that 1,883 manufacturing establishments (representing 154 industries) reported. These had a combined capital of $54,274,227, employed 37,955 persons, paid $18,789,500 for wages and $36,674,308 for materials, and had products valued at $71,810,173. The city is a great wholesale and distributing-point. Immense quantities of coal are transhipped from its wharves. The commerce is mostly coastwise. Lines of steamships run to Baltimore, Philadelphia, and New York. It has 33 banking institutions with an aggregate capital of $30,000,000. The deposits in the savings-banks exceed $40,000,000. As a seaport for 200 years the town grew slightly, though its commerce was extensive. With manufactures came marvelous development. Since 1860 the population has increased three-fold. Pop. (1890) 132,146; (1900) 175,597.

WILFRED H. MUNRO.

Provincetown: town; Barnstable co., Mass.; on the northern extremity of Cape Cod and the N. Y., N. H. and Hart. Railroad; 55 miles by water and 120 by rail S. E. of Boston (for location, see map of Massachusetts, ref. 5–K). It is noted as the first landing-place of the Pilgrim Fathers in America; as the birthplace of the first child born in New England of English parents; and as a popular summer resort. It has a deep and commodious harbor on the inner side of the cape, almost entirely landlocked, and free from obstructions. The principal industries are whaling and cod and mackerel fishing. The town has a national bank with capital of $200,000, a savings-bank, a public library, several hotels and summer boarding-houses, and a weekly newspaper. Pop. (1880) 4,346; (1890) 4,642; (1900) 4,247.

Proviso: a clause or provision introducing a condition, as into a contract, a statute, or a will; a conditional stipulation. See CONDITION.

Provo: city; capital of Utah co., Utah; on the Provo river, and the Union Pac. and the Rio Grande West. railways; 3 miles E. of Utah Lake, 48 miles S. S. E. of Salt Lake City, near the western base of the Wasatch Mountains (for location, see map of Utah, ref. 4–M). It is in an agricultural region; contains the Utah Insane Asylum, Brigham Young Academy (Latter-Day Saints, opened in 1876), Proctor Academy (Congregational, opened in 1887), a national bank with capital of $50,000, a savings-bank, 2 private banks, a semi-monthly, 2 daily, and 2 semi-weekly periodicals; and has manufactories of flour, leather, woolen goods, and lumber. Pop. (1880) 3,432; (1890) 5,159; (1900) 6,185.

Provoost, prō'vōst, SAMUEL, D. D.: bishop; b. in New York, Mar. 11, 1742, of Huguenot ancestry; graduated at King's College, New York, 1758, and the University of Cambridge, England; entered the Church of England ministry 1766, and in same year became assistant minister of Trinity church, New York; espoused the popular side at the breaking out of the war, and retired to his country home during the struggle; became in 1783 rector of Trinity church, chosen by the patriot churchmen of New York, and in 1787 was consecrated Bishop of New York at Lambeth, England; was chaplain of Congress in 1785, and in 1789 chaplain of the U. S. Senate; read prayers at St. Paul's chapel on occasion of the presence of Washington and the Congress directly after the inauguration exercises in 1789; resigned the care of Trinity church in 1800, and in 1801 received a coadjutor. During the closing years of his life he retired from all public offices. D. in New York, Sept. 6, 1815.

Revised by W. S. PERRY.

Provo River: a river of Utah which rises on the west slope of the Uinta Mountains, flows westward in a deep, wild cañon through the Wasatch Mountains, and empties into Utah Lake, which is tributary to Great Salt Lake. It is about 100 miles long, and of sufficient volume without storage to irrigate 100 sq. miles of land. The upper portion of the stream was formerly a branch of Weber river, but was turned from its original course by *débris* deposited by the stream itself in Kawas valley. It was one of the principal tributaries of Lake Bonneville, and built the large delta on which the town of Provo now stands. Consult *Report on Arid Lands*, by J. W. Powell (Washington, 1879), and *Lake Bonneville* by G. K. Gilbert (Monograph No. 1 U. S. Geol. Surv.).

ISRAEL C. RUSSELL.

Provost-marshal: in the army and navy, an officer who attends to the execution of martial law, the fulfillment of sentences by courts martial, and the like. He preserves order in towns and districts under military control, and has certain summary powers under the articles of war.

Prowse, DANIEL WOODLEY: See the Appendix.

Prudden, THEOPHILE MITCHELL, Ph. B., M. D.: b. at Middlebury, Conn., July 7, 1849; educated at Yale College, Heidelberg, Berlin, and Vienna, graduating M. D. from the Yale Medical School in 1875; devoted himself to pathology, and was lecturer on normal histology at Yale Medical School; in 1881 became director of the pathological laboratory of College of Physicians and Surgeons, New York; in 1892 was elected Professor of Pathology in the latter college. Among his works are *Manual of Normal Histology* (1881); with Delafield, a *Handbook of Pathological Anatomy and Histology* (1885); *Story of the Bacteria* (1889); *Dust and Its Dangers* (1891); and *Water and Ice* (1891).

Pruden'tius, AURELIUS CLEMENS: poet; b. in 348 A. D. in Northern Spain; studied law; practiced as an advocate; held several high positions, and received in 394 a military appointment at Rome under the Emperor Theodosius, but retired afterward from public life and devoted himself exclusively to theological studies and religious poetry. The date of his death is unknown. He is last heard from in 405. Of his *Liber Cathemerinon* and *Liber Peristephanon*, two collections of hymns, several pieces became very popular, were translated into other languages, and are still in use. Among his other books, all written in Latin verse, are *Hamartigenia*, on the origin of sin; *Psychomachia*, on the contest between good and bad in the human soul; *Contra Symmachum Libri Duo*, to persuade the Roman emperor not to restore the altar and statue of Victory cast down by Gratian. There are complete editions of his works by Arevalus (Rome, 1788; rep. Migne, lix., lx.), by Obbarius (Tübingen, 1845), and by Dressel (Leipzig, 1860). A new revision of the text is promised by Huemer for the *Vienna Corp. Script. Eccl. Lat.* An English translation of the *Cathemerinon and other Poems of Prudentius* appeared in 1845 (London). See also F. St. John Thackeray, *Translations from Prudentius* (London, 1890; Latin text and verse translations; notes, introduction on life and times, etc.). See J. Schmitz, *Die Gedichte des Prudentius und ihre Entstehungszeit* (Aachen, 1889), and A. Puech, *Prudence: Étude sur la poésie lat. chrétienne au IVe siècle* (Paris, 1888).

Prudhommes, Conseils de: See FRANCE (*Justice*).

Prume, FRANÇOIS HERIN JEHIN: See the Appendix.

Prune [viâ Fr. from Lat. *pru'num*. See PLUM]: the dried fruit of certain kinds of plums. The finest sorts are called *prunelles*. The best-known prunes come from France, but Germany furnishes large amounts of a coarse kind. Turkey and Spain also export prunes. They are used as a mild laxative for children, and are extensively employed in cookery. They are sometimes dried by artificial heat and sometimes in the sun, or perhaps more commonly are half dried by stoves, the process being finished in the sun. California is an important prune-producing country. Its product is usually lighter colored than that of France, because the fruit is dried without heating or cooking. The chief variety used there for the commercial article is Prune d'Agen. The plums are shaken from the tree and dipped in lye to facilitate the drying process.

Revised by L. H. BAILEY.

Pruning [*prune* < M. Eng. *proinen*, from O. Fr. *provain* > Mod. Fr. *provin* < Lat. *propa'go*, *propa'ginis*, slip, cutting. Cf. Eng. *propagate*]: the act of cutting off parts of a tree or shrub, either for the purpose of producing a certain shape or of increasing the production of fruit or timber, or improving the size and quality of the fruit and the ease of picking the crop and caring for the plant; also to facilitate the fighting of insects and fungi. Forest trees are pruned to increase the quantity of timber in the trunk by diminishing the side branches, beginning at the lower part of the tree. In fruit trees the branches are thinned out in order to admit the air and light more freely to the leaves, blossoms, and fruits, and to concentrate and increase the nourishment for the branches which remain. In pruning for the purpose of producing fruit it is necessary to know on what branches and buds the fruit grows. The grape generally bears on shoots of the current year (see GRAPE), the peach on those of the preceding year, and the apple and pear on wood of two or three years' growth. It is generally considered that early spring or late winter is

the best season for pruning. For explicit directions, see the various fruit manuals. The only special volume devoted to the pruning of fruits in the U. S. is Bailey's *American Grape Training*. Revised by L. H. Bailey.

Pruri'go [Mod. Lat., from Lat. *pruri'go*, an itching, deriv. of *pruri're*, itch]: a condition of the skin, characterized by intense itching and by the presence of small points filled with a watery liquid.

Prussia (in Germ. *Preussen*): the principal state of the German empire, comprising almost two-thirds of its entire area.

Boundaries, Area, and Physical Features.—It extends from lat. 49° 6′ 45″, its extreme southern point in the Rhine province, to 55° 53′ 40″ N., and from lon. 5° 50′ to 22° 50′ E. It is bounded by the North Sea, Oldenburg, Denmark, Mecklenburg, and the Baltic on the N., by Russia on the E., the Austrian empire, the kingdom of Saxony, Thuringia, Bavaria, Hesse, and Alsace-Lorraine on the S., and by Luxemburg, Belgium, and the Netherlands on the W. It includes also the detached territory of Hohenzollern. Among the islands belonging to it are Rügen, Fehmarn, and Alsen in the Baltic and the North Frisian islands and Heligoland in the North Sea. Its area is 134,463 sq. miles. The principal part of the kingdom in the north and east belongs to the great northern plain of Europe. In the main it slopes gently to the N., and only in places along the coast is broken by sand-dunes, the highest in Europe. At Rügen chalk cliffs rise abruptly from the sea. The northeast coast of Schleswig-Holstein is high and cut in by numerous fjords. Along the North Sea, however, it has frequently been necessary to build dikes to protect the low-lying land from overflow. In the south and southwest the surface is for the most part hilly or mountainous. The principal mountains are the Sudetic range, including the Riesengebirge (5,255 ft.), on the S. toward the borders of Austria, further westward the Thuringian and Hartz Mountains, and still further to the W. the Teutoburgerwald, the Weser Mountains, the Taunus, and the Westerwald. Hohenzollern lies in the Swabian Alps. The principal rivers are the Rhine, Ems, Weser, Elbe, Oder, Vistula (Weichsel), Niemen, and their affluents. The coast has a number of bays, among them the Kiel, Rügen, and Pomeranian Bays and the great Gulf of Dantzic so called, and some large inlets, the most important of which are the Stettin, Frisches, and Kurisches Haff. There are small lakes in the north and northeast—in Holstein, Pomerania, West and East Prussia—but they also occur in other parts of the kingdom.

Climate, Soil, and Products.—The climate of Prussia is temperate and on the whole salubrious. The harvest season is short in the northeast, and the higher regions of the west are characterized by raw winds; the more protected parts of the country, however, adjoining the Sudetic range, Saxony, the S. of Hanover, and the middle Rhine, are mild and equable. The mean annual temperature of East Prussia is 6·33° C.; about the confluence of the Moselle with the Rhine it reaches 10·1° C. About the lower waters of the Vistula and the Oder only careful draining carried on through centuries has rendered the land available. The highest parts of this region consist for the most part of sand and clay. The northwestern provinces have in parts dry and barren soil alternative with marsh and turf moor. The most fertile portions of the kingdom are in the province of Saxony, the foot-hills of the Sudetic Mountains, and the Thuringian, Weser, Westerwald, and Taunus uplands. The total productive area occupied by crops and forests is 20,853,532 hectares. The principal agricultural products, arranged in the order of the area occupied in their production, are rye, hay, oats, potatoes, wheat, barley, beetroot, rape-seed, flax, hops, and tobacco. Fruit is grown in the warmer parts of the country. Wine is produced on the Rhine and the Moselle, the Saale and Unstrut, and in Silesia. Stock-raising is extensively carried on. Of minerals there is a large production. The most important are coal, iron, zinc, lead, copper, cobalt, nickel, and rock-salt. Amber is found on the Baltic coast.

Population and Government.—The population of Prussia in 1895 was 31,855,123, divided among the fourteen provinces as follows: East Prussia, 2,006,689; West Prussia, 1,494,360; Pomerania, 1,574,147; Posen, 1,828,658; Brandenburg, 2,821,695; Berlin, 1,677,304; Saxony, 2,698,549; Silesia, 4,415,309; Hanover, 2,422,020; Schleswig-Holstein, 1,286,416; Westphalia, 2,701,420; Hesse-Nassau, 1,756,802; Rhine province, 5,106,002; Hohenzollern, 65,752. With respect to nationality 26,438,070 are Germans, 2,872,197 are Poles, 164,162 are Czechs, 139,399 are Danes, 121,345 are Lithuanians, 89,786 are Dutch and Frisians, 67,967 are Wends, and 64,441 are of other nationalities. With respect to creed 19,232,449 are Evangelical, 10,252,807 Roman Catholics, 372,058 Israelites, and 95,349 belong to other denominations. The Roman Catholics are settled principally in the Rhine province, Silesia, Westphalia, and Posen. In 1900 the population was 34,463,377. The government is a hereditary constitutional monarchy administered by the king and the Landtag. The latter consists of two chambers—the Herren-haus, or House of Lords, and the Abgeordneten-haus, or House of Delegates, with 433 members elected for three years. The king is the German emperor. As the principal state in the empire, Prussia has 17 representatives in the Bundesrath and 236 members in the Reichstag. See German Empire.

Army, Finance, and Education.—The Prussian army forms the principal part of the army of the empire. Including the contingents of the minor states, but exclusive of the armies of Saxony, Bavaria, and Würtemberg, its peace footing consists of 376,841 men in the different branches of the service, with 19,382 officers, surgeons, etc. The state of its finances, according to the budget of 1893–94, was as follows: Total receipts, 1,893,313,260 marks, the principal items of which were direct taxation, 135,166,000; indirect taxes, 71,164,000; mines and salines, 138,361,229; railways, 938,732,081; domains and forests, 88,773,734; total national debt, 6,243,773,430 marks, with a sinking fund of 17,079,453 marks. The public educational system has reached a particularly high standard of development. Education is general, and in the elementary schools compulsory. There were (1891–92) 34,742 public elementary schools, 606 public middle schools, 315 gymnasiums, pro-gymnasiums, and Real pro-gymnasiums, 122 schools for the training of teachers, 10 universities (with 14,635 matriculated students), and various institutions for special and technical training.

Manufactures, etc.—Prussia is one of the greatest manufacturing countries of Europe. Its iron industry is among the foremost in the world; it also yields about half of the world's product of zinc. The principal manufactures are metallic wares, machinery, cotton goods, silk, velvet, linen, cloth, paper, and leather. Its exports include manufactured goods of great variety, grain, timber, wool, live stock, etc. In 1893 Prussia had 18,367 miles of railways, about 90 per cent. of which is the property of the state. Of internal waterways all the rivers named are navigable, and there are in addition several canals.

History.—A Prussian people (Pruzi, Prutheni), akin to the Letts and Lithuanians, first appeared in history near the end of the tenth century in the region to the E. of the Vistula. In that same century Adalbert, Bishop of Prague, endeavored to convert them to Christianity, but was killed by them in 997. In the eleventh and twelfth centuries they were involved in conflicts with the Poles, who failed to effect a conquest; but in 1283 the Teutonic Order conquered the country. In 1309 Marienburg became the headquarters of the order. For more than 200 years the Teutonic Order ruled the country, but ultimately it broke down through the enmity of Poland and Lithuania and its own internal deterioration. By the peace of Thorn (1466) the whole country W. of the Vistula was ceded to Poland, and her sovereignty was acknowledged over the remainder. In 1511 Albrecht, Margrave of Brandenburg, of the family of Hohenzollern, was elected grand master and in 1525 he dissolved the order and transformed the greater part of East Prussia and a small part of West Prussia into a temporal hereditary dukedom. The connection between the dukedom and Brandenburg thus begun was not, however, finally accomplished until after the death of Duke Albrecht Friedrich (1618), and the consequent extinction of the lateral line, when the dukedom fell to the electoral house of Brandenburg. It continued, however, a fief of the Polish crown until 1656, in the time of Friedrich Wilhelm, the Great Elector, whose long and successful reign (1640–88) marks the real beginning of the Prussian state.

For the subsequent history of Prussia, see German Empire (*History*), and for further details see the biographies of her kings—Frederick William I., II., III., and IV., Frederick II., William I., and the articles on the Seven Years' War, the Franco-German War, and Napoleon I.

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1881); Joh. Gust. Droysen, *Geschichte der preussischen Politik* (5 vols. in 14, Leipzig, 1868–86). Works on special periods: Ranke, *Memoirs of the House of Brandenburg, and History of Prussia during the Seventeenth and Eighteenth Centuries* (translated from the German by Sir Alexander and Lady Duff Gordon, 3 vols., London, 1849), and *Denkwürdigkeiten des Staatskanzlers, Fürsten von Hardenberg* (5 vols., Leipzig, 1877); Thomas Carlyle, *History of Friedrich the Second, called Frederick the Great* (6 vols., New York, 1858–66); Hillebrand, *La Prusse Contemporaine et ses Institutions* (Paris, 1867); Seeley, *Life and Times of Stein; or Germany and Prussia in the Napoleonic Age* (3 vols., London and Boston, 1879). WILLIAM H. CARPENTER.

Prussian Blue, or **Berlin Blue**: ferric ferrocyanide, Fe_4Cfy_3, or Fe_7Cy_{18}. It is produced by precipitating ferric chloride or sulphate with potassium ferrocyanide; or by precipitating the ferrous sulphate (copperas) with the same reagent, and oxidizing the product by some convenient method. It is intensely blue, and is used as a pigment. Its solution in oxalic acid is used as a blue ink and for bluing linen, etc. It is used in dyeing and calico-printing, being formed in the cloth. See CALICO-PRINTING.

Prussian Carp: See GIBEL.

Prussian Language, Old: See OLD PRUSSIAN LANGUAGE and LETTIC RACE, THE.

Prussic Acid: See HYDROCYANIC ACID.

Pruth: a tributary of the Danube. It rises on the northeast side of the Carpathian Mountains in Galicia, runs through Bukowina, forms the boundary between Roumania and Russia, and enters the Danube at Reni, 13 miles below Galatz, after a course of about 520 miles. It becomes navigable from near Jassy.

Prutz, ROBERT EDUARD: poet; b. at Stettin, Prussia, May 30, 1816; studied philology, philosophy, and history at Berlin, Breslau, and Halle, and afterward edited with Arnold Ruge the *Halleschen Jahrbücher*, a periodical which advocated liberal ideas in science, religion, and politics. Owing to his radical views he was for a long time excluded from the academic career until in 1849 he became Professor of Literature at the University of Halle. He soon resigned this position, and devoted himself entirely to literary and scientific pursuits. As a poet Prutz belongs to the patriotic bards who, previous to 1848, fought for greater political liberty in Germany. Besides the *Gedichte* (1849), *Aus der Heimat* (1858), *Herbstrosen* (1865), he published several dramas filled with the same patriotic spirit (*Moritz von Sachsen, Erich der Bauernkönig*), and a number of novels that disclose a great talent for satire. His researches in the history of German literature, which are embodied in the monographs *Der Göttinger Dichterbund* (1841), *Geschichte des deutschen Journalismus* (1845). *Vorlesungen über die Geschichte des deutschen Theaters* (1847), have insured Prutz a permanent position in the history of literature. He also exerted great influence on the literary production of his time as a critic in the *Deutsche Museum*, a literary periodical which he edited 1851–66. D. at Stettin, June 21, 1872. JULIUS GOEBEL.

Prynne, WILLIAM: Puritan writer and agitator; b. at Swanswick, Somersetshire, England, in 1600; studied at Oriel College, Oxford, and graduated 1620; studied law at Lincoln's Inn; was converted to Puritanism by Dr. John Preston, lecturer at that inn; in 1633 issued his celebrated *Histrio-Mastix, the Player's Scourge*, which was construed into a libel upon the queen; was brought before the Star Chamber, fined £5,000, expelled from the University of Oxford and from Lincoln's Inn, set on the pillory at Westminster and Cheapside, had both ears cut off, and was sentenced to imprisonment for life. Having issued from his prison a tract entitled *News from Ipswich*, he was again fined and pilloried, had the letters S. L. ("Seditious Libeler") burned upon his cheek, was imprisoned in close confinement in Caernarvon Castle, and afterward in the castle of Mont Orgueil in the island of Jersey. In 1640 Prynne was released by warrant from the House of Commons. Elected a member of Parliament for Newport, he conducted the proceedings against Laud; became recorder of Bath 1647; took an active part in favor of the Presbyterians in their struggle with the Independents; advocated a reconciliation between Parliament and the king; was arrested for denying the supremacy of Parliament in a pamphlet entitled *A Brief Memento* (1648); was with others ejected from Parliament by the army Dec. 6, 1648; attacked Cromwell and the army in his writings; was again imprisoned in 1650 and 1651; advocated the restoration of Charles II.; was elected to the new Parliament 1660; was made keeper of the records in the Tower; was reprimanded by the House of Commons 1661 for new offenses in his writings; published a vast number of political, legal, and antiquarian treatises. D. in London, Oct. 24, 1669.

Pryor, ROGER ATKINSON, LL. D: lawyer; b. near Petersburg, Va., July 19, 1828; graduated at University of Virginia 1848; studied law; became connected with the press at Petersburg 1851; was an editor of the Washington *Union* 1852 and of the Richmond *Enquirer* 1853; went as special commissioner to Greece 1855; edited a newspaper entitled *The South* 1856–67; sat in Congress 1857–59; was again elected in 1860, but did not take his seat on account of the secession of Virginia; was chosen to the provisional congress of the Confederate States at Montgomery, and to the first regular Confederate congress; entered the Confederate army as colonel of the Third Virginia Regiment; was made brigadier-general after the battle of Williamsburg; was taken prisoner Nov., 1864, and imprisoned in Fort Lafayette, but was released after four months' detention. In 1865 began the practice of law in the city of New York, devoting himself to his practice until in 1890 he was appointed judge of the court of common pleas, to which office he was elected in 1891 for a term of fourteen years. By virtue of the revised constitution of 1894 he becomes a justice of the Supreme Court on and after Jan. 1, 1896, for the remainder of his term of fourteen years, the court of common pleas being then abolished. Revised by F. STURGES ALLEN.

Przemysl, pzhem'is'l: town; in the province of Galicia, Austria; on the river San, an affluent of the Vistula; 61 miles by rail W. of Lemberg (see map of Austria-Hungary, ref. 3–J). It is the see of a Roman Catholic and a United Greek bishop, has many educational and benevolent institutions, and manufactures of spirits, machinery, etc. Since 1874 it has been strongly fortified. Pop. of the commune (1890) 35,619.

Psalmana'zar, GEORGE: the assumed name of a literary impostor, whose real name and early history have remained unknown. He is supposed to have been born in the south of France in 1679; received a good education under Jesuit instructors; led for some time a vagrant life, roaming through France, Germany, and the Netherlands; ultimately attracted the attention of Mr. Innes, chaplain of a Scotch regiment at Sluys, Holland, who succeeded (as he supposed) in converting Psalmanazar to Christianity, took him to London, and presented him to Bishop Compton and others as a native of Formosa. It is uncertain whether Innes was a dupe or an accomplice in this affair, but he received promotion for his missionary zeal, and Psalmanazar was encouraged to draw up a *History and Description of the Island of Formosa off the Coast of China* (1704), illustrated with many engravings and with copious specimens of the pretended Formosan language, into which he translated the Catechism of the Church of England. Psalmanazar was sent to Oxford, but soon repented of and confessed his imposture, applied himself to study, became skilled in Oriental history and literature, and spent nearly half a century in London, chiefly occupied in writing for the booksellers. He completed Palmer's *History of Printing*, wrote several volumes of the *Universal History*, and led an exemplary life. D. in London, May 3, 1763. His autobiographical *Memoirs* appeared in 1764.

Psalmody [via O. Fr. and Lat., from Gr. ψαλμῳδία, liter., singing of psalms; ψαλμός, psalm + ᾠδή, song, singing]: as usually defined, the act, art, or practice of singing psalms; but properly, in a wider sense, not only the vocal rendering of the songs used in public worship, but also the study of their origin and history, as well as of the tunes to which they are sung. Psalmody may be considered as ancient and modern. In the former the songs were all rhythmical, and necessarily performed in the chanting or recitative style.

That God was worshiped publicly in song before David's time is clear, not only from the inherent probability of such praise, but also from the readiness and facility with which the responsive hymn of male and female voices was sung after the passage of the Red Sea. No direction, however, was given for such worship in the Law. It was David, the Psalmodist as well as the Psalmist of the Old Testament, who instituted the formal, stated, liturgical services of praise. He had a trained choir of 4,000 Levites, who, however, came out in full force only on great occasions. Over

these were three leaders—Heman, Asaph, and Ethan or Jeduthun—who directed them by beating time upon cymbals. The treble (*Alamoth*, 1 Chron. xv. 20) was led by the harps ("psalteries" in the English version), and the bass (*Sheminith*, 1 Chron. xv. 21), not in harmony, but simply an octave lower, by lyres or citharas ("harps" in our version). Many, though not nearly all, of the Psalms of David and his followers were composed partly for use in this service, and the superscriptions of a considerable number have reference to this design. In some of these allusion is made to the musical instruments by which they were to be accompanied; in others to the pitch (treble or bass) in which they were to be sung; and in a few to some familiar tune to which they were to be adapted. Some of the Psalms give evidence of adaptation to responsive singing, which was usually done by the two divisions of the choir, though sometimes, as in Ps. xxiv., the service was probably divided between the Levites and the people. The latter did not commonly join in the singing, except, apparently, in refrains and familiar formulas of praise, where they were enjoined to come out in full chorus. Some alterations in matters of detail were made in the service of praise in the second temple, the system being extended also, so as, for example, to have one psalm appropriated to each day of the week.

As to the musical system of the ancient Jews, nothing definite is known. The primary design of the accents in the Hebrew Psalter is that of musical notation, but these are no longer understood except in their secondary use of interpunction. It is possible that the synagogue-worship of later times and the old Christian chants retain traces of the simple recitative melodies of the ancient temple.

In the New Testament little is said of praise in public worship. The temple-service was of course maintained, with gradual modifications, until the dispersion. Hearty and unrestrained singing, being a necessary part of Christian worship, is often enjoined in the Epistles. The services were no doubt a selection from the temple-psalms, with the old tunes, which held a place far into the history of the early Church. To these were gradually added Christian hymns, which were at first modeled after the psalms, and were doubtless set to the same simple music. The Syrian Church had a larger hymnology and more elaborate music than its sister churches.

The development of psalmody in modern times in accordance with the needs of the Church has been due chiefly to two causes—the gradually increasing and ultimately predominant use of metrical songs as supplementing the old rhythmical forms, with a corresponding change in the tunes, which improved with the progress of musical science, and the growth of an hymnology in which the manifold experiences of Christians have found full expression. Still, many of the psalms have always been retained in essential substance, and have remained the best source of inspiration and culture for good hymn-writers. Music became a regularly constituted portion of church-service in the fourth century. Its early development in the Western Church was largely due to Ambrose, Bishop of Milan, and its progress during the Middle Ages to the improvements effected by Pope Gregory I. From them the names of the two old standard styles of chanting have been derived. Until the Reformation sacred music was under the control of the clergy. Metrical psalmody with harmony probably arose long before that era in Germany, but had not made much general progress. The efforts of Luther and many of his helpers, by the adaptation of secular airs and the composition of new tunes, resulted in a widespread enthusiastic interest in sacred music among the Protestants in that country. Ever since, also, it has been from Germany that the greatest influence and the healthiest tone have been given to the musical department of psalmody. In those lands where the influence of Geneva has had chief control, as most conspicuously in Scotland, this part of worship has been largely influenced by a tendency to plainness and severe simplicity in both words and music; yet congregational singing is hearty and general.

J. F. McCURDY.

Psalms [M. Eng. *psalm, salm* < O. Eng. *sealm, salm*, early loan-word from Lat. *psalmus* (cf. Fr. *psaume*) = Gr. ψαλμός, song to the harp, deriv. of ψάλλειν, twitch, play a stringed instrument]: the title given in the Septuagint version to the book in the canon which the Hebrews called the Praise Songs, and in English the Psalter. They are sometimes called the Psalms of David, as if all or the majority of the 150 had been composed by him. In the Hebrew Bible we find the whole collection divided into five books (i.–xli.; xlii.–lxxii.; lxxiii.–lxxxix.; xc.–cvi.; cvii.–cl.)—a division which assumed its final shape before the completion of the Old Testament canon, but was only accomplished after several hands at various periods had helped toward the permanent arrangement. This partition is doubtless a designed correspondence with the five books of the Law. In the places assigned to the several psalms also there is evidence of careful arrangement according to principles more or less obvious, such as a tendency to place in the same group compositions of the same individual, or of the same period, or upon the same general subject, or written in the same style, or for a similar liturgical purpose.

As to the *authorship* of the several poems the superscriptions traditionally attached to many of them are the only guide. Seventy-three of the psalms are thus assigned to David, and in nearly every case the correctness of the title is attested by strong evidence in their matter and style. The same criteria enable us to assign with great confidence a certain number of the anonymous psalms to the same author, making his whole contribution to be about eighty. Twelve are ascribed to the singer Asaph, which designation also included certain of his descendants who inherited his poetical and musical gifts. Thirteen or fourteen proceeded from the "sons of Korah." Two were written by Solomon (lxxii., cxxvii., in whose superscriptions we should read "of" and not "for," as in the Revised Version). One, Ps. xc., is accredited to Moses. It is difficult or impossible to assign the remaining psalms with certainty to their true authors. The dominant school of Hebrew critics questions the correctness of these traditional ascriptions, and assigns almost all the psalms to a period long after David—indeed, some scholars set the whole collection in the Maccabean era.

As to the *matter* of the Psalms, it must suffice here to say that they were the outflow of the spiritual life of the most highly endowed natures of a long period of Israel's history. Thus they contain a record of their adoration, confessions, petitions, and aspirations as these were conditioned, on the one hand, by their conceptions and knowledge of God and of his dealings with men, and on the other by their own inner history and outward circumstances. We find in the Psalms a vital appreciation of the ideas of God and Providence that had been unfolded in the teachings of the Law, and the most practical illustrations of the duty and privilege of worship and obedience. And so fresh, various, just, and profound are their views of the spirituality, holiness, and goodness of God, and their representations of the yearnings, conflicts, and triumphs of the earnest soul, that the Psalter has not only prompted and made valuable all the hymnology of the Church, but has always been the chosen consoler and counselor of the Christian heart. See PSALMODY.

LITERATURE.—Of modern commentators in English on the Psalms may be recommended J. A. Alexander (3 vols., New York, 1850); J. M. Neale and R. F. Littledale (4 vols., London, 4th ed. 1884, rich in patristics); J. J. S. Perowne (2 vols., 6th ed. 1886, the best, on the whole); C. H. Spurgeon (7 vols., 1870–84, strong in Puritan and pithy comment); A. Maclaren (in *Expositor's Bible*, 3 vols., 1894).

Revised by S. M. JACKSON.

Psalms of Zoroaster: designation of the *Gāthās* or metrical selections in the AVESTA (*q. v.*), containing the teachings, exhortations, and revelations of Zoroaster, the prophet of ancient Iran. The Gāthās are five in number, and they comprise seventeen short psalms, averaging about a dozen stanzas each. The fivefold grouping is based upon the meters in which they are composed. The pith of Zoroastrianism is contained in these psalmodic selections; the prophet exhorts men to eschew evil and choose the good, the kingdom of light rather than the kingdom of darkness, and their reward shall be eternal. He enunciates the doctrine of dualism in a sort of Iranian Sermon on the Mount. The Gāthās are the oldest part of the Avesta, and the language in which they are written is more archaic than that used elsewhere in the ancient sacred books of the Parsis. See ZOROASTER.

A. V. WILLIAMS JACKSON.

Psammetichus I. (Egypt. *Psemthek*): the first king of the twenty-sixth Egyptian dynasty (666–612 B. C.). By marriage he gained alliance with the Ethiopians of NAPATA (*q. v.*), and by the aid of Ionian and Carian mercenaries he overthrew the Assyrian governors of the Delta region who

had been installed by Assurbanipal of Assyria. His ambition was to make Egypt strong at home, hence he encouraged Greek immigration (see NAUCRATIS and TAHPANHES), giving the colonists exclusive trade privileges. He built largely at various places, such as Heliopolis, Mendes, Memphis, Abydos, and Thebes, and during his reign a very remarkable renaissance in art occurred. He was succeeded by NECHO (*q. v.*), who continued the same policy. Psammetichus II. and Psammetichus III. were rulers of small importance. The latter was defeated at Pelusium by Cambyses, who set up the twenty-seventh or Persian dynasty in 527 B. C.

CHARLES R. GILLETT.

Psa'ra, or **Ip'sara**: a small island in the Grecian Archipelago, W. of Scio, belonging to Turkey. It is rocky and barren, but was densely peopled and very prosperous before the Greek revolution, but having been taken by the Turks in 1824 its commerce was destroyed, its agriculture fell into decay, and its population decreased very much. At present its inhabitants live mostly by fishing.

Pseudepig'rapha [Mod. Lat. = Gr. ψευδεπίγραφα, neut. plur. of ψευδεπίγραφος, falsely inscribed or ascribed; ψευδής, false + ἐπιγράφειν, inscribe; ἐπί, on + γράφειν, write]: those writings which bear the names of Old or New Testament characters as authors or principal subjects, but which never formed part of the canon, either Hebrew or Christian. They were produced between 300 B. C. and 300 A. D. Those which antedate Christ are to be distinguished from the APOCRYPHA (*q. v.*) of the Old Testament, which have a place in the Septuagint translation and in the canon of the Greek and Latin Churches, and were formerly printed along with the canonical Scriptures in English Bibles. These books are: I. and II. Esdras, Tobit, Judith, The Rest of Esther, Wisdom, Ecclesiasticus, Baruch with the Epistle of Jeremiah, The Song of the Three Children, The Story of Susanna, The Idol Bel and the Dragon, The Prayer of Manasses, I. and II. Maccabees. As no distinction is made between the New Testament Apocrypha and Pseudepigrapha, since all alike are and have always been uncanonical, both will be treated in this article under the term "Apocrypha." These pseudepigrapha are worthless as history of the time they pretend to date from, yet have a certain value as specimens of the thought of the times in which they were produced. They were surely not written by the authors they claim, yet are not on that account to be classed as forgeries, in the modern sense of the term, since it was allowable then to issue writings under the name of some well-known man of a past age. Thus in the Hebrew canon the name Solomon is attached to writings or parts of writings with which he had nothing to do. So, in the nearly unanimous judgment of Hebrew scholars, is it with the names Moses, David, Isaiah, Zechariah, and others. The object of such attribution was to gain the wider currency for the real author's views. The device was of a very naïve kind.

I. PSEUDEPIGRAPHA OF THE OLD TESTAMENT.—The best collection is still that of J. A. Fabricius, *Codex pseudepigraphus Veteris Testamenti* (2d ed. Hamburg, 1722). O. F. Fritzsche, as appendix to his *Libri apocryphi Veteris Testamenti Græce* (Leipzig, 1871), gives these Pseudepigrapha: The Psalms of Solomon, the Fourth and Fifth Book of Esdras, the Apocalypse of Baruch, and the Assumption of Moses. Migne devotes the greater part of the first volume of his *Dictionnaire des Apocryphes* (Paris, 1856, 2 vols., small folio) to the Old Testament Pseudepigrapha, and gives annotated French translations of the Book of Adam, the Book of the Conflict of Adam, the Book of Enoch, Third and Fourth Esdras, the Ascension of Isaiah, the Book of Joseph, Third and Fourth Maccabees, Prayer of Manasses, the Testament of the Twelve Patriarchs, the Psalms of Solomon, Odes of Solomon, Letters of Solomon. E. C. Bissell, in his commentary on the Apocrypha in the Lange Series, gives a revised English translation of all the Apocrypha mentioned above, and an account of Fourth and Fifth Maccabees, the Book of Enoch, the Sibylline Oracles, the Apocalypse of Baruch, the Psalms of Solomon, the Assumption of Moses, the Ascension of Isaiah, the Book of Jubilees, and the Testaments of the Twelve Patriarchs. The Five Books of the Maccabees in English translation were edited by Henry Cotton, Oxford, 1832 (but still in print). A translation of the Ethiopic Apocrypha, which will include some Pseudepigrapha, into French has been begun (Paris, 1893, *seq.*). The variations in the numeration of Esdras, or Ezra, comes from the fact that the Roman Church, following the Vulgate, calls Ezra and Nehemiah respectively I. and II. Esdras. It also classes as canonical some books which Protestants call apocryphal. The Pseudepigrapha, as a whole, have been recently studied by W. J. Deane, *Pseudepigrapha* (Edinburgh, 1891), who discusses the Psalter of Solomon, the Book of Enoch, the Assumption of Moses, the Apocalypse of Baruch, the Testaments of the Twelve Patriarchs, the Book of Jubilees, the Ascension of Isaiah, and the Sibylline Oracles, and by J. E. H. Thomson, *Books which Influenced our Lord and his Apostles, being a Critical Review of Apocalyptic Literature* (Edinburgh, 1891), which is a study of the Book of Enoch, the addition to Daniel, the Apocalypse of Baruch, the Psalter of Solomon, the Book of Jubilees, and the Assumption of Moses. Of many pseudepigraphical works we know only the names. (See list in Migne, *l. c.*) The better and fuller known may be divided into—

A. *Lyrical Writings.*—(1) *The Psalms of Solomon*, eighteen psalms of a Messianic character, dating about 75–63 B. C., designed to cheer the drooping hopes of the Jews. The place of composition is Palestine, and the language was Hebrew. They throw much light upon the Pharisee opinion in the time of Christ. Best edition, with English translation, by H. E. Ryle and M. R. James, *Psalms of the Pharisees, commonly called the Psalms of Solomon* (Cambridge, 1891).

B. *Prophetical Writings.*—(1) Numerous apocalypses in the general style of the genuine prophets, and, like their writings, giving a picture of the future greatness of Israel. Of these may be mentioned (2) *The Book of Enoch*, particularly noteworthy because quoted by Jude (vv. 14, 15) and frequently in the Christian Fathers. (3) *The Assumption of Moses.* Latin translation in Fritzsche, *l. c.* (4) *Fourth* (or *Second*) *Esdras* is found among the Apocrypha of the English Bible, but has no proper place there. It dates from the time of Domitian (close of the first century), and consists of seven visions in the style of Daniel. English translation in the Apocrypha, revised by Bissell, *l. c.* (pp. 641–664). Cf. R. L. Bensly, *The Missing Fragment of the Latin Translation of the Fourth Book of Ezra, Discovered and Edited with an Introduction and Notes* (Cambridge, 1875). Its general purport was to foretell that the Romans would be overthrown. It was written in Greek, but by a Jew. (5) *The Apocalypse of Baruch.* Cf. J. J. Kneucker, *Das Buch Baruch* (Leipzig, 1879). It was written in Greek and in Palestine by a Jew soon after the destruction of Jerusalem by Titus. In it Baruch so completely supplants Jeremiah that God makes to him the revelation of the future and the consolatory speeches. It closes with a letter to the nine and a half tribes in the Babylonian captivity. It was apparently used by PAPIAS (*q. v.*), but not much known in the early Church. (6) *The Rest of the Words of Baruch.* Cf. edition by J. Rendel Harris (Cambridge, 1890); not the same as the preceding, though similar. It closes with an account of Jeremiah's martyrdom, caused by his persistence in praising Jesus as the Son of God. This fact marks it as a Christian apocalypse, at least in its present form. It is dated by Harris in 136 A. D. (7) *The Ascension of Isaiah*, an account of what Isaiah saw as he was being borne to the seventh heaven, dating from the first Christian century, and essentially a Jewish apocalypse with Christian additions and interpolations. From it comes the patristic references to the alleged fact that Isaiah was martyred by being sawn asunder. There is a Latin translation by A. Dillmann (Leipzig, 1877), and an English translation by G. H. Schodde in the *Lutheran Quarterly* for Oct., 1878.

C. *Testaments or Wills.*—(8) *The Testaments of the Twelve Patriarchs*, English translation by R. Sinker, in *The Ante-Nicene Fathers* (New York, vol. viii., 1–38). It is the supposed utterances of the twelve sons of Jacob, and is a tissue of moral precepts, prophecies, especially of the Messiah, and various facts about themselves. It was written in Greek in the second century by a Jewish Christian. (9) *The Testament of Abraham.* Greek text, for the first time edited with introduction and notes, by M. R. James, with an appendix, containing extracts from the Arabic version of the Testaments of Abraham, Isaac, and Jacob, by W. E. Barnes (Cambridge, 1892). It was known to the early Church, and apparently popular. It has come down in two forms, but may be dated from the second Christian century. It purports to give the sights seen by Abraham in the future world. Perhaps the most remarkable single trait is Abraham's flat refusal to die when God requests him to do so, and the pains God took to overcome his aversion. (10) *The Testaments of Abraham, Isaac, and Jacob* (see just above). That of Abraham is similar to the one just noticed. The Testament of

Isaac is an account of the death of Isaac and the ethical discourse which preceded it, and of the experiences in the future world which followed it. Of the same nature is the Testament of Jacob.

D. *Historic and Haggadic Literature*, or tendency writings on the basis of genuine canonical Scriptures. (11) *The Book of Jubilees*, or *Little Genesis*, essentially the history of the chosen people down to Sinai, as contained in Genesis and the first part of Exodus, with legendary and haggadic additions, written originally in Aramaic by a Jew in Palestine in the first Christian century. It pretends to be revelations made to Moses on Mt. Sinai. In complete form it only exists in Ethiopic, in which language it was edited by A. Dillmann in Ewald's *Jahrbücher der biblischen Wissenschaft* (1849–51). There is an English translation by R. H. Charles, in the *Jewish Quarterly Review* (1893, *seq.*), and another by G. H. Schodde (Oberlin, 1888). Cf. H. Rönsch, *Das Buch der Jubiläen* (Leipzig, 1874). (12) *The Book of Adam and Eve*, also called *The Conflict of Adam and Eve with Satan*, probably written in Arabia by an Egyptian Christian, perhaps as late as the fifth century. It goes over the history as given in Genesis, down to the call of Abraham, with much haggadic matter of an interesting character. There is an English translation by S. C. Malan from the Ethiopic text as edited by E. Trumpp (London, 1882). (13) *Life of Adam and Eve*, in Latin, edited by W. Meyer (*Vita Adæ et Evæ*, Munich, 1879). It gives in rather an interesting manner an account of the adventures of the pair after their expulsion from paradise, the difficulties they had to get food, their journeys, etc. (14) *The Testament of Adam*, edited and translated into German by C. Bezold, *Die Schatzhöhle* (Leipzig, 1883–88, 2 parts). (15) To the same general class belong *The Sibylline Oracles*, a collection of pseudepigraphical poems of various dates, written in hexameters in Greek, studied imitations of Homer in meter and diction. The oldest part is the third book, which was apparently produced in Alexandria by some Jew of the second pre-Christian century who worked up current fragments of the old Greek and Latin Sibylline books for the purpose of the Jewish propaganda. But the present work, in twelve books, contains pagan and Christian elements, and is from the second or third Christian century. It was much quoted by the early Fathers as inspired, particularly its allusions to the advent of Christ, which they took to be prophetic. In contents it combines history and prophesy, rebukes heathen idolatry, and exhorts to repentance before it is too late. It was lost to sight during the Middle Ages, but regained and first printed at Basel in 1545. The best editions are by C. Alexandre (2d ed. Paris, 1869) and Aloisius Rzach (Vienna, 1891). There is an English translation by M. S. Terry (New York, 1890).

II. Apocrypha of the New Testament.—Unlike the Old Testament Apocrypha, the New Testament Apocrypha have never had a place in the canon. They are also of decidedly minor importance. The most of them are found collected in English trans. in vol. viii. of *The Ante-Nicene Fathers*, ed. Coxe (New York, pp. 349–598), and are divisible into A. Gospels; B. Acts of the Apostles; C. Apocalypses; D. Epistles; E. Apostolic Liturgies; F. Didactic; G. Apostolical Canons and Constitutions; H. Apostolic Church Directory. The best editions of the original texts are those of J. A. Fabricius (2d ed. Hamburg, 1719), and by C. Tischendorf, *Acta apostolorum apocrypha* (Leipzig, 1851); *Evangelia apocrypha* (1854); *Apocalypses apocryphæ* (1866).

A. *Gospels.*—(1) "The Protevangelium of James the Lord's brother," or "the birth of Mary the holy mother of God, and very glorious mother of Jesus Christ." It gives an account of the conception, birth, and infancy of Mary and the same facts concerning her son. (2) "The Gospel of Pseudo-Matthew." It has substantially the same matter as the preceding by way of introduction, but contains an account of the flight into Egypt, and of the youth of Jesus full of miracles. (3) "The Gospel of the Nativity of Mary." It includes the betrothal of Mary and the conception. (4) "The history of Joseph the carpenter." It is supposed to be told by Jesus Christ, and mostly relates to the death of Joseph. (5) "The Gospel of Thomas": confined to the childhood and youth of Jesus, and a tissue of miracles. (6) "The Arabic gospel of the infancy of the Saviour." (7) "The Gospel of Nicodemus": Part i., the acts of Pilate—the events of the Passion; part ii., the descent of Christ into hades. (8) "The letter of Pontius Pilate" which he wrote to the Roman emperor concerning our Lord Jesus Christ. (9) "The report of Pilate the procurator concerning our Lord Jesus Christ," sent to Augustus Cæsar in Rome. Two Greek forms are extant. (10) "The giving up of Pontius Pilate"—i. e. an account of his alleged arrest and transportation to Rome by the Cæsar as a punishment for the "darkness and the earthquake which had come over the whole world" after the death of Jesus. Pilate shifts the blame of the deed upon the Jews, is, however, beheaded, but not before a heavenly voice assured him that all the generations and families of the nations would count him blessed, because under him had been fulfilled the things prophesied of Christ. (11) "The death of Pilate, who condemned Jesus." In contradiction of the preceding, this Apocrypha attributes Pilate's death to suicide, and tells how malignant spirits forced the transportation of the body from Rome to Lausanne. It is a late production. (12) "The narrative of Joseph of Arimathæa, that begged the Lord's body; in which also he brings in the cases of the two robbers." One of the most popular Apocrypha, limited in time to the death day of Jesus. (13) "The avenging of the Saviour." This is a combination of two distinct legends—the embassy of Nathan from Judæa to the Emperor Tiberius to carry the treaty of the Jews to Rome and the story of Veronica. (14) "The Gospel of Peter." A fragment of it, in Greek, was discovered by Ulysse Bouriant in a tomb at Akhmim, Upper Egypt, in 1886, but not published till 1892. It relates only to the passion and resurrection history. It is one of the best of the apocryphal gospels, and was believed in the early Church to be authentic. The original text has been edited by several scholars—e. g. Adolf Harnack (Leipzig, 1893), J. Armitage Robinson and M. R. James (London, 2d ed. 1892), H. von Schubert (Eng. trans. Edinburgh, 1893). English translations are given by the last two.

B. *Acts of the Apostles.*—There exist Acts of Peter and Paul, Paul and Thekla, Barnabas, Philip, Philip in Hellas, Andrew, Andrew and Matthias, Matthew, Thomas, Thaddeus, John, Consummation of Thomas, Martyrdom of Bartholomew.

C. *Apocalypses.*—There exist Apocalypses of Paul, John, and Peter. The last was found in the same MS. which contained the Gospel of Peter, mentioned above. It is the merest fragment, but revolting in its gross conception of the future world. There is also an apocalypse entitled "The Book of John concerning the Falling Asleep of Mary" and another on the "Passing of Mary."

D. *Epistles.*—(1) One by Jesus in reply to Abgarus, King of Edessa, who wanted Jesus to come and cure him. It is given by Eusebius, *Church History*, i., 13 (Am. trans. ed. McGiffert, pp. 100, 101). Jesus promises after his ascension to send one of his disciples to heal the king. In the "Acts of Thaddeus" the correspondence is alluded to, and there is added that Jesus sent Abgarus his portrait miraculously stamped upon a towel. Cf. R. A. Lipsius, *Die edessenische Abgarsage kritisch untersucht* (Brunswick, 1880). (2) Three by the Virgin Mary—viz., to Ignatius, urging him to constancy; to the Messinians of Sicily conveying a blessing; and to the Florentines an exhortation to faith, prayer, and patience. These epistles are of the briefest, being only 11, 17, and 5 lines long respectively in the annotated edition of Fabricius, *Codex Apocryphus N. T.*, 2d ed., pp. 834–852. (3) A letter of Paul to the Laodiceans (Fabricius, *l. c.*, 873–879), another to the Corinthians (*id.*, 918, *seq.*), and the famous correspondence with Seneca—six letters of Paul and eight of Seneca. Cf. Teubner, ed. of Seneca, by F. Haase (Leipzig, 1872–74, vol. iii.), and Fabricius, *id.*, 880–904. The best discussion of the matter is by J. B. Lightfoot, *Com. on Philippians.* The genuineness of the correspondence was widely accepted from very early times, but it is now considered a clumsy forgery. (See for text and discussion also, E. Westerburg, *Der Ursprung der Sage, dass Seneca Christ gewesen sei*, Berlin, 1881.) (4) A letter of Peter to James (Fabricius, *id.*, 907–913), in which among other things secrecy is enjoined upon him as respects his preaching. (5) A letter of John in reply to a dropsical man who had asked him to heal him, or rather a single sentence, ordering in the name of the Trinity a cure. This was wrought on receipt of the letter, and the man out of gratitude sought John and was baptized. Cf. Fabricius, *id.*, 926–928. There are other similar forgeries known by title. By far the most elaborate publication upon the whole subject of these apocryphal remains of the apostles was produced by Richard Adelbert Lipsius, *Die apocryphen Apostelgeschichten und Apostellegenden* (Brunswick, vol. i., 1883; vol. ii., 1st part, 1887; vol. ii., 2d part, 1884 (*sic*); supplement, 1890).

E. *Apostolic Liturgies.*—These are alleged to be the work of Mark, James, and the blessed apostles collectively. They are translated into English in *The Ante-Nicene Fathers* (New

York, vol. vii., 529–572). Another liturgy is attributed to the apostles in the Apostolical Constitutions, *id.*, pp. 470, *seq.*

F. *Didache*, or *The Teaching of the Twelve Apostles.*—Found by Bryennios in 1873, but not published till 1883. It is one of the earliest Apocrypha and the most respectable. It doubtless embodies much genuine apostolic teaching, and throws welcome light upon the primitive Church usages. It is one of the most precious relics of the post-apostolic age. The best edition in English, with translation and notes, is by Philip Schaff, *The Oldest Church Manual* (New York, 1885; 3d ed. 1889).

G. *Apostolic Canons and Constitutions.*—See Apostolic Canons and Constitutions. Eng. trans. in *The Ante-Nicene Fathers* (New York, vol. vii., pp. 387–508).

H. *Apostolic Church Directory*, independent of, yet similar to, the seventh and eighth books of the Apostolic Constitutions. Greek text and German trans. by J. W. Bickell, *Geschichte des Kirchenrechts* (Giessen, 1843, pp. 107–132).

Samuel Macauley Jackson.

Pseudo-Clementines: See Clementines.

Pseudo-erysipelas: See Phlegmasia.

Pseudo-Isidorian Canons: See Decretals, False.

Pseudoneurop'tera [Mod. Lat., from Gr. *ψευδής*, false + Mod. Lat. *Neuroptera*, an order of insects]: a group of insects, recognized by some entomologists, which contains the dragon-flies, day-flies, and stone-flies. See Odonata and Plecoptera; also Entomology.

Pseudopodia [plural of *pseudopodium*, Mod. Lat., from Gr. *ψευδής*, false + *πούς, ποδός*, foot]: the temporary variously shaped processes given off from the body-substance of various protozoans, as amœbas and foraminifers, and serving for locomotion, ingestion, etc. See Cilia.

Pseudoscorpii [Mod. Lat., from Gr. *ψευδής*, false + *σκορπίος*, scorpion]: a group of arachnids or spider-like animals which resemble the scorpions in the general shape of the body, the segmentation of the abdomen, and the large pincer-like first pair of legs, but which differ from them in the absence of pectines, tail (see Scorpiones), and terminal poison-stings, as well as in the possession of a tracheal respiratory system. All of the species are small and are to be sought in dry places—under bark and among moss and some among old books and papers. They appear to feed upon mites and small insects, and are occasionally found adhering to flies, bees, etc., and in this way they are carried from place to place. The order first appears in the Carboniferous. Some sixteen species are described from the U. S. See Hagen, *Proceedings of the Boston Society of Natural History*, xiii., 1870.

J. S. Kingsley.

Pseudotsu'ga: a genus of coniferous trees established by Carrière in 1867, closely related to the firs (*Abies*) and the hemlocks (*Tsuga*), but differing from the former by having pendulous cones whose scales are persistent, and from the latter by having smooth branchlets after the fall of the leaves. Only one species is known, *P. taxifolia*, the Douglas spruce, mostly known in books and catalogues as *P. douglasii*. It is a gigantic tree of the Oregon, California, and Rocky Mountain region, 200 to 300 feet high, and 8 to 15 feet in diameter. See Conifers. Charles E. Bessey.

Psittaci [Lat. *psittacus* = Gr. *ψιττακός*, parrot]: an order of birds containing the parrots (see Parrot), characterized by a hooked and cered beak movably articulated with the brain-case, a strong lower jaw, and by having the outer toe turned backward. The tongue is thick, fleshy, and sometimes brushy; the number of primaries and tail-feathers is ten. The furculum is weak, imperfect, or absent. The order is divided into from one to nine families; but a good division is into three families, *Psittacidæ*, the true parrots, *Stringopidæ*, owl-parrots, and *Cacatuidæ*, cockatoos. F. A. Lucas.

Pskov, or **Pskoff**: government of European Russia; bounded N. by the governments of St. Petersburg and Novgorod. Area, 17,069 sq. miles. The surface is mostly flat, abounding in small lakes and rivers; marshes are numerous, forests extensive. Agriculture is almost the only branch of industry, with the exception of cattle-rearing; hemp and flax are staple products. Pop. (1897) 1,136,580.

Pskov, or **Pleskov**: capital of the government of Pskov, Russia; 160 miles S. S. W. of St. Petersburg (see map of Russia, ref. 6–C); 9 miles N. W. is Lake Pskov, 50 miles long by 13 broad. Pskov is the see of an archbishop, and has a cathedral, numerous churches, and considerable manufactures, and a trade in fish and flax. Pop. (1897) 29,555.

Psocidæ [Mod. Lat., from Gr. *ψώχειν*, rub to pieces]: a family of insects, the sole representatives of the order *Corrodentia*. They are small forms with incomplete metamorphosis, with biting jaws, sometimes without wings, but when these are present, having the fore wings the larger. All of the species feed on dry vegetable matter, and several species (winged) occur on many of the forest trees of the U. S. through the summer. Among the wingless forms are the so-called book-lice, minute light-colored forms occurring in neglected books, etc., where they may do considerable damage.

J. S. Kingsley.

Psophi'idæ [Mod. Lat., named from *Psophia*, the typical genus, from Gr. *ψόφος*, an inarticulate noise]: a family of birds represented by the trumpeters of South America. The form is heron-like; the neck comparatively short; the bill short, compressed, and curved toward the tip, which is prolonged over the lower mandible; the nostrils inserted in a membranous groove, large and oblique; the wings short, concave, and rounded; the tail very short, the tarsi long and slender, covered with transverse scales; the toes moderate, the three in front united at the base, the hind one small and somewhat elevated; the claws curved and acute. Only a single genus is known (*Psophia*), containing five species, found in various parts of Brazil and the northern portions of South America. Revised by F. A. Lucas.

Psori'asis [Mod. Lat., from Gr. *ψωρίασις*, itch, deriv. of *ψώρα*, itch, scurvy, mange]: a skin disease in which there are at first elevated red patches upon which large scales of epidermis appear, the skin between the patches often cracking and bleeding. There are many varieties distinguished by writers, but, except in the case of the syphilitic diseases called psoriasis, the causes are very obscure. There seems to be some connection between psoriasis and the rheumatic habit or chronic rheumatism. Fortunately, syphilitic psoriasis can often be distinguished from true psoriasis. For the former the appropriate remedies for the specific disease are to be employed. For the latter the best treatment appears to be the use of vapor-baths, followed by strong alkaline applications, and then by tarry ones, with the internal administration of arsenic. These means will very much mitigate, but will scarcely cure, the disease, which tends to linger, relapse, and become chronic.

Revised by W. Pepper.

Pso'rosperms [from Gr. *ψωρός*, scab (in allusion to the sores they make on fishes) + *σπέρμα*, seed]: parasitic protozoa, allied to the Gregarinida (*q. v.*), which occur on and in fishes, where they make sores or cysts, and at times are so numerous as to cause extensive mortality.

Psyche, sī'kĕ [= Lat. = Gr. Ψυχή, liter., soul]: in a Greek legend preserved by Apuleius, a lovely mortal, the daughter of a king. Venus was jealous of her beauty, and ordered Cupid, her son, to inspire Psyche with a desire for the basest of men, but the god of love, on beholding her, himself loved her. Thenceforth he visited her every night, requesting her never to see him or inquire who he was. But from curiosity, and the dread lest he should prove to be a monster, as her sisters told her he was, she came to him with a lighted lamp while he slept. Overcome with joy at his loveliness, she carelessly allowed a drop of hot oil from her lamp to fall upon his arm. Cupid therefore left her with reproaches. After many calamities she became the menial slave of the jealous Venus, who treated her with great cruelty; but her lover invisibly assisted her, and finally, having secured her immortality, made her his wife. The myth is plainly allegorical, and is a figure of the progress of the soul, by the aid of divine love, through the calamities of this life to a happier life hereafter. In art she is represented as a tender virgin with the wings of a butterfly, or as a butterfly itself, for the word *ψυχή* means butterfly as well as soul. Revised by J. R. S. Sterrett.

Psychological Apparatus and **Psychological Measurement**: See Recording Apparatus, Psychological, in the Appendix.

Psychology [Gr. *ψυχή*, soul, mind + *λόγος*, discourse, reason]: the science of the mind.

Historical.—Modern psychology has had its principal development in Great Britain, Germany, and France. Germany has undoubtedly had greatest influence in this movement considered in all its branches. The two main currents of development previous to the rise of the new so-called "scientific" psychology, designated as respectively "speculative" and "empirical," had their initial impulse, as well as their fruitful pursuit, respectively in Germany and

Great Britain. German psychology down to the rise of the Herbartian movement was a chapter of deductions from speculative principles. English psychology was a detailed analysis of the experiences of the individual consciousness. Kant, Fichte, and Hegel may sufficiently represent the succession in Germany; James Mill, John Stuart Mill, Hume, Reid, and Bain, that in Great Britain.

The work of Herbart and his school tended to bring a more empirical treatment into German thought, and its significance was twofold. It excited opposition to the speculative method; and it prepared the Germans for the results of English analysis. It is, further, a legitimate supposition that the spirit of experimental inquiry which has swept over Germany in the nineteenth century was made more easily assimilable by workers in this department, also, by the patient and extraordinary attempt of Herbart to construct a "mechanic" and "static" of mind in his *Psychologie als Wissenschaft* (1824).

To German thinkers also belongs the credit which is due to originators of all new movements which show their vitality by growth and reproduction, in that the experimental treatment of the mind was first advocated and initiated in Germany. This is treated of more fully below.

The contribution of France to psychology has been decidedly of less importance, yet the work of these writers has also illustrated a fruitful and productive movement. It has been from the side of medicine that French work has influenced current widespread conceptions of consciousness. Mental pathology and the lessons of it for the theory of the mind have come possibly most of all from France, or at any rate—not to disparage the admirable recent work of English and German investigators—the tendency, so to speak, of the French treatment of consciousness has been to approach mental operations from the abnormal side.

In the U. S. the influences which have tended to control psychological opinion have been mainly theological on one side and educational on the other. The absence of great native systems of speculative thought has prevented at once the rationalistic invasions into theology which characterized the German development, and the attempts at psychological interpretation which furnished a supposed basis of fact to the idealistic systems. In Germany various "philosophies of nature" sought to find even in objective science support for theoretical world-dialectic, and psychology fared even worse, since it is, *par excellence*, the theater for the exploitation of universal hypotheses; but in the U. S. men did not speculate much, and those who did were theologians. So, naturally, the psychologists were theologians also. Jonathan Edwards had a doctrine of the agent, because free will was a question of theology.

The educational influence was auxiliary merely to the theological. The absence of large universities with chairs for research; the nature of the educational foundations which did exist under denomination control; the aim of education as conceived in the centers where the necessity for supplying growing towns with pastors was urgent; the wholesome fact for civilization that the Puritans had traditions in favor of the school and the religious school—all these things made it only necessary that books sound in their theological bearings, or affording homiletic lessons in living, should be written in a topic of such central importance. Even the term "psychology" is only now becoming domesticated; "mental" and "moral" philosophy were the titles of courses of instruction on the "soul."

The type of philosophy which these conditions encouraged was, it may easily be imagined, realistic; and it is probably for the reasons which have been indicated that the Scottish natural realism was the North American type of thought, and is now, except in the great university centers where systematic philosophy has become an end in itself, apart from its duty to theology and education. As far as psychology was concerned, this realistic tendency was a great good. It led to a magnification of mental reality, to a reverence for the "utterances of consciousness," to a realistic interpretation of the "immediate knowledge of self," to a firm settling of the great "intuitions," cause, time, space, God, etc.; and in as far as this led to the direct examination of consciousness and to the testing of philosophical claims by consciousness, it prepared the way for a better and broader method. This tendency is marked even in the more influential works in theology. Channing and Emerson, no less than Henry B. Smith and Charles Hodge, lay the corner-stone of argument again and again in the proof "from consciousness."

This tendency to a psychological view of philosophy and its basis in the religious motive is seen also in Scotland, the home of realism; and it is there a part of the British method of thought which has already been spoken of. The works on psychology written in the U. S. up to 1880 were, as would be expected, from the hands of theologians and educators, usually both in the same person; for it is a further proof of the association of psychology and theology that the mental and moral philosophy in the colleges was almost without exception put in the hands of the president of the college, and he was by unanimous requirement a preacher. Edwards's *Freedom of the Will* (1754); Tappan's *Review of Edwards* (1839) and *Doctrine of the Will Determined by an Appeal to Consciousness* (1840); Hickok's *Rational Psychology* (1848) and *Empirical Psychology* (1854); Porter's *Human Intellect* (1868) and *Moral Science* (1885); McCosh's *Psychology* (1887) and *First and Fundamental Truths* (1889)—these and similar books, all works of the highest value, show the psychology of the U. S. up to about 1880.

Coming to the present state of psychological thought, the writer's task is made easier by reason of the divorce which has been forced between psychology as a science on the one hand and metaphysics on the other. As was said above, Herbart, while failing in his attempt to apply mathematics to mental "permutations and combinations," yet prepared the way for a new treatment of mental phenomena. After his attempt it began to be seen that the facts of conscious life were first in order of importance, and were capable of treatment in a detailed way quite independently of the questions of Being, the Absolute, and the like. The works of Volkmann, *Lehrbuch der Psychologie* (4th ed. 1894), and Lipps, *Die Grundthatsachen des Seelenlebens* (1883), illustrate this.

This was only to begin to do what had been doing in England since Locke; but the Germans went further: they asked the question—which had been groped upon before by Descartes, by Leibnitz, and by Reid—how can psychology be a science when one of the evident conditions of the flow of mental states, of their integrity and their trustworthiness, the brain, is left quite out of account? What is the law of connection of mind and brain? Is it possible to modify the brain and so to modify the mind? If so, then that great instrument of scientific work, experiment, may perform a part for the psychologist, also, and his resources be magnificently enlarged. This is the question of experimental psychology. It was answered in Germany in the affirmative. Lotze, in the author's view, deserves the credit of it; and Wundt is the founder of the science in the sense that he first realized the expectations of Lotze's genius by actually planning and executing experiments on a large scale, which made the affirmative answer an irreversible fact of history. Lotze's *Medicinische Psychologie* appeared in 1852, Wundt's *Grundzüge der physiologischen Psychologie* in 1863. Between the two came Fechner, whose theoretical construction of the new work and its methods shows all the exactness of treatment of similar discussions of natural-science principles by electricians and chemists, and published the formulas in which he attempted to give universal statement to the discoveries of E. H. Weber on the intensity of sensation-states. Fechner's *Elemente der Psychophysik* appeared in 1860. Apart from the actual development of this new method—a point to be spoken of later on—it has profoundly modified the general conception of psychology, even where its validity as a method has been denied. There has been nothing less than a revolution in the conception of psychology since the publication of the works just named. One of the motives of this revolution came thus from Germany. The other—for it has two great phases—is due to English thinkers, the evolutionists, of whom Herbert Spencer (*Principles of Psychology*, 1855) is the chief. These two influences are seen in two great points of contrast, easily made out between the psychology of to-day and that of yesterday in the U. S. The two main characteristics of the latter, for purposes of the present contrast, are, first, its character as so-called "faculty-psychology," and, second, its character as holding to what may be called a "ready-made" view of consciousness—technically an "intuition" view of consciousness. In opposition to these characters, current psychology is "functional," holding to mental functions rather than to mental faculties; and finds this function to be genetic rather than intuitive—the functions "grow" instead of being "ready-made."

The old conception of "faculties" made the different phases of mental process in large measure distinct from one another. Its earliest and most defensible statement was by Aristotle. Memory was a "faculty," a "power" of the

mind; thought was another, imagination a third. The new functional conception asks how the mind as a whole acts, and how this one form of activity adapts itself to the different elements of material which it finds available. The old terms "memory," "thought," etc., are retained; but with the distinct understanding that they do not stand for divisions in the mind, or different processes, one of which may be held in reserve when another is acting, etc. On the contrary, the process in consciousness is one, and it is a psycho-physical process as well. The particular way in which this one function shows itself is a matter of adaptation to the changing conditions under which the activity is brought about. This transition is due in part also to the insight of Herbart and to the demand for unity insisted upon by the evolutionists. The other point of contrast is equally plain. The "genetic" point of view, in current discussion, is opposed to the older "intuitive" point of view. The mind is looked upon as having grown to be what it is both as respects the growth of the man from the child and as respects the place of man in the scale of conscious existences. The understanding of mental facts is sought in the comprehension of their origin as well as their nature; and the question of the validity or worth of "intuitive" beliefs in consciousness is subordinated to the question as to how the mind came to have such beliefs. Both of these points of contrast have been further defined by the progress of general philosophy in the U. S. The demand for unity in mental interpretation has not come from naturalistic evolution alone (John Fiske, *Outlines of Cosmic Philosophy*, 1874; Thompson, *System of Psychology*, 1884); an equally pressing demand has come from idealistic metaphysics, which seeks for continuity in the natural series as zealously as does the advocate of evolution. The influence of Hegel, as interpreted in the works of Green of Oxford, and later in those of Edward Caird, has been potent in effecting this transformation. It is easy to see also that the same union of forces is quite feasible as respects the genetic development of consciousness, although the new idealists have not done justice to this growing tendency in modern psychology.

The line of cleavage, in the current discussions of general psychology, is drawn on the question of the interpretation of mental "function," both sides claiming the same full liberty of genetic research and the same resources of analysis and experiment. The "associationists," on one hand, carrying on the tradition of the British empiricists, construe mental function after analogy with the ordinary interplay of forces in the objective world; the "apperceptionists," on the other hand, hold that mental function is a form of irreducible cosmic process. Apart from original monographs on special topics, no work on psychology to-day commands much attention, either from psychologists or from students of philosophy, which does not show itself alive to this main issue. In the U. S. the works of Lotze and Wundt have had great influence in the direction of this general statement of the problems of psychology, and it is especially the philosophy of Lotze which is replaeing by a reasoned and critical realism the earlier theological dogmatic view so long prevalent in the U. S. by inheritance from Scotland.

On the literature of present-day psychology the following passage is translated from a German work, itself fully representative of the state of knowledge, *Grundriss der Psychologie*, by Prof. O. Külpe, of the University of Leipzig (pp. 27, ff.): "About the middle of the nineteenth century experimental and psycho-physical psychology began its course in Germany. While Herbart recognized a threefold influence of the body upon the mind . . . it was Lotze who made a thorough beginning in the employment of the data of physiology. Lotze, indeed, began his work with certain metaphysical expositions after the manner of the older German writers, and is very far from the recognition of a universal psycho-physical parallelism; but he does not hesitate to speak of the nervous conditions of mental processes, and he had the good fortune to suggest hypotheses of value where exact knowledge was wanting. The real foundation of experimental psychology was laid, however, by G. T. Fechner, who sought to carry out in a thorough-going way the conception of a functional relation between mental and physical processes. Although the mathematical form which he gave to this relation does not hold, yet he gave to the exact science of psychology an extraordinary impulse by reason of the new conceptions which he introduced, the methods of proeedure which he both formulated and applied, the working over which he gave the material he had in hand, and the observations and researches which he himself carried out. . . . The union of the experimental and psychophysical was finally accomplished by Wilhelm Wundt . . . in his classical *Grundzüge der Physiologischen Psychologie* (1874; 4th ed. 1893). By this unity of conception and his comprehensive treatment of all mental phenomena . . . he has made the current phrase 'modern psychology' applicable. . . . Wundt gave a further important impulse to the cultivation of experimental psychology by founding the laboratory in Leipzig in 1879, and establishing the *Philosophische Studien*, a journal devoted mainly to the publication of researches in his institute.

"Additional works may be mentioned of very recent date which must be reckoned in their character as belonging to the modern psychology thus founded by Wundt, although they differ more or less essentially in system and in theory from him and from one another: Höffding, *Psychologie in Umrissen* (2d ed. 1893; German trans. from the Danish; English trans., 1891); Ladd, *Elements of Physiological Psychology* (1887); Sergi, *La Psychologie Physiologique* (trans. from the Italian); W. James, *The Principles of Psychology* (1890); Ziehen, *Leitfaden der physiologischen Psychologie* (1891; Eng. trans., 2d ed. 1894); Baldwin, *Handbook of Psychology* (2d ed., 1891; 1st ed. 1889–90); J. Sully, *The Human Mind* (1892)."

It will be seen that of the seven works thus cited by Külpe three are by U. S. writers, and to them must be added *Psychology: Descriptive and Explanatory* (1894), by George T. Ladd, and the journal, *The Psychological Review*, edited by J. McK. Cattell and J. Mark Baldwin (vol. i., 1894). Another important French work of recent date is *La Psychologie des Idées-Forces*, by A. Fouillée (1893). Other important contributions to experimental psychology—apart from the long series of monographs and research articles published in Germany and the U. S.—are Helmholtz, *Physiologische Optik* (1867; French trans., 2d ed. 1890, ff.) and *Tonempfindungen* (1863; English trans.); Stumpf, *Tonpsychologie* (1883, 1890); and Münsterberg, *Beiträge zur Experimentellen Psychologie* (parts i.–iv., 1889–93).

The contribution from the side of mental pathology has become important on account of the *rapprochement* which has obtained in recent years between the alienist and the psychologist. The works of Pierre Janet, *Automatisme psychologique* (1889) and *L'État mental des Hystériques* (1892–93); and of Bernheim, *Suggestive Therapeutics* (English trans., 1889) and *Études de la Suggestion* (1892), are most important. To them should be added the works of Ribot, *Diseases of the Will* (English trans.; 5th French ed. 1889); *Diseases of Memory* (English trans.; 5th French ed. 1888); *Diseases of Personality* (2d ed. 1888; English trans. 1891), together with the many original contributions on the subject of hypnotism and aberrations of personality published in the *Revue Philosophique*, edited by T. Ribot (vols. i.–xxxvi., 1876, ff.), and summed up in part in *Les Altérations de la Personnalité* (1893), of A. Binet.

Further, the treatment of psychology, in accordance with the British tradition, from the point of view of description and analysis, has been carried forward by Ward in the article *Psychology* in the *Encyclopædia Britannica*, 9th ed. This type of research has also had its organ of publication in *Mind: a Journal of Psychology and Philosophy*, edited by G. Croom Robertson (vols. i.–xvi., 1876, ff.) and by G. F. Stout (new series, vols. i.–iii., 1892, ff.).

Finally, the genetic treatment of consciousness has been advanced by the works of Spencer, *Principles of Psychology* (1855; 3d ed. 1880); Romanes, *The Origin of Human Faculty* (1884–88); Morgan, *Animal Life and Intelligence* (1891); and Galton, *Inquiries into Human Faculty* (1883) and *Natural Inheritance* (1889).

Experimental Psychology.—The present age is the age of science because it is the age of devotion to science and of the results in science. But it is a very different thing to say that this is the age of scientific method. Former ages have seen devotion to science and results in science, but no former age has, as an age, realized a scientific method. In general philosophy what has been called scientific method is better known, as has been said above, in a twofold way—as empirical and critical. Retrospectively, what we have to rejoice at in philosophy is due about equally to two traditions, represented by Hume and Kant. The burden of current idealism, as far as it is worthy of consideration in our time, is to purify and conserve the work of Kant; and the burden of empiricism, under the same restriction, is to refute Kant with the only weapons which he himself considered of worthy temper. The battle is drawn at these close

quarters, and round them both is thrown a common ring of scientific procedure.

In psychology the modern transformation comes most strongly out. Here we find an actual department of knowledge handed over to a new class of men for treatment, so remarkable is the demand for scientific method. It is no longer sufficient that a psychologist should be familiar with general philosophy and its history or capable of acute logical criticism of systems; it is necessary, if he would deal successfully with the new problems and gain the ear of the advanced philosophical public, that he should reason from a basis of fact and by an inductive procedure. In short, he must not bring his philosophy as speculation into psychology, but must carry his psychology as fact in its connection with physiology, ethnology, etc., into general philosophy. To illustrate this change and its effects on general theories, recent discussions of the idea of space may be cited in comparison with its earlier and more speculative treatment. The reasoning of James, Wundt, Bain, and Spencer differs so essentially from the argumentation of Kant and earlier men that it is almost impossible to find common ground between them. No one among those who accept Kant's results depends, in our day, very largely upon his reasons; the question is shifted to another field. The physiologist has as much to say about it as the psychologist, and the speculative philosopher must recognize them both. This tendency in philosophy may be expressed by a chemical figure as a "precipitating" tendency. We are endeavoring, and successfully, too, to throw all questions which are capable of such treatment to the bottom as a precipitate—a psychological precipitate—and are then handing them over to the psychologist for positive treatment. As long as the data remained in a solution of ninety parts water (which, being interpreted, means speculation) it was difficult to handle them scientifically. While admitting the utility and necessity of ontology in its place, psychology claims that its place must be better defined than formerly, and that whenever a sediment, a residuum, a deposit, apart from a speculative solvent, can be secured, this is so much gain to positive science and to truth.

One of the ideas which lie at the bottom of the so-called new psychology, therefore, is the idea of *measurement*. Measurement (determination in quantity and time) is the resource of all developed science, and as long as such a resource was denied to the psychologist he was called a scientist only in his function of description and classification; not in the more important functions of explanation and construction. And the justification of the application of measurement to psychological facts has come, not from theoretical considerations—for they were all opposed, and still are in many of the books of the new idealism—but from practical attempts to do what philosophy declared to be impossible; that is, experiment has been the desired and only reagent. It is true that theoretical justifications are now forthcoming of the application of experiment to consciousness, but they are suggested by the actual results, and were not in sufficient currency to hinder the influence of Kant's ultimatum, for example, that a science of psychology was impossible.

By experiment is meant experiment on the nervous system, with the accompanying modifications it occasions in consciousness. Efforts have been made in earlier times to experiment upon states of consciousness directly. Descartes deserves credit for such efforts, and for the intimation he gives us in his theory of emotions of an approach to mind through the body; but the elevation of such an approach to the place of a recognized psychological method was not possible to Descartes, Kant, or any one else who lived and theorized before the remarkable advance made in the nineteenth century in the physiology of the nervous system. Even as it is, many questions which will in the end admit of investigation from the side of the organism are in abeyance till new light is cast upon obscure processes of the brain and nerves.

A little further reflection will show us that the employment of experiment in this sphere proceeds upon two assumptions which are now generally admitted and are justified as empirical principles, at least, by the results. They are both assumptions which the physical scientist is accustomed to make in dealing with his material, and their statement is sufficient to exhibit their elementary importance, however novel they may sound to those who are accustomed to think and speak of mind as something given to us in entire independence of its organic basis. The first of these assumptions is this: That our mental life is always and everywhere accompanied by a process of nervous change. This is seen to be necessary to any method which involves the passage of mind to body or the reverse by the interpretation of effects. Which is cause and which effect, the mental or the physical change, or whether they both are effects of an unknown cause, is immaterial; to consider such a question would be to introduce what has been called the speculative solvent. It is sufficient to know that they are always together, and that the change in one may be indicated in symbols which also represent the change in the other. The second assumption is based upon the first, viz., that this connection between mind and body is uniform. By this is meant what in general induction is called the uniformity of nature. Any relation sufficiently stable to admit of repeated experiment in the manipulation of its terms is in so far uniform. Experiment would be useless if the relation it tends to establish were not stable, since the result of such experiment would give no antecedent likelihood as to the result of others under similar circumstances. Experimental psychology, therefore, rests upon the assumption that a relation of correspondence—be it coexistence or causation—once clearly made out between a mental and a nervous modification, it must hold good under any and every repetition of the same experiment under the same conditions. These two assumptions made, we have at once the possibility of a physical approach to the facts of consciousness. The result is a relative measurement of such facts in terms of the external stimulation of the nerves, in regular and normal conditions of the activity of attention.

The need of experiment in psychology is exceedingly great. When we remember that, in the search for causes in the natural world, the difficulties are vastly enhanced by the fact that single causes are never found at work alone, and that it is the function of experiment so to eliminate elements in a causal complex that isolated agencies may be observed at work; and when we further reflect that no single function of mind is ever found operating alone, but that all accompany and modify each—the inadequacy of simple observation in this field becomes apparent. A sense-stimulation, for example, may arouse an intellectual train, an emotional outburst, a course of action; are all these the effects of a single cause? A course of action, conversely, may result from an emotion, a thought, a memory, an association, a sensation, an inspiration; can the simple description of the resulting action indicate which is its cause? Antecedents and consequents are thrown into the mental life in inextricable confusion. External or bodily causes—an odor, a spoken word, a pain, an internal organic movement—may start a train. This train may be hindered or advanced by a thousand considerations or emotions; other bodily or mental causes may modify it. And all together make up the cause or complex antecedent state; while vague analogies of thought and feeling, such as temperament, heredity, education, make variations between individuals, and the present condition of the brain and nerve centers make variations in the same individual. How can we single out the cause, in this network, by observation? It is as vain as to discover the cause of a conflagration from examining the blaze; was it a match, lightning, friction, chemical composition? Only one step can determine: The reconstruction, under artificial circumstances, of the conditions, and the endeavor to exhibit a single isolated cause. This is experiment.

Further, it is apparent that such a means of experimentation may become available either under artificial or under natural conditions, according as the nervous stimulation is due to an external excitation, or arises from some unusual condition of the organism itself. All cases of brain or nervous disease, on the one hand, offer opportunities for boundless observation, the unusual manifestations being changes due to the organic disturbances of disease. Here nature has arranged and actually performed the experiment for us, the only difficulty being the physiological one that the cerebral disturbances are as obscure as the mental states which they are used to explain. All such cases of mental changes due to internal organic changes are classed together under the name of *physiological psychology*. On the other hand, experiments may be arranged for the normal stimulation of the sense organs—skin, muscles, special senses—under artificial conditions. This is, strictly speaking, *experimental psychology*. See PSYCHO-PHYSICS, PSYCHOMETRY, MEMORY, VISION, and SENSATION. See also RECORDING APPARATUS, PSYCHOLOGICAL, in the Appendix.

Physiological Psychology.—This branch of psychology includes all the matter covered by such topics as HYPNOTISM, ILLUSION, LOCALIZATION (*Cerebral*), and PHYSIOLOGY (of brain and nerves). It aims to discover all the facts of the connection between mind and body, and to propound theories of the central nervous processes of thought, feeling, etc. The methods of this science are largely those of experimental physiology, the results of experiments upon living animals being the most direct aid to it. Its contributions to the welfare of man through the practical work of the brain surgeon, the oculist, the aurist, and the alienist, are of the highest importance.

Race or Folk Psychology.—The science of the mental traits of races and peoples and of the mental development of man; the study of mind in its social characteristics, and in its products in society, the state, religions, customs, and institutions. It accepts all the results of ANTHROPOLOGY (*q. v.*), and views them as the manifestations of the mind. It examines ancient philosophies, cults, and civilizations; literatures, history, laws, mythologies, traditions, the sources from which the human mind has drawn its culture in all ages. It values the reports of travelers in respect to savages, heathen, and degenerate races; the conditions of social life everywhere. For in all these manifestations of the life of the human mind we have direct information respecting its nature and capacities.

Animal or Comparative Psychology.—As might be expected, the study of animals is of extreme importance for the science; for animals show striking evidences of the phenomena of consciousness both in its lower and in many of its higher forms. It is perhaps destined, judging from the contributions it has already made to some departments of research, to throw as much light upon human psychology as comparative anatomy has upon human physiology. As is the case with many physical functions, so certain intellectual states are seen in animals in a less developed and complex state, or in a more sharpened and predominant state, than in man; and thus the necessity for a genetic study of these states is met to a greater or less degree. Instinct, for example, attains its most perfect form in animals, memory is often remarkably developed, and certain of their senses show a degree of acuteness which we would never expect the corresponding human senses to possess. And the study of animals for psychological purposes is not limited to observation of their habits, productive as such observation is; but the physiological method is capable of much more extended use than in experiment upon man. Condemned animals may be directly used for purposes of neurological research under conditions which rule out all pain to the creatures. The variety of problems which may thus be reached is limited only by our ability to state them and our ingenuity in planning the experiments. See INSTINCT, IMPULSE, and LOCALIZATION (*Cerebral*).

Infant Psychology.—The importance of the early study of mind is to be equally insisted upon. By it mental facts are reached, as far as they ever can be, at their origin and in their simplest form. It is more important to know what mind is than what it becomes. The child serves to correct the reports of adult life by opening up object lessons in the growth of mind. At the outset the child mind is lower than the highest animal mind, since, while its human possibilities have not emerged, its instinctive equipment is not as varied as that of animals; but in its rapid development it exhibits the unfoldings of organic mental growth in correspondence with the growth of the bodily system, an advantage found in none of the other fields of observation. See GENETIC PSYCHOLOGY.

Abnormal or Medical Psychology.—As in the former sources of information we deal with mind in health, here we come to consider it in disease—that is, we look to all abnormal or diseased conditions of the mental life for light upon its nature and upon its legitimate operations. It includes all cases of variation from the normal and healthy activity of conscious mind—sleep-walking, dreams, insanity in its multiplied forms, loss of memory, loss of speech, hypnotism, idiocy, hallucination, disturbances of consciousness generally. All these variations afford—as such variations in any science afford—instructive views into the working of mind in its most intimate character. And the reason for this is plain. Such cases offer immediate occasion for the application of the logical *method of difference*, which consists in removing part of a cause or effect and observing the consequent variations in the corresponding effect or cause. This procedure enables us to attach an effect to its true cause. One most general result of the study of mental disease, for example, is this: that we have learned to seek its cause in diseased conditions of the body, rather than in obscure mental movements or supernatural influences. It has been well said that a man deprived of one of his senses from birth is a subject especially prepared by nature for the application of the method of difference. The science of mental disease and its cure is called *psychiatry*. See INSANITY.

Social or Collective Psychology.—This department of psychological study endeavors to investigate the mental and moral life of man in its social and collective conditions. The evident need of such subjects as sociology and criminology is the knowledge of the laws of human feelings and action when man is found in crowds, orderly or disorderly, and in organizations, legitimate or criminal. This need is felt in construeting the history of society, both by sociologists and by psychologists.

Individual or Introspective Psychology.—The older psychologists proceeded by introspection or direct observation of the events of the individual consciousness. The various branches of the experimental science now described deal rather with mind in its objective and collective aspects. It must be remembered, however, that all the results of objective psychology must have their final interpretation in terms of the consciousness of each normal man. The method of the old psychology, *internal observation*, must finally be appealed to, therefore, after all is said, for the actual confirmation of all psychological truth.

This final psychological resort, introspection or internal observation, takes on three distinct phases. In the first place, the simple fact of *consciousness*, that inner aspect which makes mental facts what they are, in its primitive form, is at once awareness of the states of self. However vague and indefinite this primitive awareness is at first, it is still a beginning. There is no experience in conscious life which leaves absolutely no trace of itself. Once it is an experience, a modification of subjectivity; then it may become the object of the developed act of inner observation. The first fleeting sensations of the child, when there is no subject or object, no store of memory images, no idea of self, exhibit in isolation the kind of primitive consciousness that lies at the basis of all knowledge of self. In adult life these experiences are assimilated to the developed forms of intellect and their separate meaning is lost. But in this category are included the vast number of first experiences as they pass steadily on in time, something every moment; and all the information we glean from them before we recall, examine, and reflect upon them. Second, the state of mind called *primary-memory*—the lingering in consciousness of an event just after the event itself is gone. The immediate past hangs around us as a line of trailing cloud on the horizon of consciousness. So speedy and involuntary is this presence of the shortly-past that it is sometimes considered the first stage of our inner observation; yet this can not be held in the sense of denying the immediate awareness of the primitive consciousness. For example, a loud noise, or a spoken word, may be unintelligible until its quick recall enables us to recognize it. We have had, in these cases, the "immediate awareness" of the first event, but the examination of the after-image which it leaves adds much to the scientific value of the experience. Third, we reach *reflection*, or conscious observation. By reflection is meant the inspection of the events of the inner world as distinct objects of our knowledge. It is the highest form of internal observation. Thus, by reflection, inner happenings are built up into hypotheses concerning the nature and processes of the mental life. See PERCEPTION, MEMORY, IMAGINATION, THOUGHT, CONSCIOUSNESS, WILL, ASSOCIATION OF IDEAS, SENTIMENT, MOTIVE, MIND, and PHILOSOPHY.

Applied or Educational Psychology.—It is evident that education has two claims to make upon this study. The first of these two duties of psychology to education is this: It should take its place as a factor in liberal collegiate culture in both of the functions which a great branch of learning serves in the university curriculum—i. e. undergraduate discipline and instruction, and post-graduate research discipline. The second great educative function of psychology is this: It should mould and inform educational theory by affording a view of mind and body in their united growth and mutual dependence. Education is a process of the development under most favorable conditions of full personality, and psychology is the science which aims to determine the nature of such personality in its varied stages of growth, and the conditions under which its full development may

be most healthfully and sturdily nourished. One of the first duties of psychology, therefore, is to criticise systems of education, and to point out "the better way" in education.

Pedagogy as a science treats of the application of psychological principles to the development of normal and cultured personality. The ground-work of such a science must be afforded, therefore, by psychology; and inasmuch as the teacher has to do with body as well as mind, and with mind principally through the body, it is experimental or psychophysical psychology to which this duty to theoretical education mainly comes home. It is needless to say that there is no such science of pedagogy in existence. Most of the books on this topic are unworthy of serious attention. Further, the German *a priori* systems of pedagogics find their main value in keeping awake the expectation and the *amour penser* of teachers, not in affording them much empirical assistance in their task. Psychology is aware of this duty, however far she may be from performing it. Children are studied with some soberness and exactness of method. Statistical investigations of the growth of school children, of the causes and remedies of fatigue in school periods, of the natural methods of writing, reading, and memorizing, are carried out. The results of several such inquiries were plotted for exhibit in the department of anthropology at the Columbian Exposition in Chicago. Questions of school hygiene are intelligently discussed. The relative values of different study-disciplines are weighed in view of the needs of pupils of varying temperaments and preferences. Among those who have addressed themselves to this task in the U. S., with information and influence, two names may be mentioned—that of Dr. W. T. Harris, U. S. Commissioner of Education, and President G. Stanley Hall, of Clark University, editor of *The Pedagogical Seminary* (vols. i.–iii., 1891–94). Another journal for the application of sound psychology in education is *The Educational Review*, edited by Prof. Nicholas M. Butler, of Columbia College, New York (vols. i.–vii., 1891–94).

Relation of Psychology to Philosophy.—The traditional connection with philosophy is not severed by these directions of psychology. The change in psychological methods was due in part, as has been said above, to changes in philosophical conception, and it is only part of the same fact that scientific psychology reacts upon philosophy in the way of healthful stimulus. Both the critical idealistic and the critical realistic methods of philosophy are richer and more profound by reason of the lessons of the new psychology. It was only just that the modern science which owed one of its earliest impulses in the U. S. to a book from an advanced thinker of the former school, the *Psychology* of Prof. John Dewey, should repay the debt by its reconstruction of the Kantian doctrine of apperception in terms acceptable to the later thinkers of that school. And it is no small gain to both schools that their issue should be joined on ground which stretches beyond their old battlefields by all the reach of territory covered by the modern doctrines of naturalistic evolution and the association psychology. Philosophy escapes the charge of Lewes that her discussions are logomachy when the disputants on both sides are able to look back upon those even of the late period of Lewes and admit the essential truth of both of their hotly contested formulas. As far as this is the case, the writer ventures to say that it is due to the progress of psychology in giving content to the terms of the logomachy and in enabling the best men to reach more synthetic and more profound intuitions.

The relation of psychology to theology, also, is close, and must remain so. And the obligation must become of greater mutual advantage as psychology grows to adult stature and attains her social self-consciousness in the organization of knowledge. The benefits which theology might have gained from psychology have been denied in great measure through the unfortunate attempt to impose the theological method upon the treatment of the whole range of mental fact. The treatment of "anthropology," included in the textbooks of systematic theology, bears about the same relation to that of psychologies like Höffding's and James's as the physiology of the traditional philosophy bore to the work of the neurologists and morphologists.

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J. Mark Baldwin.

Psychom'etry, or **Mental Chronom'etry** [*psychometry* is from Gr. ψυχή, soul, mind + μέτρον, measure]: the science of the measurement of reaction-times, or of the duration of mental acts. It is only since 1860 that anything like exact and scientific efforts have been made to measure the time or duration of mental states. The necessity of some such measurement first arose in astronomy, where the most exact determinations of transit and other periods must be made. A source of error in such observations was early seen to be the time taken up by the transmission of the excitation of the retina to the brain, and the time taken by the impulse given to the hand to record the event, to travel from the brain to the hand. This element of "personal equation" in astronomical work is elevated to a distinct problem in psychometry, and its conditions are extended to include all mental states which have the physical basis accessible for the employment of experiment.

Before the rise of experiment desultory treatment had been given to the comparative rapidity or slowness of our "ideas," such questions as whether all "ideas" were successive or some simultaneous, speculations on the cause of the rapidity of dreams, etc.; but being only general descriptions of fact, and depending on individual experience and testimony, such observations were almost useless in general mental theory. With the positive work now done in psychometry, it is quite astonishing how many side-lights are thrown on other questions and to what unexpected uses time determinations may be put.

Proceeding on the assumptions made in Psycho-physics (*q. v.*), we observe that any period of time which is occupied jointly by a physiological and a mental process, and which may be recorded by movements traced by a time-registering apparatus, will involve as one of its factors the time of the mental process considered for itself. If, then, we have means of measuring the time taken by the physiological process alone, we may by subtraction find the mental time. Now these conditions are realized in every instance in which we perform a movement in response or reaction to a sensation from without. For example, suppose one hears a word and then writes it; the sensation of sound is the central link in a chain of nervous processes beginning in the ear and ending in the hand. From the ear the stimulus is transmitted to the brain, and from the brain the command to move is carried to the hand; between these two processes the third or mental fact, sensation and volition, has taken place. Such a chain of events involving any sensation and movement, and a conscious event connecting them, is called a "simple reaction," and the time that it takes the "simple reaction-time." The determination of this time is the first problem of psychometry.

The simple reaction-time is determined for any sense with its reaction in movement (for example, a sound and consequent movement of the right hand) by connecting the hand's movement with a very delicate clock (chronoscope or chronograph) in such a way that there is an instantaneous stoppage of the clock upon the movement of the hand. This is arranged by directing the person experimented upon to press an electric button when he hears a signal, say a bell-stroke. Let the bell-stroke emanate from the clock as it reaches a certain indication upon its dial, and the experiment is ready for trial. The experimenter stands ready to press the button—the bell sounds—he presses—the clock stops. The dial-face indicates the time which elapsed between the actual sound of the bell and the movement of the hand. Calling the time taken up by the nervous process from the ear to the brain "sensory-time" (*S*), that taken by the nervous process from the brain to the hand "motor-time" (*M*), and the time of the mental event between them

"perception-time" (P), the simple reaction-time (R) can be expressed in this equation:

$$(1) \qquad R = S + P + M,$$

in which S and M are purely physiological.

This determination has been made by a great number of observers upon three of the senses—sight, hearing, and touch—with remarkable uniformity of result. It varies with different classes of sensations and individuals from $\frac{1}{8}$ to $\frac{1}{5}$ sec.

Experiments of Helmholtz and Dubois-Reymond have determined the velocity of both sensor and motor nerve-transmissions, so that we may substitute known values for S and M in the formula given above, as follows:

$S + P + M = \cdot 15$ sec. (about).
$S + M = \cdot 06$ sec. (about).
$P = \cdot 09$ sec. (about).

The word "about" indicates variations for the different senses. For all the senses the general law will hold that the purely physiological time ($S + M$) is less than half of the entire reaction-time.

Having the simple reaction-experiment arranged, we may vary the conditions in a variety of ways, and thus arrive at the most favorable mental attitudes for quick reactions. In the simple experiment the excitation was expected, but the exact moment of its occurrence was not known. If this exact moment is given to the "subject" by a preliminary signal, the reaction-time is diminished. Again, if neither the kind of excitation nor the time of its occurrence is known, the time is greatly increased. From these two variations we gather that the state of the attention has a great influence upon the reaction. As we would expect from our ordinary experience, when the attention is taken unawares a longer time is required to respond actively to external influences.

Another exceedingly important influence is practice. This is due to the artificial conditions of all experiment, and the increased facility we acquire by personal adjustment. We react a thousand times daily under less artificial circumstances, and since the reaction-time is diminished by practice, it is probable that our customary, habitual responses to stimuli of sense are more quickly performed than the most favorable experiments would indicate.

Having now reached what may be called the "mental" time (P), the question arises: How is this to be divided between the perception or apprehension of the sensation and the volition to respond by movement? Two methods of experiment have been devised for breaking up this period into its elements. The first consists in experimenting on cases of very close physical association—as between hearing and speech, right hand and foot, etc.—where the reaction is almost automatic and the will-element is practically ruled out. The subject agrees beforehand to repeat any familiar word spoken to him as soon as he hears it. Experiments of this kind led Donders and Jaager to the following principle: The relative times of perception and volition depend upon the degree of physiological association between the receiving and reacting organs; when this association is close, the mental time is largely taken up with perception; when loose, it is nearly all occupied with volition.

The other method, that of Wundt and Baxt, consists in repeating the excitation one or more times before the voluntary impulse for the reaction is given. Thus the perception-element is repeated, and the difference between this time and the simple reaction-time is the time due to the additional act of perception. For example, let two equal and moderate excitations, say bell-strokes, follow each other quickly, the reaction being made only after the second; we then have the equation (here p represents the perception of the first stroke, which carries no volition with it):

$$(2) \qquad R' = S + p + P + M.$$

On repeating the experiment with only one stroke, we have as before:

$$(1) \qquad R = S + P + M.$$

Subtracting (1) from (2), we have:

$$R' - R = p.$$

Here R' and R are readings from the clock. This gives a numerical determination for p. The volition-time will then be $P - p$.

From this latter experiment a curious result follows if the successive excitations are of very different intensities. If the more intense really follows, it is, nevertheless, heard first, and the less intense, really first, follows after; or they may appear to be simultaneous, though really successive. This is the case, in general, whenever the attention is strongly drawn to the second stimulus and follows from the principle already spoken of, that the attention, when concentrated, diminishes the reaction-time. This will be the case in general whenever the diminution in the reaction-time of the second exceeds the real interval between the two. The same phenomenon is experienced often when one is awakened by a loud noise. He hears the noise after he awakes, though it was the noise that awaked him. It simply means that because of the dormancy or preoccupation in dreamland, the reaction-time of the sound is lengthened into his waking consciousness, while the shock to the nervous apparatus was sufficient to rouse him from sleep. This shows also the dependence of the order of associated states of memory upon the movements of attention in the first experience rather than upon the order of external events. The fact is also important in astronomical observation; a new excitation to the eye, such as the appearance of an expected star on the meridian, is anticipated by the attention and given a reaction earlier than its true position would confirm.

The distinction between perception and reproduction—that is, between a direct intuition and a memory-picture—is very artificial, inasmuch as reproduced images enter in all our perceptions and influence their time. We have dealt heretofore with simple perception as if this influence did not exist, but a moment's reflection shows that it should be taken into account in all time-measurements. In the experiments just spoken of, in which attention plays a part—that is, in which the subject knew before he experienced the excitation, its nature and quality—the reaction-time was diminished, for the reason that it was possible to call up a memory-picture of previous experiences and hold it before the attention in such a way that the voluntary impulse could be set in play almost immediately upon the discharge of the sensory centers. For example, if the subject expects the stroke of the bell, he recalls the sensation of a previously heard stroke and the organs are in readiness to respond. So what the writer has called pereeption-time really results from a diminution due to reproduction. The true time for perception must be obtained by experimenting with excitations entirely unexpected, and the differences between the reaction-time in this case and that of an expected excitation of the same nature due to the influence of reproduction simply is sometimes half the true perception-time.

The problem then arises to determine the reproduction or simple "association-time"—that is, the time which elapses between the full pereeption of a first image and that of a second which the first suggests. To do this, we must first determine the time of a complete association-reaction—that is, the time which elapses from, say, the hearing of a word, as "storm," and the utterance of a closely associated word, as "wind." The association must be spontaneous with the subject, and the original word a monosyllable and very familiar. The uniformity of result is surprising, considering the variety and indefiniteness of our customary associations. Our equation is (A representing the new element due to association):

$$(3) \qquad R' = S + P + A + M.$$

Reacting again for the word alone without the associated image, we have

$$(1) \qquad R = S + P + M.$$

By subtraction, $A = R' - R$; hence value for A.

The average of experiments gives this value about $\frac{3}{4}$ to $\frac{4}{5}$ sec. These results hold only for close associations established by long habit, especially those dating back to childhood or early life. A third process upon which experiment has been employed is that of discernment—that is, the act of distinguishing between given images and indicating the distinction by choice. The excitation, say a red light, is agreed upon, and is exhibited to the subject indiscriminately with another, say a blue; the subject to react only when he sees the red. In this process, it is seen, two intellectual acts occur: 1, Comparison of the visible light with the reproduced image in consciousness; 2, a judgment as to their identity or non-identity, and these imply, 3, the act, first of all, of simple perception, and 4, last of all, the act of volition, as in preceding cases. Letting D represent the whole distinction-time, we have:

$$(4) \qquad R' = S + P + D + M.$$

Reacting simply:

$$(1) \qquad R = S + P + M.$$

By subtraction, $D = R' - R$.

Thus arrived at, the time of "distinction" is found to be for two indiscriminate stimuli, $\frac{1}{20}$ to $\frac{1}{10}$ sec. longer than the simple reaction-time. The reason for saying two stimuli is that the time is lengthened, as we would expect, when the possible choices are increased. For example, if we use three lights, red, blue, and green, the time occupied in a true discrimination is longer, and it increases geometrically. Wundt experimented with the letters of the German alphabet, and Cattell with both Roman and German printed characters. Cattell finds that it takes about $\frac{1}{2}$ sec. to see and name a single letter, and that it takes longer to distinguish the German characters than the Roman.

The time of the judgment has entered also into all our measurements heretofore, and it is impossible to isolate it as a distinct intellectual act for the purpose of experiment. As an act in time, it can be viewed only in particular cases and under prescribed conditions, and even then the time is to be considered relatively to that of other processes of necessity involved. Trautscholt has studied the time of the "judgment of subordination," from genus to species. A word is spoken, and the subject reacts as he conceives a word in logical subordination to the given concept, for example, animal—dog. An element of association which it is impossible to eliminate enters largely here. By the same process as before, we find the value of J (judgment) from the equation of the entire reaction to be about 1 sec.—slightly longer than that of the simple association. It varies also with the nature of the logical terms. That is, (1) the time is longest when the subject is abstract, and the predicate a more general notion (virtue—honesty); (2) shortest when the subject is concrete, and the predicate particular (hound—Bruno).

Besides these and other positive results, additional important contributions to psychological science have been made. It may be well, in closing, to indicate some of the more general bearings of these time-measurements.

All this work has tended to the emphasizing and defining of the voluntary side of the mind, as given in acts of the attention. The results here alone more than pay for the entire work the researches involve. That the will is the question of capital importance both in psychology and general philosophy, and that philosophers are hopeful and expectant of results in the theory of our active life as never before under the lead of speculation, are largely due to the new psychology. The experimental work described above has cleared up the problem of the attention in many of its conditions: its relation to the time-sense and the origin of the idea of time, its inseparable connection with muscular activity, its bearing upon intensities everywhere in mental experience, its influence in our perception of the external world and of space—indeed, one can not arise from the study of experimental psychology as it spreads its data out before us without the conviction that it is upon the theory of mental effort in attention with feelings of resistance that the psychology of the future will be erected.

Again, such experiments show both the isolated character of mental states in their dependence on physiological states, and at the same time the clear necessity of a circumscribing, grouping, and arranging consciousness of which they are states; a unity, an individual active self, which the manipulation of single states does not impair. From the work now spoken of, we have the emphatic emphasis of a principle of activity by which alone single, successive, or simultaneous states have any meaning or significance in our mental life. For description of psychometric apparatus, see RECORDING APPARATUS, PSYCHOLOGICAL, in the Appendix.

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Psycho-physic Law: See PSYCHO-PHYSICS.

Psycho-physics [Gr. ψυχή, the soul + φύσις, nature, physics]: literally, the science of the mind considered in its relation to physical nature. The word has been used in this broad sense, i. e. to indicate the general topic of the relation of mind and body. This is, however, better covered by the phrase physiological psychology. (See PSYCHOLOGY.) Psycho-physics is accordingly now restricted to a particular kind of research, and so becomes a department of psychology considered as an experimental science.

In this restricted sense, psycho-physics deals with the measurement of the intensity, as it is properly called—the quantity or "mass," as the psychologist uses the words—of sensation. The conception of intensity needs no further explanation; it is simply the difference between the light of one candle and of two or more, the sound of a bell near and far. It is a property of all sensation. The problem which presents itself is to reach a formula for such intensities in terms of the amount of stimulus required at the end organ to produce a given increase or decrease in conscious intensity. To illustrate, suppose a candle illuminates a page to a certain extent, how many candles would illuminate it enough to enable one to see twice as distinctly, or as distinctly at twice the distance? Is there any general law of the ratio of intensity of external stimulus to intensity of internal sensations which will hold good for all the senses? Or is there a different law for each of the different senses? Or, again, is the entire case simply a matter of subjective estimation, varying with the mental and bodily conditions of the individual?

These questions were at one time hotly discussed, but have now been practically answered by the establishment of a single law of relation between stimulus and sensation, which holds good for most of the senses found to be most easily accessible, has been partially proved for other classes of sensations, and is under judgment in default of sufficient experimentation for a remaining group of sense-experiences. Before entering more particularly into details it is well to define and explain several terms of current use among physiological psychologists.

By excitation (or stimulus) is meant the external force which excites a sense-organ, whether it be of sufficient intensity to produce a sensation or not. The feeblest sensation which we are able to experience or feel from any sense is called the perceptible minimum; the theoretical point at which such a sensation, when further enfeebled, disappears from consciousness, the threshold of sensation; and the amount of excitation which is just sufficient for the perceptible minimum of sensation, the threshold excitation for that sense. For example, air-vibrations are the excitation for sensations of sound; the feeblest sound which it is possible to hear under determined conditions is the perceptible minimum, and the number of units agreed upon—bells, notes, etc.—which are needed to produce this perceptible minimum makes the threshold excitation for this sense. Further, the amount of excitation needed to raise or lower the intensity of a sensation by the smallest amount which can be distinguished, and the corresponding difference in the sensation, are called the smallest perceptible difference in excitation and sensation respectively. Thus if 1 unit be the threshold of excitation for sound and an addition of 1/3 unit is necessary to produce any perceptible increase in the sensation, then 1/3 is the smallest perceptible difference of excitation for sound.

With these definitions in mind, we may turn to the problem of finding a law of measurement for intensities of sensation. The preliminary question as to a standard of measurement is already answered in the resort to experiment, viz., the standard must be a scale of excitation-values, determined by physical measurement, as pounds, velocities, etc. Given a threshold-value of each excitation, we may double, treble . . . it, endeavoring to find some law of increase in the corresponding sensations whereby a corresponding internal scale may be erected. The first step is seen, therefore, to be the discovery of the perceptible minimum of each sense, which may serve as zero point on the sensation-scale, its exciting stimulus being the unit point on the excitation-scale. This brings the investigator to an actual research on all the sense-organs in turn—experiments to determine the minimum of sight, hearing, touch, etc. The methods by which this is done are simple. Any device by which excitation may be lowered or heightened gradually below or above the threshold may serve the purpose. For touch and the muscular sense small balls of cork may be used—differing so slightly in size that when placed, say on the back of the hand in succession, the difference between the last one which is felt and the next which is too light to be felt is as small as possible. By running the series in the reverse order, from weights too small to be felt to others barely felt, and by an equation and average of errors, the point is determined where the excitation produces the smallest perceptible sensation.

Simple as this procedure seems, the conditions are so complicated in some of the senses as to occasion great embarrassment. The eye, for example, is found to have a

"natural light" of its own, arising from mechanical movement, friction or chemical action, from which it is never entirely free, and the smallest perceptible sensation of light must always include this natural factor. The conditions of the body before the experiment also cause great variations, as is seen in experiments on temperature and smell sensations. The threshold-value for temperature is much higher or lower, for example, according as the earlier state has been one of higher or lower temperature. The following table exhibits the results of Fechner's experiments on the perceptible minimum:

PERCEPTIBLE MINIMA.

Touch	Pressure of ·002–·05 gramme.
Muscular sense	Contraction of ·004 mm., right internal muscle of the eye.
Temperature	1–8° centigrade (normal heat of skin 18·4°).
Sound	Ball of cork 1·001 gramme falling ·001 meter on glass, ear distant 91 mm.
Light	Cast on black velvet by candle distant 8 ft. 7 in.

It is not necessary to examine each of these determinations, for the actual numerical values are not of great importance, even where Fechner has not been confirmed by other experimenters. The fact that there is a minimum under normal conditions, and its determination with sufficient accuracy to give ground for further inferences, is all that the theory requires.

So far two points have been gained—i. e. the zero on the sensation-scale and the unit-value, a positive known quantity from the table above, on the excitation-scale. Next in order is the graduation of both scales in an ascending way by relatively equal values.

It is a common fact of experience that excitations and sensations do not apparently sustain the ordinary relation of cause and effect to each other. Two candles do not illuminate a page twice as much as one; two violins, pitched in the same key, do not double the sound of one; and as intensities increase it is a matter of ordinary observation that very little variations are brought about by well-marked changes in the stimulus. This result of general observation recurs to us as we advance in the consideration of the values on our scales, for we would expect, from this rough judgment of daily life, that larger increments would have to be made the higher we ascend on the excitation side to produce regular equal increments on the sensation side.

This is confirmed by a further research undertaken on all the senses in turn, an experimental determination of the amount of increased excitation necessary to produce the smallest perceptible difference in sensations of the same kind. Let us suppose a given excitation for pressure, then increase it slightly until it is judged greater than before, determine the ratio of the increment to the former excitation, repeat the experiment with a much larger excitation, making the same fractional determination, and compare the results. It is found that the fractional increase in excitation necessary to produce a perceptible difference is constant for each sense. This means that the absolute increase is not constant, but becomes greater as the intensity of the initial excitation becomes greater. For example, if the initial excitations in two experiments be 6 and 9 grammes, a relative fractional increase of 1/3 would be in one case an absolute increase of 2, and in the other of 3 grammes.

There are three general methods of determining the smallest perceptible difference for any sense, due in their formal statement and description to Fechner. They are known as the methods (1) of smallest perceptible differences, (2) of true and false cases, and (3) of mean errors. There is a fourth, of especial importance in researches on sight—that of mean gradations (Plateau); but it is not necessary to speak of it further.

1. The method of smallest perceptible differences is most direct. It consists in adding to a given excitation until the difference is barely perceived. The difference between the initial and the resulting excitation is the first determination of the quantity required. A plainly perceived difference is then added to the same initial excitation, and reduced till no longer perceived. This gives a second determination. The averaging of these two results is the correct value, which may be called DE (difference or differential of excitation). Its ratio to the first excitation is expressed by the fraction $\frac{E}{DE}$. The relative degree of sensibility for any sense, it will be observed, is inversely proportional to the amount of excitation required to give the smallest perceptible difference in sensation, i. e.

$$S\,(\text{sensibility}) = \frac{DE}{E}.$$

2. The method of true and false cases consists in comparing two excitations (say weights), the subject of the experiment judging them to be equal or not. The number of true and false judgments is recorded, and the ratio between them indicates the approach of the difference of excitation to its minimum value. The relative sensibility again varies, as the actual difference between the excitations varies, and also directly as the number of true judgments (in relation to total cases), i. e.

$$S = E\,\frac{S\,(=\text{total cases})}{N\,(=\text{true cases})}.$$

3. The method of mean errors consists in comparing two stimuli (weights, etc.) and judging them equal, then in taking their real difference, positive and negative, in a great number of cases, adding these differences without regard to signs, and dividing by the entire number of cases. The mean error is thus arrived at. The sensibility is inversely proportional to the mean error, i. e.

$$S = \frac{1}{D}\,(=\text{mean error}).$$

Proceeding by one or all of these methods, the smallest perceptible difference of excitation for each of the senses is established. The following table gives these values, subject to revision for certain classes of sensation, especially sight, when the conditions of experiment can be made more free from error:

SMALLEST PERCEPTIBLE DIFFERENCES.

Touch	1/3
Muscular sense	1/17
Temperature	1/3
Sound	1/3
Light	1/100

The values given, it may be well to repeat, represent the amount of a given excitation which must be added to that excitation to be felt in consciousness. For example, if the eye is already stimulated by a light which represents 1,000 candles, at least 10 candles (a fractional increase of 1/100) must be added to produce any perceptible increase in the intensity of the light. Any number less than ten would seem to have no effect on consciousness whatever, and so with the relative values given for the other senses.

To revert to the original problem, it will be remembered that the two determinations already arrived at for all the senses are only steps in a process of measuring the intensity of sensations in terms of external stimuli. So far there have been determined the smallest perceptible sensation (giving the starting-points on the scale) and the smallest perceptible differences of excitation in the upward graduation of the scale. The results of this second research may be stated in general language thus: In order that sensation may increase by successive equal additions, their excitations must increase by a constant fraction of the excitation itself, i. e. by additions which are not equal, but which increase in ascending the scale of intensities. For example, the successive additions to a sound, to be barely perceived, would require the following series of additions to the stimulus:

$$1/3,\ \frac{1+1/3}{3},\ \frac{1+1/3+\frac{1+1/3}{3}}{3},\ \text{etc., or } 1/3,\ 4/9,\ 16/27,\ \text{etc.,}$$

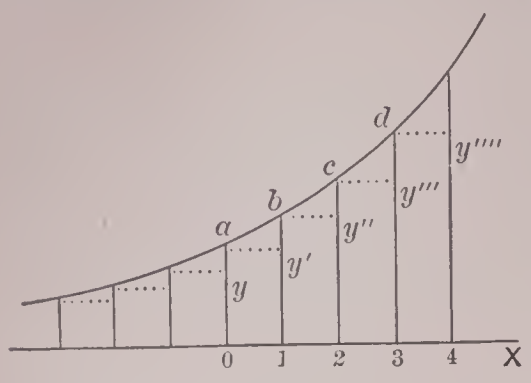
and the actual excitations would be the series

1, 4/3, 16/9, 64/27, etc.

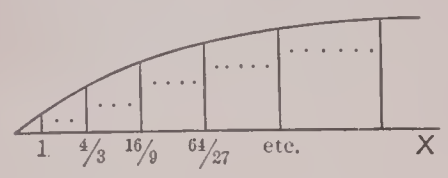
This general principle is called the law of Weber, and may be stated in a variety of ways, of which perhaps the easiest to carry is this: That in order that sensations may increase in intensity in an arithmetical series, their excitations must increase in a geometrical series. The law may be exhibited in a linear way to the eye in diagram 1 below.

Let X represent a series of sensations 0, 1, 2, etc., increasing by a constant quantity from the zero-point 0; let the upright lines represent at each point the excitation necessary for the sensation of that intensity. By drawing the dotted lines parallel to X, it is seen that the successive additions made to the vertical are not equal, but grow constantly greater, i. e. for hearing, $y' = y + y/3$, $y'' = y'$

$+ y'/3$, etc. Having erected these vertical lines by the law of increase given in the table, the curve *a b c d*, etc., may be plotted through their extremities, being the "curve of excitation."



The same relation may be shown in an inverse way, in diagram 2 below, in which the scale of increasing excitation is given on the line X, the vertical line representing the sensations increasing by a constant quantity. The curve connecting the extremities is the "curve of sensation."



A further mathematical expression has been given to this law by Fechner. As may be seen below, it is open to some criticism; yet it is ably defended, and whatever may be its fate as a mathematical deduction, the law of Weber as given above will not be involved.

Assuming, says Fechner, that the smallest perceptible differences in sensation are equal for any value of the excitation (an assumption which has no proof), and that very small increments of sensation and excitation are proportional to each other, we may throw Weber's formula into the following equation (*DS* being increment of sensation, *DE* increment of excitation, and *K* a proportional constant),

$$DS = K\frac{DE}{E},$$

in which all the quantities have been determined in the tables already given. Considering this as a differential equation, we may integrate it and reach the form

$$S = K \log E,$$

or the sensation varies as the logarithm of the excitation—the celebrated "logarithmic law" of Fechner.

Considered under its more general form, as indicated in the principle of Weber, this law has an unequal application to different sensations. For sight, touch, and hearing it is fully established; for taste and smell it is still in doubt, by reason of the mechanical difficulties which these senses offer to experimental research. It applies under restrictions to estimation of linear distance by the eye, to perception of the passage of small periods of time, and to discrimination of local positions in the skin. In all cases its application is restricted within upper and lower limits of intensity of sensation. When too intense the organism fails under the stimulus, reaching the limit of its vibratory responsiveness, and when too faint, either the stimulus does not excite a conscious reaction, or the attention fails to discriminate the sensation.

It may not be out of place to indicate the principal criticisms which have been urged against Weber's law, both in its general result and in the method of research which it involves.

Both of the assumptions made by Fechner—that the perceptible differences of sensation of the same sense are equal for all intensities of stimulus, and that the increments of sensation and excitation are proportional—are called in question. The results of late physiological work tend strongly in favor of the first assumption, and it is probably safely established. The second with the application of the differential calculus is so plainly subject to criticism that even its strongest advocates only attempt to justify it by the results. Really it is only infinitely small quantities that can be considered differentials or proportional to each other; while by the law of growth, arrived at by Weber, they are shown not to be proportional. This argument, adverse to Fechner's formula, is ably presented by Delbœuf. Another objection is brought also to the doctrine of "threshold." It is claimed that there is not a constant threshold for any of the senses, but that the minimum of sensation varies with the condition of the organism, the concentration of attention, etc. If this criticism should be shown, however, to be valid, it would still be possible to establish a table of variations or a coefficient of "personal equation" for individuals, and still preserve the principle of Weber. The objection formerly drawn from the fatigue of the organ under prolonged experiment is now met by the principle called by Fechner the "parallel law"; if the experiments are performed at very close time-intervals, the degree of exhaustion may be considered as approximately the same for any two successive excitations. Any modification, therefore, which either excitation undergoes from the element of fatigue is corrected in the ratio between that and the other excitation. For example, the smallest perceptible difference *DA* above an excitation *A*, reached by adding a new excitation *B*, is expressed by the fraction $\frac{B}{A}$; but any modification which affects both *B* and *A* to an equal degree does not alter their ratio.

The philosophical significance of Weber's law is the ground of main interest. That it is an established law of the relation of the mind and body as respects sensation, that it confirms the general assumption that there is a universal and uniform connection between the mental and the physiological—these points must be admitted, whatever may be a more particular interpretation of the law itself. As to its meaning for our theory of the mind, and whether it has any such meaning, there is more room for difference of opinion, and three distinct interpretations are commonly held among psychologists. Each of these is advanced in answer to the question which Weber's law obviously suggests, i. e. why is it that the relation of cause and effect does not hold between sensation and excitation? why is sensation proportional to the logarithm of excitation and not to excitation itself?

The first of these interpretations, that of Fechner, is that Weber's law represents the ultimate principle of connection between mind and body; that they are so constituted as to act upon each other in a logarithmic relation. It is of necessary and universal application wherever mind and body are brought into organic connection. In short, on this view the law is strictly psycho-physical. This interpretation has been very generally discredited, principally because it forbids all further research or explanation. Nothing is ultimate which may be explained, and if physical or mental reasons can be given—as the other two theories hold they can—for the disproportion between sensation and stimulus, then the assumption that it is ultimate is gratuitous. Fechner supports his view by two considerations: first, that the physiological theory, as stated below, is inadequate, and, second, that the law holds in cases of nervous exhaustion. The latter point is met by the consideration that in cases of extreme exhaustion the entire series of stimuli is intensified by a given amount throughout, and when the exhaustion is not extreme it corrects itself by the "parallel law" spoken of above.

Again, it is held, especially by Wundt, that the law is strictly psychological—that is, that the disproportion between sensation and excitation is due to the perception or discrimination of the sensation. On this theory it is not the real sensation which is experimented upon, but perceived sensation, and in the process of taking the sensation up into our apperceptive life it is modified as to its intensity. For example, the single fact of attention to a sensation changes its intensity; what effect might not the act of directing the mind to it, as is required in the above experiments, have upon it? In answer to this interpretation it may be said that it can never be critically established, since there are no means of getting at the true worth of sensation except as it is interpreted in our attentive consciousness. By intensity we mean intensity to us, in our intellectual life, and to speak of the intensity of sensations in a relative way, apart from the appereception and comparison of them, is to become unintelligible. Wundt, however, has an ulterior end in view—the support of his doctrine of apperception—and he himself admits that he would not exclude the physiological interpretation.

The third interpretation, which is probably the true one, makes the disproportion spoken of purely physiological. According to the advocates of this theory the law of cause and effect does hold in this case, as in others, but a part of the internal cause is lost in the transmission by the nerves, so that the true excitation at the brain-center is less than at the peripheral organ, and is in direct proportion to the intensity of the sensation which it causes. Briefly stated the following facts tend to support this view: (1) The phenomenon of nervous arrest would lead us to expect a diminution of the stimulus between the organ and the brain; (2) nerve-action is dissipated in heat; (3) force is lost in the exciting

of the internal organ, hence, by analogy, we would expect the same in the stimulation of the centers; (4) the general parallel between electricity and nerve-action would indicate resistance to be overcome in the one case as in the other; (5) on general grounds a loss of force may be expected in an extended or complicated mechanism. A decided preference for the last view seems justified by the facts, although Wundt has been recently re-enforced by reliable results. Criticism so far seems to show that Weber's law represents the method of nervous "summation" of stimulations at the centers, but under this term a great many particular influences have to be included. See RECORDING APPARATUS, PSYCHOLOGICAL, in the Appendix.

LITERATURE.—Fechner, *Elemente der Psychophysik* and *Revision der Hauptpunkte der Psychophysik*: Wundt, *Physiologische Psychologie* (1893); Müller, *Zur Grundlegung der Psychophysik*; Külpe, *Grundriss der Psychologie* (1894); Ladd, *Elements of Physiological Psychology* (1887); Jastrow, *Critique of the Psychophysical Methods* in *The American Journal of Psychology*; Ribot, *German Psychology of To-day* (1886). J. MARK BALDWIN.

Psychosis: a mental state considered as subject for investigation, generally in connection with the accompanying nervous condition or NEUROSIS (*q. v.*), which accompanies it.

Psychotheism: See ETHNOLOGY.

Psychrometer: See HYGROMETER.

Ptah (The Opener): "the father of the gods"; perhaps the oldest of the Egyptian deities; worshiped in Memphis from the first dynasty on. He is represented in the form of a mummy, with head and hands free. In his hands was the scepter which stood as the symbol of power, and beneath his feet was the symbol of truth. Among several composite forms in which he appears was that of Ptah-Sokar-Osiris, the god of the resurrection and of the nether world. In this form he was regarded as the first King of Egypt and as creator of the world. CHARLES R. GILLETT.

Ptarmigan [(by analogy of Gr. words in *pter-*) from Gael. *tarmachan*: Ir. *tarmochar*]: any grouse of the genus *Lagopus*, the members of which are distinguished by the legs being densely feathered to the claws, the nasal grooves closed over with feathers, and the development of sixteen or eighteen tail-feathers. Ptarmigans are characteristic of the high northern regions of the globe, and, with the exception of one species, assume a white coat during winter; in summer they are of a more or less reddish or brownish gray. They are thus an instance of a double protective mimicry, harmonizing with the snow in winter and the rocky barrens in summer. In winter they seek the shelter of thickets of willows, birches, etc., but in summer they frequent plains. When pursued in winter they frequently dive into the loose snow, in which they work their way with great ease. The female begins to lay her eggs about May or June, and deposits about eight or ten eggs in the nest. A number of species have been recognized, of which *Lagopus albus* inhabits both hemispheres, *L. rupestris* and *L. leucurus* North America, and *L. mutus*, *L. hemileucurus*, and *L. scoticus* the Old World. *L. scoticus* is extremely closely related to *L. albus*, and has been even regarded as the permanently dark insular form of that species. Revised by F. A. LUCAS.

Ptenoglossa [Mod. Lat., from Gr. πτηνός, feathered + γλῶσσα, tongue]: a name employed in some schemes of classification of the molluscs to include the purple shells (*Ianthinidæ*), the sun-shells and mason-shells (*Solaridæ*), and the wentletraps (*Scalaridæ*).

Pteran'odon [Mod. Lat.; Gr. πτερόν, wing + ἀν-, un-, without + ὀδούς, ὀδόντος, tooth]: a genus of pterodactyls, or extinct flying reptiles, from the Cretaceous of Kansas, distinguished from all previously known genera of the order by the entire absence of teeth, and hence regarded as the type of a sub-order, *Pteranodontia*. The typical *Pteranodon longiceps* has the skull about 30 inches long and the lower jaw nearly 2 feet. The rami of the lower jaw are closely united for more than half their length, as in the skimmers (*Rhynchops*). *P. comptus* is a small species, while *P. ingens* was very large, and the skull must have measured nearly 4 feet. O. C. MARSH.

Pteridophytes: See FERNWORTS.

Pterocarpus: See KINO.

Pterocletes [from *Pte'rocles*, the leading genus]: a sub-order of birds, sometimes considered as an order, containing the sand-grouse forming the single family PTEROCLIDÆ (*q. v.*).

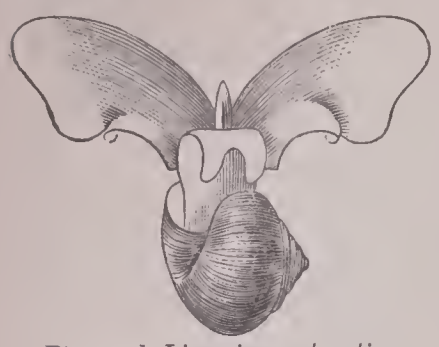
Pteroc'lidæ [Mod. Lat., named from *Pterocles*, the typical genus, from Gr. πτερόν, wing + κλείς, κλειδός, key, bolt, tongue of a buckle]: a small family of birds peculiar to the Old World, containing the so-called sand-grouse; birds about the size of pigeons and intermediate in structure between them and the grouse, although the balance of characters is rather in favor of the pigeons. The form is as much that of the pigeon as the grouse; the bill is short, compressed, and the culmen curved to the tip; the wings and tail are elongated and pointed; the tarsi moderately robust and covered with feathers; the toes rather stout, the three in front more or less united, the hinder rudimentary or wanting. Two genera are recognized by authorities—(1) *Pterocles*, with about fifteen species, and (2) *Syrrhaptes*, with two. In color these birds are dull yellowish above, with darker markings, harmonizing well with the surface of the country they inhabit. They are found in Southern Europe, as well as in Africa and Asia, in dry sandy places or deserts, rocky plains, and wooded grounds. They feed chiefly upon hard seeds, bulbs, and insects. The females lay from two to four eggs on the bare ground. *Pterocles arenarius* and *P. alchata* are found in Southern Europe. *Syrrhaptes paradoxus*, although strictly an Asiatic species, sometimes makes incursions into Europe as far westward as the British islands. One of these visitations was made in 1859, another in 1863, in which year it made its appearance at 148 European localities, as recorded by Prof. Alfred Newton—"from Galicia to Donegal, and from Gascony to the Faröe islands." Another irruption occurred in 1888. The reason for these curious and irregular migrations is unknown, but the primary cause may be failure of food-supply in some portion of their habitats. Revised by F. A. LUCAS.

Pterodactyl [Gr. πτερόν, wing + δάκτυλος, finger]: any one of a group of extinct flying animals, confined to the Mesozoic or Reptilian age, and usually regarded as an order of reptiles. The anterior limbs were adapted for flight by the elongation of the fore arm and fifth or outer digit, corresponding to the little finger of the human hand. By this means an expanse of membrane was supported as in the bats, which these animals in some respects resembled. The head was large, the jaws long, and in most forms armed with teeth. In many points the skull approached that of birds. Nearly all the bones were pneumatic, with very thin walls, as in most birds. The skin seems to have been destitute of scales or feathers, as no traces of either have been discovered. The earliest pterodactyl yet known is *Dimorphodon macronyx* from the Lower Lias of England. Many species occur in the Oolitic lithographic slates in Bavaria. A few fragments only are known from the Wealden, while the English Greensand has furnished many large species. Others from the Upper Cretaceous were the latest forms of this group known from the Old World, and were perhaps contemporaneous with the gigantic species from the Upper Cretaceous shales of Kansas. These were all destitute of teeth. The largest of them (*Pteranodon ingens*, Marsh) probably measured between the tips of the fully expanded wings nearly 25 feet. Several smaller species occur in the same formation, but all were large in comparison with the common European forms. O. C. MARSH.

Pterodactyl.

Pteroglossus: See Rhamphastidæ and Aracari.

Pterop'oda [Mod. Lat.; Gr. *πτερόν*, wing + *πούς*, *ποδός*, foot]: a group of molluscs formerly regarded as a class but now known to be merely a subdivision of the tectibranch division of the opisthobranchiates. (See Gasteropoda.) They are fitted for a free-swimming life upon the high seas by the development of the lateral lobes (parapodia) of the foot into fins or wing-like swimming organs. Two divisions are recognized, the *Thecosomata*, with a shell (either external or internal), which feed on protozoa or algæ, and the shell-less *Gymnosomata*, which are rapacious, feeding largely upon the members of the other group. The pteropods frequently occur (especially in the Arctic seas) in immense schools, and some species form the food of the right whales, the "brit" of the whalers. None of the pteropods are large, and the numbers required to make the fields of brit, sometimes miles in extent, can hardly be imagined. J. S. K.



Pteropod, *Limacina antarctica* (enlarged).

Pterylog'raphy [from Mod. Lat. *pteryla*, feather tract (from Gr. *πτερόν*, feather + *ὕλη*, forest), + *γραφία*, from *γράφειν*, write]: that branch of ornithology which treats of the arrangement of the feathers of birds. The science originated with Nitzsch, who first showed that not only are few birds evenly clad with feathers, but that the feathers are disposed in definite tracts, or pterylæ, between which are bare spaces, apteria, and that the arrangement of these tracts and apteria differs in and is characteristic of various groups of birds. F. A. Lucas.

Ptolemaic System: the name generally applied to the ancient system of astronomy, because the only systematic description of it extant is found in the *Almagest* of Ptolemy. (See Ptolemy, the author.) There is no reason to believe that any important part of it was the work of Ptolemy himself; its development was probably the work of many generations of observers and thinkers before his time. The writings of these men are nearly all lost, and thus it happens that the name of Ptolemy is associated with the system. The fundamental doctrines of the system are these: (1) The earth is a globe. The proofs given by Ptolemy that we do not live upon an extended plain, but on the surface of a globe, are those familiar to every schoolboy. They were better known and appreciated in ancient times than is commonly supposed. (2) The celestial sphere, with all the heavenly bodies, performs a revolution around the earth every day, on an axis called the axis of the world. We now know that this apparent motion is caused by the revolution of the earth on its own axis, but the ancients referred the motion to the heavens. (3) The earth is in the center of the celestial sphere. The apparent proofs of this given by Ptolemy must have seemed to him very strong, but they are a simple result of the revolution of the earth on its own axis. (4) The celestial sphere is so much larger than the earth that the latter is a mere point in comparison. (5) The earth has no motion of translation, but remains at rest in the center of the sphere. (6) The seven planets are arranged in the following order from the earth: the Moon, Mercury, Venus, the Sun, Mars, Jupiter, Saturn. (7) The moon and sun revolve around the earth in eccentric circles—that is to say, in circles whose center does not coincide accurately with the center of the earth. Mercury, Venus, Mars, Jupiter, and Saturn do not move uniformly around the sphere, but move around the circumference of an epicycle, whose center does move uniformly. The epicycle was intended to account for the alternate, direct, and retrograde motions of these planets, which we now know to be due to the revolution of the earth around the sun.

Notwithstanding the falsity of this system it had two merits—that of being founded on careful and exact observations and reasonings, and that of accounting for the salient phenomena of the celestial motions. S. Newcomb.

Ptolemais: See Acre.

Ptolemy [from Lat. *Ptolemæ'us* = Gr. *Πτολεμαῖος*]: the name of thirteen kings of Egypt, forming the thirty-third dynasty, who ruled for nearly three centuries, from the death of Alexander of Macedon till the Roman occupation (323–30 B. C.). The period, in its earlier portion, till the death of Ptolemy III. (221 B. C.), was one of considerable splendor, rivaling that of previous dynasties. The policy of employing Greek mercenaries was continued, and they grew to be the ruling class. The dominant spirit was Greek, not Egyptian. The royal residence was at Alexandria, whose population was mainly foreign, and that city became the center of Greek culture and science. For political reasons toleration was shown to the religious ideas and preferences of the Egyptians, who were regarded simply as servile subjects, and their land as the principal possession of the Ptolemies. Temples were repaired or built anew, as at Karnak, Edfu, and Philæ, and the most important of the native deities found entrance into the Greek pantheon. Twice during the period the native spirit broke forth into insurrection. The first revolt was at the death of Ptolemy IV. (204 B. C.). It emanated from Thebes and spread through the Delta region. With the aid of Rome it was crushed in the Delta in 198 B. C., and the reign of Ptolemy V. established firmly, but Thebes did not succumb till 186 B. C. The other insurrection occurred at Thebes in 88 B. C. during the reign of Ptolemy VIII. In 85 B. C. it was subdued, and Thebes was given over to final destruction. Roman power had been increasing in Egypt during a large part of the period after Ptolemy III., and it was actually dominant long before the final occupation after the defeat of Antony and Cleopatra by Augustus (30 B. C.).

The founder of the dynasty was Ptolemy I. (Soter), the reputed son of Lagus; hence the name *Lagides*, given to the dynasty. He had been one of Alexander's most trusted generals, and at the partition of the empire received the governorship of Egypt (323 B. C.). He remained as a nominal tributary to the Macedonian power till 306 B. C., when he became the actual king, assuming the titles of the Pharaohs and reigning till 284 B. C. By reason of the victory of the allies over Antigonus at Ipsus in 301 B. C., Palestine, Phœnicia, Syria, and Cyprus were added to his kingdom. Ptolemy I. strengthened his land and naval forces, and established the administration and commerce of Egypt. He also laid the foundation of the greatness of Alexandria by inaugurating its library and school. His name *Soter* was given by the Rhodians, whom he aided against Demetrius (305–304 B. C.).—Ptolemy II. (Philadelphus) (284–246 B. C.) enjoyed a peaceful reign and continued the work of his father, extending trade, building roads, canals, and cities for this end. He erected the lighthouse on the island of Pharos. He also stimulated scholarship by adding to the schools and library of Alexandria. It was during his reign that Manetho compiled his history of Egypt, and that the Greek version of the Old Testament, known as the Septuagint, is supposed to have been made, in part at least.—Ptolemy III. (Euergetes) (246–221 B. C.) extended the limits of his kingdom to the N. E., it is said, even to the Indus, and he also made conquests in Arabia, while at home he showed himself an intelligent patron of learning. He received the name *Euergetes* because he restored to Egypt the gods which Cambyses had carried away.—With Ptolemy IV. (Philopator) (222–204 B. C.) the period of decadence began. His possessions in Asia were wrested from him in part by Antiochus III., and his course in sending grain to Rome at the time of the second Punic war was the occasion of the growth of the Roman power in Egypt. He founded the temple at Edfu.—His successor was Ptolemy V. (Epiphanes) (204–181 B. C.), who began his reign in his fifth year. In 201 B. C. he became the ward of the Roman senate, in 195 B. C. the Rosetta Stone, with its trilingual inscription, was erected in his honor, and in 192 B. C. he married Cleopatra I., the daughter of Antiochus.—The later succession was as follows: Ptolemy VI. (Philometor) (181–146) reigned from 181 till 170 alone, and conjointly with Ptolemy VII. (Euergetes II.), surnamed *Physcon*, from 170 till 165. During the period 165–146 he was under Roman tutelage.—Ptolemy VII. succeeded him and ruled from 146 till 117 B. C., with the exception of an interval about 130 B. C., when he was in temporary exile in Cyprus.—Ptolemy VIII. (Soter II.), surnamed *Lathyrus*, reigned from 117 till 106 B. C., when he was banished. He was recalled in 87 B. C. and ruled till 81 B. C.—Ptolemy IX. (Alexander I.) was coregent with Cleopatra III. from 106 till 89 B. C., when he was banished. He died in 87 B. C. in a naval battle.—Ptolemy X. (Alexander II.) was placed in power by the Roman senate in 81 B. C., but was soon afterward slain by an outraged people. With him the legitimate line became extinct, and the succession fell upon Ptolemy XI. (Neus Dionysus),

surnamed *Auletes*, an illegitimate son of Ptolemy VIII. He ascended the throne in 81 and died in 52 B. C. His successors were PTOLEMY XII. (DIONYSUS II.) (51–48 B. C.) and PTOLEMY XIII. (47–44 B. C.), who were successively coregents with Cleopatra VII., the daughter of Ptolemy XI. She continued to be queen till 30 B. C., when with her the line and dynasty both became extinct, and Egypt became a Roman province. CHARLES R. GILLETT.

Ptolemy (*Claudius Ptolemæus*): author; b. at Pelusium in Egypt; flourished at Alexandria in the middle of the second century after Christ. Of his personal life nothing more is known. Of his works, the *Syntaxis Mathematica* and the *Geographia* are extant. The former is a representation of the science of astronomy at the time of the author, based partly on his own researches, partly on those of Hipparchus and others. As it is the only authority for the views of astronomy entertained by the ancients, and as it formed the foundation of all astronomical science down to the time of Copernicus, the book is of the greatest interest. Having disappeared during the Dark Ages, it again became known to the Europeans through the Arabs. About 827 it was translated into Arabic, and of this Arabic translation—the *Almagest*—a Latin translation was published in 1230 under the auspices of the Emperor Frederick II. The best edition of the Greek text, accompanied by a French translation and notes, is by Halma (4 vols., Paris, 1813–28). (For the fundamental ideas of this system see the article PTOLEMAIC SYSTEM.) Of the *Geographia* a Latin translation with maps was frequently reprinted at Rome in the latter part of the fifteenth century, and it was almost the only source of geographical knowledge until the voyages of discovery by the Portuguese made its information antiquated. Editions by Wilberg and Grashof (Essen, 1838–44), and Müller (Paris, 1883).

Ptomaïnes, tō′mā-inz [Gr. *πτῶμα*, a corpse]: certain substances found in the process of putrefaction. Some of these are extremely poisonous, while others are harmless or nearly so. Nencki, in 1882, first isolated a definite substance from the products of putrefaction, starting with gelatin. Later, probably the same substance was obtained from putrid fish. Other basic products were subsequently obtained from putrid meat and fibrin. Brieger has prepared a number of the ptomaïnes, and, by his careful studies, contributed largely to our knowledge of this important class of compounds. (See Brieger, *Die Ptomaïne*, Berlin, 1885 and 1886; *Sitz. K. preuss. Akad. d. Wissenschaften zu Berlin*, 1889.) Among the ptomaïnes described by Brieger the following may be mentioned: Cadaverine, putrescine, peptotoxine, muscarine, and mydaleine. It has been shown that the ptomaïnes are the products of the vitality of micro-organisms, and this discovery is plainly of the highest importance to the science of medicine. It was formerly held that many diseases are due directly to the presence of micro-organisms in the body, but now it appears that, in some cases at least, these organisms act indirectly by secreting poisons, which are the immediate cause of the disturbance of the normal functions. If the poisons secreted by the various organisms that cause disease were thoroughly understood, the foundation would be laid for the use of remedies acting chemically as antidotes.

IRA REMSEN.

Ptosis [Mod. Lat., from Gr. *πτῶσις*, a falling, deriv. of *πίπτειν*, perf. *πέπτωκα*, fall]: a dropping of one or rarely both upper eyelids; an inability to open the eye. It may come from a degenerate or undeveloped condition of the muscle-tissue, or from palsy of the third nerve which controls the muscle of the upper lid. It has been successfully treated by tacking the orbicular muscle to the occipito-frontal. It often passes away without surgical treatment, and there are cases which are not benefited by any treatment whatever.

Revised by W. PEPPER.

Puberty [from Lat. *puber′tas*, deriv. of *puber*, mature, adult]: the period of life at which the exercise of the reproductive function becomes possible. In males of the human race it usually takes place between the ages of thirteen and sixteen, and in females somewhat earlier; and it appears that in very warm and very cold climates puberty is reached somewhat earlier than elsewhere. There are also cases of precocious development in this respect. The period of puberty is attended in males by a more complete development of the larynx, a deepening of the voice, the first appearance of the beard, etc. In the female the contour becomes rounded and more graceful, the catamenia appear, and the mammary glands are developed. There is no doubt that to those who are inclined toward constitutional disease this is a period of some danger, especially to the female. At this time, too, the mind and tastes are often rapidly developed.

Publicans [from Lat. *publica′nus*, pertaining to the public revenues, hence (masc. adj.) one who farms the public revenues, deriv. of *pub′licus*, public, deriv. of *po′pulus*, people]: in ancient Rome, tax-gatherers, farmers of the revenue, who, on the payment of a stipulated sum, obtained the privilege of levying taxes within certain districts of the Roman dominions. The extortion to which their avarice or the high price paid for the privilege often gave rise made these tax-gatherers a detested class, especially in the conquered provinces, as in Judæa, where the contempt felt for them by the Jews appears from many passages in the New Testament. The right to farm the revenues was sold at public auction for a period of five years. As the purchase became too expensive for a single person, societies of the nature of stock companies were formed, whose members contributed to the payment and received a proportional share of the revenues. After the middle of the second century B. C. the publicans belonged to the order of Equites.

F. M. COLBY.

Public Debt: See DEBT, PUBLIC.

Public Health: See HYGIENE.

Public Lands: See UNITED STATES.

Publil′ius Sy′rus: a Syrian slave, probably from Antioch, who attracted great attention in Rome in Cæsar's time as a writer of mimes. St. Jerome mentions a collection of moral sentences extracted from the writings of Publilius Syrus which was used in his time as a school-book in Rome. There exists a compilation of this description, *Publilii Syri mimi Sententiæ* (about 700 verses in all), edited by Wölfflin (Leipzig, 1869), A. Spengel (Berlin, 1874), W. Meyer (Leipzig, 1880), and O. Friedrich (Berlin, 1880). See W. Meyer, *Die Sammlungen der Spruchverse des Publilius* (Leipzig, 1877). Of the mimes themselves we have only two titles.

Revised by M. WARREN.

Puccoon, or **Indian Dye**: a general name applied in the U. S. to several dissimilar plants which yield a yellow or reddish juice, often utilized for dyestuffs. The best-known representatives are species of *Lithospermum* (*L. hirtum*, *L. canescens*, etc.), of the borage family. In many places the blood-root (*Sanguinaria canadensis*) of the POPPY FAMILY (*q. v.*) bears this name. *Hydrastis canadensis* (of the family *Ranunculaceæ*) is the yellow puccoon.

Pückler-Muskau, pük′ler-moos′kow, HERMANN LUDWIG HEINRICH, Prince of: author and landscape-gardener; b. on the family estate of Muskau, in Silesia, Oct. 30, 1785; studied law at Leipzig; served in the army during the wars against Napoleon; traveled much, and became widely known both for his enthusiasm for landscape-gardening and through his spirited traveling sketches. D. at Branitz, Feb. 4, 1871. Under his direction gardens were laid out at Muskau and at his usual residence, Branitz, in the Prussian province of Brandenburg; he also wrote *Andeutungen über Landschaftsgärtnerei* (1834). Of his traveling sketches several have been translated into English—*The Travels of a German Prince in England*, by Mrs. Sarah Austin (3 vols., 1832); *Tutti Frutti*, by Edmund Spencer (5 vols., 1834); *Mehemet Ali and Egypt* (3 vols., 1848).

Puddling: See IRON (*Manufacture*) and FURNACE.

Pudici′tia: the Roman personification of female purity, the virtue *par excellence* of womanhood, as bravery was that of manhood. From early times there was a temple to this goddess in the Forum Boarium, to which, however, only women of patrician families were admitted, though somewhat later a shrine to *Pudicitia plebeia* was established for women of plebeian origin. The cult seems to have fallen into neglect by the middle of the second century B. C.

G. L. H.

Pueb′la: an interior state of Mexico; between Tlascala, Hidalgo, Vera Cruz, Oajaca, Guerrero, Morelos, and Mexico. Area, 12,739 sq. miles. It is entirely included in the region of the plateau, most of the surface consisting of plains or rolling lands, with an average elevation of about 6,500 feet, but these are varied by groups of hills or mountains and, toward the S., by deep valleys. It is partly surrounded by the highest mountains in Mexico. The climate is temperate and healthful; the soil is generally fertile, and agriculture is the principal occupation, the most important crops be-

ing maize, agave (supplying pulque for the markets of Mexico city), and, in the valleys, sugar-cane and cotton; cattle and sheep raising are important industries in some districts. Deposits of silver, copper, and other metals, and coal are known, but are worked only on a small scale. The beautiful "Mexican onyx," a variety of alabaster, comes principally from this state, and many varieties of marble are quarried. The manufactures, especially of cotton and woolen goods and of pottery, are considerable. The state has many interesting antiquities. Pop. (census 1895) 979,723, of whom a large proportion are civilized Indians.

HERBERT H. SMITH.

Puebla (in full, *Puebla de Zaragoza*; formerly *Puebla de los Angeles*): capital of the state of Puebla: on the plateau, near the confines of Tlascala and the Malinche Mountain; 7,200 feet above the sea (see map of Mexico, ref. 7–H). It is clean and healthful, but, aside from the fine cathedral and churches, there are few pretentious buildings. Two parks and a large number of public squares add to the beauty of the place. It is noted for its manufactures of cotton and woolen cloths, etc., and for the onyx and marble quarries of the vicinity. It is connected by rail with Mexico, Vera Cruz, and Oaxaca, and has a thriving trade. The Indian element is largely represented in the population. Puebla was founded as a mission village by the celebrated Toribio in 1532. The U. S. troops under Scott had their headquarters here June–Aug., 1847. Later it was a noted center of the clerical party, and was twice besieged and taken by Comonfort 1856–57. The French, on their first advance, were repulsed from Puebla May 5, 1862, in a battle which is annually celebrated under the name Cinco de Mayo; they captured it in May, 1863. Pop. (1895) 91,917.

HERBERT H. SMITH.

Pueblo: city; county-seat of Pueblo co., Col.; on both sides of the Arkansas river, at the confluence of the Fontaine qui Bouille, and on the Atch., Top. and S. Fé, the Chi., Rock Is. and Pac., the Denver and Rio Grande, the M. Pac., and the Colorado Southern railways; 120 miles S. of Denver: elevation 4,660 feet above sea-level (for location, see map of Colorado, ref. 5–E). It is in an agricultural, mineral, and stock-raising region; has the largest iron and steel works between the Missouri river and the Pacific coast; and is noted for its extensive smelting works. It is easy of access from Leadville and other mining centers and from the great coal-deposits of Trinidad, Cañon City, and nearer fields. There are 3 smelters (the largest in the world), 5 great blast furnaces, numerous machine-shops, rolling, blooming, planing, and nail mills, iron and brass foundries, fire-brick works, lead-pipe works, brewery, large slaughtering-plant, oil-refinery, canning factory, artificial-ice factory, pipe-works, and many minor manufactories. Artesian wells in the city supply a wonderful mineral water. Within a radius of a few miles are thirty oil-wells. The Union Stock-yards occupy an extensive tract of land. The city has gas-works, Holly water-works, electric lights, electric street-railways, 39 churches, 16 public-school buildings, public-school property valued at over $800,000, a collegiate institute of the Methodist Episcopal Church South, 2 Roman Catholic schools, 8 hotels, public library, board of trade building, the Colorado Mineral Palace, a permanent structure for the exhibition of the mineral resources of the State, grounds and buildings of the State Agricultural Society, and the State Asylum for the Insane, together with 7 other hospitals and asylums. In 1900 there were 4 national banks with combined capital of $600,000, and 2 savings-banks with capital of $100,000, and 2 monthly, 3 daily, and 11 weekly periodicals. The assessed valuations of 1894 aggregated $9,877,134. Pop. (1880) 3,217; (1890) 24,558; (1900) 28,157. C. H. SMALL.

Pueblo (pweb'lō) **Indians**, or **Pueblos**: certain families of North American Indians. The term *pueblo*, meaning a town or village, as distinguished from a mere encampment or temporary settlement, was applied by the early Spanish explorers to the great terraced communal house-structures of the sedentary agricultural Indians of Mexico, New Mexico, and Arizona. Later it was adopted as the name of the inhabitants themselves rather than of their villages; hence the use here of the term to designate principally the sedentary town-building Indians of the arid region—or Aridians—of whatsoever stock or period.

Stocks or Families.—The Pueblos proper, who still maintain more or less perfectly their original modes of life, are all included in four linguistic families or stocks, representing twenty-eight tribal groups occupying as many villages in New Mexico, Arizona, Texas, and Chihuahua, in Mexico, detailed in the articles on the KERESAN, TAÑOAN, SHOSHONEAN (*Tusayan*), and ZUÑIAN INDIANS. As the special characteristics of each of these families are treated under the titles given, only those traits more or less common to all of them and to other extinct representatives of the Aridian phase of culture, such as the Mansos, who were probably Tañoan, will be described. See TAÑOAN INDIANS.

Physical Appearance.—Setting aside the changes which have been wrought on the Pueblos by various admixtures with other peoples during the last three centuries, they were, although representing distinct linguistic families, curiously similar to one another. All were originally a comparatively diminutive people, the men averaging not much more than 5 feet in height; the women were even shorter. As a rule, the men were dark or tawny, the women comparatively fair or olive. The men were spare, and rather sharp-featured, but mild of expression and intellectual in appearance. It is significant that while the Pueblos were strictly Indian in type, though more diminutive and refined, there was far greater individual variation among them than among the less advanced Indians. This variation was more pronounced among the Zuñian Indians and least so among the Tañoans, who led a less restricted life.

Dress.—Their wearing material was mostly woven of bark, yucca fiber, cotton or cottonwood down, fur, and feathers. The men wore cat-skin or rabbit-skin robes or pelisses of feather work, or else elaborately striped and embroidered mantles of cotton, gayly embroidered coats of the poncho variety, kilt-skirts tasseled and embroidered, held in place by long, broad cotton girdles, buckskin tights reaching above the knee, or else leggings of long strips of the same material wound round and round the leg, and fastened at the knee with beautifully woven garters or interbraided strands of colored cotton yarn; or, again, long crocheted stockings reaching high up the thighs. The feet were protected by sandals of plaited yucca, or more rarely by buskins or moccasins of buckskin with rawhide soles. The hair was banged to the eyebrows; two long side-locks depended from the temples, and the back hair was tied in a bunch with a plaited ribbon into which a bunch of brilliant feathers (preferably of the macaw) was stuck; a fillet of fiber, or plaited husks, dyed of the color symbolizing the quarter to which the wearer belonged, was bound about the crown. The costumes of priest-chiefs were far more elaborate, being symbolically varied. The warriors wore cone-shaped helmets of thick hide, or headgear made from the headskin of the puma, bear, horned antelope, or bison. They also wore cuirasses of skin, or of padded cotton and yucca, and carried round shields of basketry, of heavily and closely netted cotton, or of thick rawhide, symbolically painted. They carried short lances, javelins, and throwing-slats, long-bows, war-clubs, very broad flint or obsidian knives sheathed in pouches suspended from the belt in front, wood-hafted stone axes stuck through the left fold of the girdle, or else wooden swords edged with close-set blades of obsidian or other flinty material, and slings of skillfully braided yucca.

The costume of the women differed little. They wore a long *camisa* or sleeveless gown of cotton which reached below the knee. An embroidered mantle of cotton, a light head-shawl, leggings and sandals, or moccasins like those of the men, but uncolored, or, for house wear, thickly knitted stockings, completed the dress. The hair of the women was banged slightly in front, parted lengthwise over the middle of the head, and done up in two square knots back of the ears for matrons; in two round coils, "like pitcher handles" (as the early explorers describe them), over the ears for the unmarried women. They wore numerous ornaments, certain of them as amulets of maternity, and others, like those of the men—bracelets, finger-rings, and ear pendants.

Habitations.—Among the Eastern tribes the parallelogrammic form of house-clustering seems to have prevailed, while among the interior and Western tribes the polygonal or rounded village was more usual; but in all, the outer walls were usually built highest, the terraced stories of the town descending from them and looking inward on open courts and alleys. There were no doorways in the lower stories, but access was gained by means of very long-poled ladders, arranged like well-sweeps, so that they could be easily swung up at night for protection. The houses, particularly of the lower stories, were entered through scuttles in the roofs by means of step-logs or ladders. The windows below were mere portholes, while above they were larger and

sometimes well glazed with plates of selenite or mica. In the upper stories were both doors and windows. The cellular houses of these villages were divided, but slightly, into wards or septs corresponding to the number of tribal divisions, and again subdivided into sets of quarters, according to the number of clans in each division. These quarters were permanently occupied only by the women (to whom they belonged) and the children. The men of the tribe, both married and single, had as permanent quarters the large semi-subterranean kivas, of which there was one for every division of the tribe. Here all councils of the clan-clusters were held and ceremonials of the secret cult-societies belonging to them performed. Here also, especially in winter, the men assembled to labor at their looms, at weapon-making, and at minor arts. Here also they sought amusement, and here the "elders" taught the adult youth the lore and regulative usages of the particular division to which they belonged. Lawsuits or disputes between the clans were settled here, while the affairs of the tribal divisions were administered from the principal kiva of the town, usually that of the leading division. In this kiva also, all tribal affairs were conducted, and strangers from other tribes were entertained. Each household in the clan-quarters occupied three or more rooms, according to numbers—for the rooms were very small—and was presided over by the eldest matron. There were always a kitchen, a storeroom, and an eating and living room, in the latter of which the husbands came to meals with their families or visited their wives.

Occupations and Methods of Life.—The women cared for the families, prepared all food, made the pottery and basketry, and fashioned the stone-mills and other household utensils. The men were the principal weavers and spinners. They tilled the fields, raising their crops mainly by means of irrigation. The women had little truck-gardens close to the towns, where leeks, chile, or red peppers, and a few fragrant herbs were raised by hand-watering. The main meat-supply was gained by hunting, which was usually communal, and whole divisions joined in great round-ups of game, for which purpose enormous corrals were constructed. However, turkeys and other small animals were domesticated by some of the Pueblos. Land-tilling, the construction of irrigating-dams, ditches, and embankments, and all other operations conducted at a distance from the towns, were, like the hunts, communal undertakings, since the villagers, with their rich stores of food, were ever liable to predatory attacks from the neighboring nomadic tribes. This state of affairs reacted powerfully on their sociologic organization, forms of town-building, and methods of life. It also affected their intercourse with the outside world. Journeys of all descriptions were communal. This again had the effect of making the Pueblos of the interior essentially home-dwelling and extraordinarily conservative and exclusive.

Culture Characteristics.—All the Pueblo tribes were composed of clans, and descent was in the female line. These clans were families of kindred named after some animal, plant, mineral, or element. Some of the smaller tribes grouped these clans in two divisions—those of the North and South or of Summer and Winter; others had four clan-groups (those of North, West, South, and East, or of the Four Seasons), while the highly developed Pueblos had rarely fewer than six, usually (as with the Zuñians) seven groups—namely, those of the North, West, South, East, Upper, Lower, and Middle regions. The clans were grouped or related, according to the supposed analogies of their totems or namesakes (the animals, etc., from which they were named), to the various phenomena of the different regions. Thus the Puma, being fierce and loud-roaring, belonged in the north, whence came the fiercest winds and raging storms of winter; and as the Live-oak never withered in these storms, it too pertained to the north and winter; hence the clans of the Puma and the Live-oak, and others like them, belonged obviously to Winter and the North, and therefore belonged together. The Sun and the Eagle, dwellers in the skies, the Turquoise, a bit of the sky itself, were no less surely of the upper world than were the Rattlesnake and the Frog of the lower world.

Over each group of clans was a priest-chief, or "elder," the worshiper-in-chief, keeper of the medicines or powers and mysteries of the great animal-spirits and gods of the region or world-precinct which his division represented.

This priest-chief was also the oracle in all religious and secular matters in his "household." There were generally seven of these divisional priests or leaders of clan-groups, and rarely fewer than four. Among them were the "Peaceful Leader" and "Wrathful Leader," now popularly known as Governor or Alcalde, and Captain of War. These have their assistants, or *tenientes*, whose offices, like those of their superiors, are of Spanish adoption, and who are annually elected with the sanction of the supreme council of priest-chiefs or *caciques*.

The people were controlled not so much by the Peace and War Chiefs (to whom they were nevertheless obedient generally) as by the oracular and magical fathers behind them. These deserved the reverence and respect in which they were held as the "fathers and mothers" of the tribe, for they were the *penitentes* of their people, and had to labor at the sacred rites from season to season, to watch, fast, and repeat rituals, etc., days at a time on stated occasions. Therefore, under the auspices of the divisional societies, nearly all the great "customs" (such as the games, races, communal hunts, tillings, harvestings, and journeyings for wood) were annually performed for their benefit.

There were in every considerable tribe of Pueblo Indians from four to thirteen secret or tabu societies or priestly fraternities of the so-called "medicine-men" of popular tradition. These societies were systematically adjusted to the tribal sociologic organization. They pertained separately, according to their special functions, to the various regional clan-groups or divisions. Their members, with the divisional priest-caciques, were the keepers and teachers of the mythic lore and rituals, religious regulations, magic mysteries, and medicines or "potencies" of the divisions to which they belonged. Thus the name of *cult-societies*, as given them by Powell, is most appropriate. The societies of the North were wind and cold makers, and took precedence in winter; those of the South—fire-makers or masters of fire—had control in summer. Above all, the members of these cult-societies were doctors, or priest-doctors, each according to the region, season, element, and associated function of his particular society. Their practice of medicine and the application of remedies was, in theory, irrational, though strictly regulated and often both simple and surprisingly successful. The belief in the universality of disease and its spiritual or ghostly origin vastly enlarged the field of supposed usefulness and the power of these fraternal priest-doctors. Not only did they treat disease, but their more regular labors were directed toward its (spiritual) prevention.

Religion.—The religion of the Pueblos was a Nature-religion. Their gods (equally of both sexes) were animal gods, phenomenal gods, ancestral gods, and celestial gods. Supreme among the immortals was the God of the Sun-shield, the Creator of the All-makers, Water or Generation, personified in the Ocean-mother, the Sky-man, and the Earth-woman, whence all mortal things were born. Under the Sun-god were the God of Fate and his twin younger brother, the God of War; the God of Time or the Seasons, and his younger brother, the God of Dawn, etc. Apart from all was the Master of Life—son of the Sun-god and of Life, or the Great Waters. He was the Messiah of the Pueblos, who was supreme over the animal and phenomenal gods and the mediator between these mortal-like beings and the celestial or attribute gods, and was a personification of the reflection or image of the sun in the water, as the Goddess of Love, or of the Ocean, was the reflection of the Moon (Goddess of Menstruation or Maternity).

All of these gods were supposed to be related to one another as are men, creatures, and things in this world; their organization was like the sociologic organization of men. The heavenly or spiritual world was over, yet interpenetrated the visible world. As this world had a center or middle in the center of the Pueblo country, so the spiritual world had a center or middle over the Lagune of Shipapu (the hot springs of Colorado in the north of the Pueblo country), which was the place of umbilical connection between the parent spiritual world and the offspring mortal world. Thither, therefore, the rituals and offerings to the Master of Life, or Nether-sun God, were always addressed by the priests of the cult-societies.

Just as the Pueblo theory of medical practice was spiritual, so their theory of spiritual worship was largely medical. The ills of life and times were diseases to be remedied by charms and formulas and by rules of spiritual hygiene (observances and right behavior), or to be prevented by work, the business or industry of worship. In all this it was necessary to aid and be aided by the gods, and to this end, in token of sincerity, the priests abstained from meat and all other carnal things four days each month, and from eight to ten days at the summer and winter solstices, or for

longer or shorter periods whenever evil times demanded. At such times they labored day and night, making symbolic, plumed prayer-wands, as testimonials of constancy to be set up in shrines abroad as "prayers from season to season." These labors were accompanied by the repetition of traditional rituals and incantations of great length, and dramaturgic performances (the so-called *cachinas* or dances) before altars set up to symbolize one or another of the sacramental regions. Offerings of sacred prayer-meal were also made on various occasions; shell, coral, or turkois beads or other treasures were sacrificed as spirit-medicines or as payments or gifts of good will.

The people at large joined for a day in each month and four days semi-annually in these exercises of worship. In autumn the dead were remembered by all with offerings of the substance of food and other articles consumed or set free by fire, and at New Year or the "mid-time" (in November) the solemn festivals and dramaturgic celebrations of creation and of the "middle of the world" were held. The dancers of the *cachinas* were masked as animals or as demons (see Zuñian Indians), joining the priests in these representations of the re-creation of the world and the seasons.

Customs as to Marriage, Burial, etc.—The men of a clan could not marry the women of the same clan, and marriage was, therefore, almost as much an affair of the clans as of individuals, alliances taking place as much as possible outside of the clan-group as well as the clan (in order that diverse seasons and elements might be "wedded"). Until after betrothal, lovers wooed very indirectly; that is, a young man, in courting, would strive to attract the attention of his choice by general, not pointed, displays and actions. After betrothal the young man was accepted by the maternal relatives as a perpetual rather than temporary guest of their clan and of his wife. Thus divorce, of course, was chiefly in the hands of the women.

A midwife (usually a cult-priestess), the maternal grandmother or matron, and, if a priestess, the paternal grandmother, or in her place grandfather (called on the occasion "grandmother"), presided at birth. Immediately afterward birth-offerings were made by the paternal female relatives, and the child was laid, with many ceremonial observances, on a sand-heap, and an ear of "male corn" for a boy, or of "female corn" for a girl, was placed by the infant's right side. After nine days the child was presented to the Sun by the paternal elders, and formally adopted from them, and clan-named by the clanspeople of the mother, to whom thenceforward it belonged.

After death these observances were reversed. A jar of water was broken by the dead, who was thus renounced by the clanspeople of the mother to the clanspeople of the father. Presents of food and personal property were given, and the body was then washed and wrapped in blankets with sacred offerings and plumes. If the dead had been a clan or cult priest, he was buried under the ladders outside or inside of the house, the presents or offerings of the kin being burned; if not priestly, then the body of the dead (in order that the soul be facilitated in its escape from the flesh and from sorcerers) was burned with the offerings, thus being given back to the sun and earth.

Pristine History.—Originally, the Pueblos included representatives of several more stocks. In the south the Mansos, already mentioned, the Sumas, Janos, and Piman tribes belonged to them; in the west two or more Yuman tribes; others, the stocks of which are unknown, have been exterminated or absorbed principally by the Apache, Navajo, and Comanche within the last four centuries. But, howsoever diverse the stocks of the original Pueblo Indians may have been, they everywhere followed practically the same line of development, and proceeded so far toward becoming a distinctive people that the term Aridian has been adopted as best characterizing them. Evidence is complete that these Pueblo peoples were derived from numerous (probably small) tribes bordering the great arid region in an irregular semicircle from Central Utah and Colorado on the N. and Central Texas on the E. These tribes were driven southward into the deserts by stronger tribes from time to time, and were forced to live in limited areas near scant water-supplies, in widely sundered bands. As these bands increased, cultivation by means of a crude system of irrigation was necessitated. Thus the bands became fixed, and built more substantially earth-covered wooden huts: then, from scarcity of timber, larger and better houses of stone and mud were constructed, separate, yet in straggling groups around their watering-places and scattered fields. Then came their time of trial, which only the hardiest survived; tilling the soil and remaining fixed in habitation, they acquired food-stores and possessions which drew their enemies once more upon them, and forced them to flee to the cañon walls, where they became cliff and cave dwellers. The necessity of building on limited sheltered shelves of the rocks and of living in such crowded villages as the Cliff-dwellings (*q. v.*) developed at once the characteristic terraced and cellular type of architecture, and the divisions of quarters (for example, of the men from those of the women), etc., so peculiar to their pueblos of later times. Here they abode until they became too numerous for their footholds in the cliffs, and sought safety in numbers, climbing to the heights of their valley or cañon fields, and there building their many villages in one. Yet for a long time they still used their cliff-towns as farming villages, and often fled to them and built others like them when pressed by enemies. This was substantially the history of the development of the Pueblo Indian village life as found in the sixteenth century by the Spaniards.

The Zuñians were probably the first Pueblo peoples who, still living in the sixteenth century, had become fixed in the habit of *plain-dwelling* in segregated and definitely interrelated but not wholly autonomous communal villages. Nearly all of the Pueblos of other stocks were rapidly following their example at the time of the Conquest, as the Keresans had long done, and the Tusayan villagers had, although building the latest-made pueblos, most perfectly done.

Ruins.—Throughout the whole vast arid Southwest, from Central Nevada, Utah, Colorado, and Texas southward to and far beyond the boundary of Mexico, occur everywhere, except in the highest mountains, ruins which mark the presence and wanderings of the Pueblo peoples, and record vividly the stages of their slow development as communal villagers. Many hundreds of these ruins are buried under sand and drift, while others remain to be revealed only by accident. Of the conspicuous ruins, there are doubtless more than 3,000 in New Mexico, Arizona, and a small part of Utah and Colorado alone, and of smaller remains fourfold that number.

These ruins may be roughly classified, for convenience of reference, as lava-pueblos, small or single house pueblos, cliff-pueblos, communal pueblos, group-pueblos, and aggregate or city pueblos (towns), such as the Casas Grandes of Southern Arizona and Northern Mexico. An example of group-pueblos is furnished by the Seven Cities of Cibola, now in ruins, which were the original towns occupied by the Zuñis, the name being given by their Spanish discoverers in 1539–40. Some of these types are practically universal, and there are sections in which all are present; but the group-pueblos and city-pueblos occur only in comparatively limited areas. This variation in type and relative distribution represents the successive phases in development of a single or of similar peoples.

Population.—At the time of the Spanish conquest the Pueblo Indians numbered, all told, more than 30,000. That their numbers were not less is evidenced by the ruins of Pueblos which were recorded as occupied in the sixteenth century. The number of Pueblo towns in the U. S. now inhabited is only twenty-seven, an additional village (Senecú del Sur) being in Chihuahua. The total population of the modern towns is about 10,000. The Pueblo Indians, as a whole, are not materially diminishing in numbers.

Authorities.—See the works cited under Zuñian Indians; also Holmes and Jackson in Bulletin of the U. S. Geol. and Geog. Survey of the Territories, vol. ii. (1876); Wheeler Survey Report, vol. vii., *Archæology* (1879); Morgan, *Houses and House-life of the American Aborigines* (*Cont. N. A. Ethnology*, vol. iv.); and the annual reports of the Bureau of Ethnology. See also Cliff-dwellings, Indians of North America, Keresan Indians, Shoshonean Indians (*Tusayan*), Tañoan Indians, and Zuñian Indians.

Frank Hamilton Cushing.

Pueblo Largo: See Tañoan Indians.

Puerperal Fever [*puerperal* is from Lat. *puer'pera*, a lying-in woman; *puer*, child + *pa'rere*, give birth]: a continued fever, formerly supposed to be specific, appearing in puerperal women between the second and sixth days after delivery. The condition is initiated by a chill, followed by fever, uneasiness, nausea, abdominal tenderness or pain, diarrhœa, arrest of the lochial discharge, great prostration, and sometimes by delirium. Pneumonia, pleurisy, pericarditis, acute Bright's disease, and suppurative inflammation of the

PUERTO RICO

67° 30′ 67° Longitude West 66° 30′ from Greenwich 66° 65° 30′

19° 18° 30′ 18° 17° 30′ 18°

9° 30′ 10° 10° 30′ from Washington 11° 11° 30′

ATLANTIC OCEAN

Mona Passage

Cape Engaño OF SANTO DOMINGO

DASECHEO I.

MONITA I.

MONA I.

CARIBBEAN SEA

Isabela Quebradilla Camuy Hatillo Arecibo Barceloneta Manatí Vega Baja Vega Alta Dorado Toa Baja Palo Seco SAN JUAN Cangrejos Río Piedras Loiza Luquillo C. San Juan

Aguadilla Aguada Moca AGUADILLA Lares Rincon San Sebastian Anasco Anasco R. Mayaguez Mariano MAYAGUEZ Hormigueros Cabo Rojo San German Sabana Grande Pennelas Yauco Guanica Adjuntas PONCE Juana Diaz Coamo Aybonito Barranquitas SIERRA DE CAYEY Santa Isabel Guayama Salinas Arroyo Patillas C. de Mala Pascua

Arecibo R. Ciales Manatí Marovis ARECIBO Utuado Barros Comerío Cidra Aguas Buenas Guaynabo BAYAMON Toa Alta Trujillo Alto Carolina Río Grande Loíza Gurabo Juncos Caguas Piedras LUQUILLO MTS. Mt. Yunque Naguabo Ceiba Fajardo HUMACAO Humacao

PALOMINOS I. CULEBRA I. PINERO I. Bahia Honda Isabel Segunda VIEQUES OR CRAB I. Dane's Bay

VIRGIN IDS. ST. THOMAS I. Charlotte Amalie

Port of Guanica Guayanilla Port Guayanilla Ponce Port of Ponce CAJA DE MUERTOS I.

Yabucoa Maunabo

SAN JUAN and Harbor

One mile

CABRAS I. Morro Castle Fort Canuelo Bayamon R. Governor's Castle San Antonio Channel Port San Geronimo Fort Baqueron San Antonio Bridge Quarantine Ground Simona Entrance Miraflores B.

SCALE OF MILES

0 10 20 30 40

Railroads

Main Road

Cart Roads

joints may occur as complications. The disease runs a rapid course, usually terminating fatally within a week, the patient dying from exhaustion.

Puerperal fever is a septic disease that is always due either to infection from some micro-organism already existing in the woman's genital tract (auto-infection) that finds an ingress into the system through the tissues that are lacerated and bruised during labor, or (as is generally the case) to infection by the midwife or attendant, or to contact with infected bedding, clothing, or instruments (hetero-infection). In 1843 Dr. Oliver Wendell Holmes promulgated this latter theory in America, and in 1847 Semmelweis proclaimed the doctrine in Europe. It was not until bacteriologists had conclusively demonstrated to what septic infection was due that the foregoing idea was generally adopted. Now there is no obstetrician of any scientific attainments who would question the fact. There should be no deaths from puerperal fever in properly attended obstetrical cases, in which absolute cleanliness of the midwife's hands and of all things coming in contact with the patient are secured.

On the first symptoms the genital tract should be irrigated, at intervals of three to four hours, with from 3 to 4 quarts of a 1-per-cent. solution of table-salt in boiled water, to which may be added 2½ per cent. of creolin or carbolic acid, that is allowed to cool to a temperature of from 100°–105° F. If this dose does not reduce the fever in a short time, the physician may be certain that a portion of the after-birth is left within the uterus and is decomposing, and he should place the patient on an operating-table, and by means of a speculum expose the uterus and scrape its interior with a long wire scoop (curetting), following this by irrigation with a hot-salt and creolin solution. This, with a hot-water coil or hot-turpentine stupe to the abdomen, and iron, quinine, and brandy internally, comprises the necessary treatment. S. T. Armstrong.

Puerperal Insanity: perversion of the mind in women immediately after childbirth, although it may also occur before delivery, or weeks or months after labor, when excessive nursing has undermined the strength. It may therefore be considered as a derangement of the mind due to the influences of the childbirth upon the nervous system and emotional nature of the mother. Puerperal insanity may be characterized by mental agitation or excitability, or, reversely, the patient may sink into a state of mental apathy, moodiness, reticence, or despondency. There will be restlessness, inability to sleep, headache, impaired appetite, coated tongue—in some cases an increase of temperature. The bowels are usually constipated and the urine diminished in quantity. The secretion of milk is often lessened or suspended, and a sudden maniacal condition may follow immediately upon a cessation of the flow of milk. Although the delirium in some cases is violent, no evidence of inflammation or other organic disease of the brain or its membranes has been detected, on post-mortem examination, as the lesions to which the symptoms might be due. In the delirious form and in the melancholic form there is equally an aversion to the father or the child. Suicide and murder of the child are occasional occurrences. Puerperal insanity may be expected to occur in women of nervous temperament or those predisposed to insanity; in such also as are greatly reduced by previous ill health, by hæmorrhage during or following delivery, or whose blood has been impoverished. The maniacal form is apt to occur immediately after childbirth and in the young and more vigorous, whereas the melancholic type more often begins late during lactation, or in the old and debilitated, immediately after labor. The prognosis is favorable; the mind in most cases is, in time, restored to a normal condition. The patient may wholly escape it at subsequent childbirths if the system be fortified in advance by iron to correct anæmia, and care be taken to prevent unusual loss of blood during parturition. Where insanity or emotional excitability are family traits mania may recur with successive labors despite all precautionary efforts. The infant, in most cases, should be removed. Firm but gentle control of the patient is essential, and often removal from husband, family, and familiar friends is essential. Rest and sleep must be insured by cerebral sedatives and soporifics, and even the hypodermic injection of morphine may be required in obstinate insomnia and delirium. The strength must be sustained and the blood enriched by cod-liver oil, quinine, and iron.

Revised by W. Pepper.

Puerto Caballos: See Puerto Cortez.

Puerto Cabello, pwār′tō kăă-bāl′yō: principal port of the state of Carabobo, Venezuela; on a small peninsula, which, with a chain of small islands and reefs, forms a very secure and commodious harbor admitting the largest vessels (see map of South America, ref. 1–C). A railway runs inland to the copper region of La Luz. The trade of Carabobo, Lara, Zamora, and Los Andes centers here, and the port is the most important in Venezuela after La Guayra; the principal exports are coffee, cacao, dye-woods, hides, and copper ores. The port was strongly fortified in the eighteenth century, and repulsed the attack of a British fleet. During the war for independence it changed hands several times, and was the last stronghold taken from the Spaniards in 1823. Pop. (1891) 10,145. H. H. S.

Puerto Cortez′, or **Puerto Caballos**: a town and port of Honduras; on a bay of the Caribbean coast; 125 miles N. N. W. of Tegucigalpa (see map of Central America, ref. 3–G). The bay forms an excellent harbor, where the principal railway of Honduras terminates. The town, although small, is the principal northern port of Honduras. Hernando Cortés founded here (1525) the town of Natividad, subsequently abandoned for Omoa. H. H. S.

Puerto de Santa Maria, pwār′tō-dā-saan′tăă-măă-rec′ăă, or simply **El Puerto**: town; in the province of Cadiz, Spain; at the mouth of the Guadalete in the Bay of Cadiz; 22 miles by rail N. E. of Cadiz (see map of Spain, ref. 20–D). It is a handsome and well-built town, surrounded with fine promenades, and in communication with the great commercial centers, as it is the principal place for the exportation of sherry wine. Leather, soap, hats, brandy, and liqueurs are manufactured, and in May of each year an important bull-fight takes place here. Pop. (1887) 20,590.

Puerto Lamar: See Cobija.

Puer′to Prin′cipe: a town near the center of the island of Cuba; 45 miles by rail W. S. W. from its port of Nuevitas, on the northern coast (see map of West Indies, ref. 4–D). It is the third city of the island in size, is the center of a rich agricultural and grazing district, and exports sugar, hides, cattle, etc. It was originally founded in 1514 on the site of an Indian village near the coast, but was subsequently moved inland. Pop. with the district (1899) 53,140; of the city proper, 25,102. H. H. S.

Puerto Rico, pwār′tō rec′kō, or **Porto Rico**, pōr′tō ree′kō: the smallest island of the Great Antilles; separated from Santo Domingo on the W. by the Mona Passage, and having the Virgin islands on the E.; area, 3,530 sq. miles, and its dependencies, the small islands of Mona, Culebra, etc., aggregate 184 miles more. A low range of mountains, the Sierra Cayey, traverses it from E. to W., and numerous branches separate fertile and well-watered valleys; near the coasts there are equally fertile plains of considerable extent. The highest peak, Mt. Yunque, near the northeast end, is 3,688 feet above the sea. There are no volcanoes, and few severe earthquakes have been felt. The climate compares favorably with that of any other of the West Indies; foreigners easily become acclimated; the heat, even in the summer months, is seldom severe, and almost the only drawbacks are the hurricanes which sometimes blow between July and October. Nearly the whole surface is under cultivation, forest being restricted to a few mountain sides. The principal products are sugar, coffee, and tobacco for exportation, and maize, mainly for home consumption; the grazing industry is considerable, and hides are exported. There are no minerals of importance. Puerto Rico is one of the most thickly populated regions of the New World. In 1887 it had 807,708 inhabitants, or about 216 to the square mile; in 1899 the total population was estimated to be 957,000; the proportion of Negroes and mulattoes is less than in most of the other islands. With its dependencies it formed a province of Spain from 1870. The official chief was a governor chosen by the crown. Spanish is the common language, and nearly all the inhabitants are Roman Catholics; education is somewhat backward. The island was discovered by Columbus in 1493, and was conquered by the Spaniards under Ponce de Leon 1509–18. As a result of the war with Spain the U. S. demanded the cession of the island and assumed sovereignty over it and its dependencies Oct. 18, 1898. The war and the terrible hurricane of August, 1899, almost completely wrecked the commercial prosperity of the island. However, since the final settlement of the tariff relations, and through the able administration of Gov. Charles H. Allen, appointed Civil

Governor under the Act of Congress approved Apr. 12, 1900, commerce has increased rapidly. In the fiscal year ending June 30, 1900, the exports to the U. S. were valued at $3,078,648; the imports at $4,640,449.

Pueyrredon, pwā-ĕe-rā-dōn', Juan Martin: general and politician; b. at Buenos Ayres about 1780. He was chosen supreme director of the united provinces of La Plata July 9, 1816. His efficient support of San Martin resulted in the independence of Chili. He resigned in June, 1819. D. near Buenos Ayres about 1845.

Pufendorf, Samuel, Baron von: jurist and historian; b. near Chemnitz, Saxony, Jan. 8, 1632; son of a Lutheran clergyman; studied theology at Leipzig, public law at Jena, and in 1658, after a short residence and imprisonment in Denmark, published anonymously at Geneva *Elementa Jurisprudentiæ Universalis*; in 1661 became Professor of the Law of Nature and of Nations at Heidelberg; in 1667 published *De Statu Imperii Germanici*, denouncing the house of Austria and exposing the inherent weakness of the holy empire; in 1670 accepted the professorship of law at Lund, and in 1672 published *De Jure Naturæ et Gentium* (Of the Law of Nature and of Nations). Although in this work there is much that is commonplace, it marks an epoch in legal literature, being the first to give a systematic treatment to the subject-matter contained in it. He followed largely, but not servilely, the doctrines of Grotius, and supplemented them with his own ideas and with theories derived from the works of Hobbes, with whom he differed on many points. In 1677 he went to Stockholm as royal historiographer and remained there till 1688, when he entered the service of Frederick William, Elector of Brandenburg. He wrote a number of historical works on Swedish and Prussian affairs which in general are reliable, but are very tedious reading. D. in Berlin, Oct. 26, 1694.

F. Sturges Allen.

Puff-adder: a deadly serpent (*Clotho arietans*) of South Africa, deriving its popular name from its habit of puffing up the neck when irritated. It is very large and thick, and is ordinarily slow, but can move very quickly when angered. There is no known remedy for its bite.

Puff-balls: saprophytic plants of the family *Lycoperdaceæ* and order *Gasteromyceteæ*, in which the dust-like spores escape in a cloud when the ripe spore-fruit is suddenly compressed. They grow on the ground or on decaying stumps, logs, etc., and are abundant in all temperate and warm climates.

The proper plant of a puff-ball consists of a mass of white branching threads (often called the mycelium) which creep through the soil or decaying matter, gathering food and moisture for its nourishment. After a time there appear upon the plant at various points small rounded bodies, the young spore-fruits, consisting of compacted threads. These bodies grow rapidly, and eventually emerge from the ground. When young there is little differentiation in the tissues of the spore-fruits, but as they grow the outer layers become modified as a boundary tissue (*peridium*), more or less separable into an outer and an inner stratum, while the interior differentiates into (1) a sterile and (2) a spore-bearing portion (*gleba*), the former constituting the base or supporting part of the spore-fruit, while the latter fills the upper, usually enlarged part.

The spore-bearing tissue is penetrated by numerous narrow, tortuous passages lined with perpendicularly placed cells (the *basidia*), each of which produces several spores. The young basidia are smooth, but protrusions appear upon them later, grow out, become elongated, and finally form spores by enlargement at the distal end. Thus it follows that the tortuous passages above mentioned contain myriads of spores. When ripe these are set free by the deliquescence of most of the spore-bearing tissue and the evaporation of the surplus moisture. Certain thick-walled threads do not deliquesce, and are known collectively as the "capillitium." The peridium now breaks irregularly, or in some species more or less regularly, allowing the spores to escape and be carried away by the wind.

The more common puff-balls of North America may be arranged under several genera as follows:

1. *Geaster*, the earth-stars, in which the outer peridium splits stellately, becoming reflexed away from the thin persistent inner one. Of the sixty-eight known species, many have a wide distribution, while others appear to be restricted to particular regions. Thus *G. saccatus* (Fig. 1) occurs in North and South America, the East Indies, and Australia. *G. fimbriatus* is found throughout Europe, North and South America, the West Indies, South Africa, and

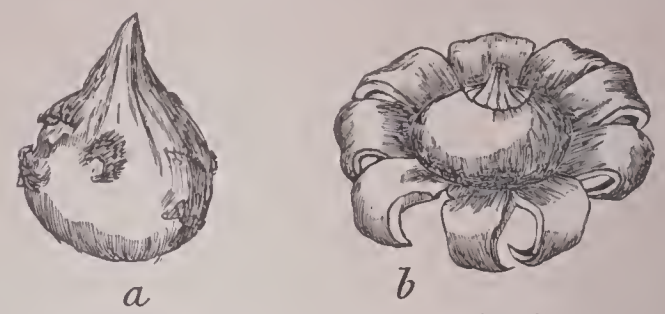


Fig. 1.—*Geaster saccatus*. *a*, before, and *b*, after the rupture of the outer peridium. Slightly reduced.

Australia. *G. hygrometricus* (Fig. 2) appears to be found in all parts of the world. The segments of its outer peridium

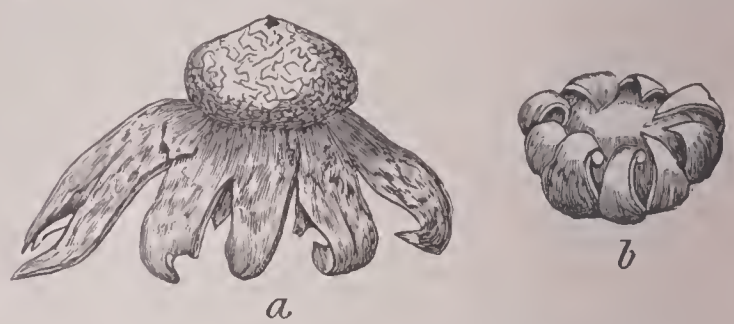


Fig. 2.—*Geaster hygrometricus*. *a*, when moist; *b*, when dry. Slightly reduced.

are strongly hygrometric, opening when moist, and becoming inflexed when dry. On account of some structural peculiarities, it is regarded by Morgan as the type of a separate genus, *Astræus*.

2. *Tylostoma*, the stalked puff-balls, in which at the maturity of the spore-fruit its sterile base rapidly elongates into a stalk. About twenty-five species of these curious plants are known. They occur in all parts of the world, especially in dry and sandy regions. One of the most widely distributed species is *T. mammosum* (Fig. 3, *a*), which occurs in Siberia, Europe, North America, and Australia. *T. fimbriatum*, another common species, occurs in Europe and Australia also. *T. campestre* (Fig. 3, *b*) and *T. meyenianum* (Fig. 3, *c*) are known only from the Rocky

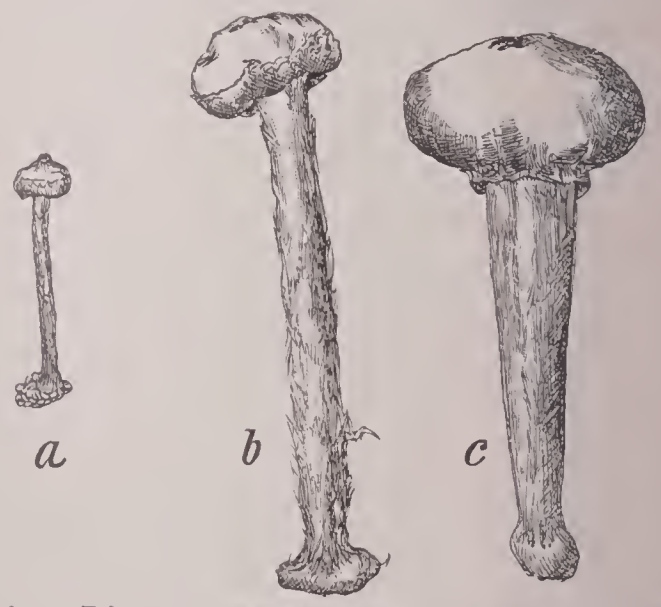


Fig. 3.—*a*, *Tylostoma mammosum*; *b*, *T. campestre*; *c*, *T. meyenianum*. All two-thirds natural size.

Mountains and adjacent regions, the latter ranging southward to Peru.

3. *Calvatia*, the big puff-balls, in which the spores escape by the irregular rupture of the peridium of the large spore-fruit, the gleba soon breaking up entirely. When young and perfectly fresh they are edible and nutritious.

One of the most common of the big puff-balls is *C. maxima*, which is globular or nearly so, white, and from 6 inches to a foot in diameter. Occasionally it attains an enormous size; one found in Ohio was 20 inches in diameter and weighed 17¾ lb. It is found in grassy fields in Europe, Asia, and North America. Another common species is *C. craniiformis* (Fig. 4), which is much like the preceding, but smaller, and with a more distinct sterile base.

4. *Lycoperdon*, the common puff-balls, in which the spores escape from the small spore-fruit by a regular mouth at the top.

More than 100 species are known in all parts of the world. Morgan describes thirty-one species found in North America, some of which are very pretty — e. g. *L. echinatum* (Fig. 5)—when young. *L. piriforme* is found in clusters on old logs and stumps, and is of a rich brown.

Fig. 4.—*Calvatia craniiformis*, reduced.

5. *Bovista*, the little puff-balls, in which the sterile base of the small spore-fruit is very small or wanting and the inner peridium thin and papery.

Among species indigenous to the U. S. are *B. nigrescens* and *B. plumbea*, common in pastures and meadows across the continent. *B. minor* (Fig. 6), from Ohio and Nebraska, is a good representative of the genus. Morgan has separated several species of *Bovista* and placed them in the new genus *Catastoma* because of the remarkable fact that the mouth by which the spores escape is below, as shown in Fig. 7. The outer peridium splits transversely, the lower part

Fig. 5.—*Lycoperdon echinatum*, slightly reduced.

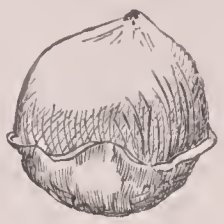


Fig. 6.—*Bovista minor*, about natural size.

adhering to the earth, while the remainder, with the attached inner peridium and its contents, blows away, thus scattering the spores.

6. *Mycenastrum*, the hard puff-balls, are similar to *Bovista*, but are of larger size and have a thick and hard inner peridium. *M. spinulosum* is 2 to 4 inches in diameter, and grows on sandy soil upon the prairies and Great Plains.

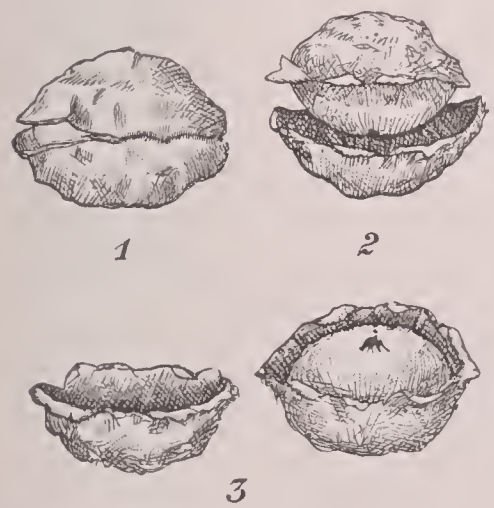


Fig. 7.—*Catastoma circumscissum*, slightly reduced.

The puff-balls are closely allied to three other families of fungi, and with them constitute the order *Gasteromycetæ*, known in a general way as the Puff-ball order. The four families may be briefly characterized as follows:

Hymenogastraceæ, the subterranean higher family.—Spore-fruit subterranean; gleba fleshy, persistent; peridium single, not separating. In many ways these fungi remind one of the subterranean sac-fungi (*Tuberoideæ*).

Lycoperdaceæ, the puff-balls.—Spore-fruit emerging from the ground; gleba spongy, deliquescing, and then powdery; peridium mostly double, separating regularly or irregularly.

Nidulariaceæ, the bird's-nest fungi.—Spore-fruit external, cup-shaped: gleba spongy, deliquescing, and leaving egg-like "peridiola." These small fungi are common on decaying wood.

Phalloideæ, the stink-horn fungi.—Spore-fruit at the surface of the ground; gleba fleshy, deliquescing into a fetid jelly, then emerging from the peridium by the elongation of the sterile base.

Literature.—P. A. Sacardo, *Sylloge Fungorum*, vol. vii. (1888); A. P. Morgan, *North American Fungi*, in *Journal of the Cincinnati Society of Natural History* (1889 to 1893); A. de Bary, *Comparative Morphology of the Fungi, Mycetozoa and Bacteria* (1887). Charles E. Bessey.

Puff-bird: any member of the *Bucconidæ*, a family of small birds having large heads and stout bills, peculiar to the tropical or warmer regions of America. They are mostly of dull plumage and equally dull disposition, sitting motionless for a long time with their feathers erected, looking as if they were puffed up, whence the popular name. F. A. L.

Puffer (in auctioning): See By-bidding.

Puffin: any bird of the auk family (*Alcidæ*, see Auk), belonging to the genera *Fratercula* and *Lunda*, which are characterized by high, compressed, highly colored bills. The best-known species is the common puffin, coulterneb, or sea-parrot (*Fratercula arctica*), found abundantly on both sides of the Atlantic. This bird is about a foot long, black above, white below, with a gray face and black collar about the neck. The bill is red with yellow and bluish markings, and is in great part shed and renewed annually, together with a little excrescence on either upper eyelid. In all, nine pieces are shed, leaving the bill of the adult in winter looking like that of a young bird. The Arctic puffin breeds

The puffin.

in burrows and lays a single white egg with a few faint gray markings at the large end. The nestlings are clad in thick down. A closely related species (*Fratercula corniculata*), known as the horned puffin, from the rather long outgrowth on the upper eyelids, occurs in the North Pacific, as does also the tufted puffin (*Lunda cirrhata*), a rather larger bird with a long tuft of yellowish feathers curving backward from above either eye. Puffins swim and dive well and fly rapidly though heavily. They feed on fish and go long distances to catch food for their young. The flesh of the various species is much used for food, and tastes much better than might be supposed from their fishy diet. F. A. Lucas.

Pug: a small, short-haired, short-muzzled breed of dogs, represented by at least three varieties, probably derived from the bulldog. The head should be massive, forehead wrinkled, eyes large and prominent, body short and wide, tail tightly curled. Color fawn with black muzzle and a dark spot on forehead, and dark line down the back. The pug is a stupid but good-natured dog. F. A. L.

Pugatcheff', Yemelyan: adventurer; b. in 1720 at Simoweisk, a village on the Don, in the territory of the Cossacks; grew up as a member of a band of robbers; served in the Seven Years' war, first in the Russian, then in the Prussian, and at last in the Austrian army, and was imprisoned for

some time after his return to Russia for attempts at sedition. In 1770 he went to Poland, and there joined the Raskolniks (*q. v.*). He resembled the murdered Emperor Peter III., and in 1773, after a rumor had been spread that Peter was not dead, Pugatcheff presented himself as the monarch, and was joined by a few other adventurers. The Raskolniks acknowledged him, and the peasantry rose in his favor; he occupied several forts on the Ural and Don; some Tartar and Finnish tribes joined him, and he was on his march to Moscow with a considerable army when he was sold by his comrades for 100,000 rubles to Suwarow. He was executed at Moscow Jan. 10, 1775.

Puget, pü'zhā', Pierre: painter, sculptor, and architect; b. at Château-Follet, near Marseilles, France, Oct. 31, 1622. At the age of fourteen he became the pupil of a wood-carver and builder of galleys named Romano. In 1639 he found his way to Florence, where he worked as a carver in wood, and then went to Rome, where he studied painting. In 1653 he returned to Marseilles, where he built a rich galley for the Queen of France, and then devoted himself to painting. In 1656 he finished the doorway and balcony of the hôtel de ville of Toulon, and later designed the new hôtel de ville at Marseilles. He was employed by Fouquet, the superintendent of the Treasury, and went to Genoa on Fouquet's business, where he remained after his patron's fall and designed palaces and produced important works in sculpture and painting. Colbert invited him to return to France and gave him employment at Toulon in the artistic decoration of Government ships, then an important branch of fine and decorative art. About 1670 he resigned this post, settled in Marseilles, and occupied himself in architectural and other art works there, and in Toulon and other cities. D. at Marseilles 1694. In the Louvre Museum one hall is named after Puget and contains his sculptures *Hercules Reposing*, *Perseus and Andromeda*, *Milo of Crotona*, and *Alexander and Diogenes*. In Marseilles is the important bas-relief, the *Plague at Milan*. W. J. Stillman.

Puget, pyu'jet, **Sound**: an arm of the Pacific Ocean; extending S. from the Straits of Juan de Fuca, in the State of Washington, and between the Coast Range of mountains on the E. and the Olympic Mountains on the W. It is perhaps the most beautiful sheet of water in the world; is about 100 miles long, has a coast-line of 1,600 miles, and an area of 2,000 sq. miles; has very many bays, coves, islands, channels, and inlets; is very deep even abreast of the shores, and forms of itself a magnificent harbor, though lacking in good anchorages on account of its depth. The tide varies from 9 feet at the N. to 15 in the narrow inlets at the extreme S. It formerly extended much farther S. (to the Willamette valley), and its regression has left a large area of low-lying, fertile land between it and the Columbia river. It has also a large area of tidal lands which can be reclaimed at small expense. Along its shores lie Seattle, Tacoma, and Olympia, with many other rapidly growing places. The shores were originally covered with forests of pines, firs, and cedars—the finest in the U. S. These have since been extensively felled, and lumber has formed the principal interest, but the timber resources are still very large. The neighboring country has fine agricultural resources and large supplies of coal and other minerals exist in the mountains. Settlement and development have proceeded with great rapidity. The entrance to the sound is dominated by the British naval establishment of Esquimault. The Olympic peninsula is but little explored. M. W. Harrington.

Pugin, pü'zhăń', Augustus: architectural draughtsman; b. in Normandy in 1762; is known by works illustrating mediæval architecture—*Architectural Antiquities of Normandy*, *Specimens of Gothic Architecture in England*, *Architectural Illustrations of the Buildings of London*, *Gothic Ornaments from Buildings in England and France*. These appeared during the years 1821–40, and were among the important aids to the new study of mediæval archæology. D. in England, Dec. 19, 1832.

Revised by Russell Sturgis.

Pu'gin, Augustus Northmore Welby: architect and architectural designer and draughtsman; b. in London, England, Mar. 1, 1812; son of Augustus Pugin, whose love for mediæval art he inherited. Having been converted to Roman Catholicism, he devoted himself with zeal to the revival of ecclesiastical architecture in England. His influence was great in fostering a taste for Gothic forms in architecture and ornament. He was a skillful etcher, and produced several works which he illustrated in this way. His principal works are *Contrasts, or a Parallel between the Architecture of the Fifteenth and Nineteenth Centuries*, *Examples of Gothic Architecture*, *Principles of Pointed or Christian Architecture*, *An Apology for the Revival of Gothic Architecture*, and *Glossary of Ecclesiastical Ornament*. D. at Ramsgate, Sept. 14, 1852.

Pugin, Edward Welby: architect; son of Augustus N. W. Pugin; b. in England, Mar. 11, 1834: at the age of seventeen undertook the completion of his father's designs and contracts; a devoted Roman Catholic, designed the cathedral at Queenstown; built more than 100 churches, besides orphanages, colleges, priories, etc.; restored the archiepiscopal palace at Mayfield; finished a superb Gothic structure begun by his father at Scarisbrook Hall. D. June 5, 1875.

Pugwash: a seaport in Cumberland co., Nova Scotia, on Northumberland Strait, 50 miles W. of Pictou (see map of Quebec, ref. 2–B). It has quarries of gypsum, limestone, and sandstone. Deals are largely shipped to Great Britain.

Pujet, Pierre: See Puget.

Pujunan Indians [*Pujunan* is from *Pusuna*, the name of a small band formerly near the mouth of American river, Sacramento co., Cal.]: a linguistic stock of Indians comprising the Maidu and Nishinam divisions, with their numerous sub-tribes, who occupied the eastern bank of the Sacramento in California, beginning some 80 or 100 miles from its mouth and extending northward to within a short distance of Pit river. Upon the E. they reached nearly to the border of the State.

Maidu (signifying man, Indian) is a collective name given to a large number of tribes or villages formerly occupying the territory between Deer creek, Lassen butte, and Honey Lake on the N., Cosumnes river on the S., the Sacramento, and in places points W. of the Sacramento, on the W., and the summit line of the Sierra Nevada on the E. The Maidu correspond to the usual type of the California Indian, being naturally peaceable, inoffensive, and indolent. They are described as extremely nomadic within a very limited area. The Maidu dialect is homogeneous.

The customs of the Nishinam, who live S. of the Maidu, differ considerably from those of the Maidu tribes, as also does their language. The tribal organization of the Maidu appears to be of an extremely loose character even for Indians. The tribal-village organization of the Nishinam answered to the tribal system of more advanced Indians, as is shown by the strictness obtaining with regard to the ownership of land. Their boundaries were defined with great precision by physical features, such as springs, hills, and valleys. They did not ordinarily destroy a member of another tribe for trespassing on their territory, but if he caught fish or game or gathered acorns on it they demanded reparation in kind.

Few representatives of the tribes survive, and these are scattered. See Stephen Powers, *Tribes of California* (*Cont. N. A. Ethnology*, iii., pp. 282–345, Washington, 1877); H. H. Bancroft, *History of California* (vols. i.–vii., San Francisco, 1884–90). See also Indians of North America.

F. W. Hodge.

Pukhtu: See Afghan Language and Literature.

Pulaski: town; capital of Giles co., Tenn.: on the Louisv. and Nashv. Railroad; 33 miles S. of Columbia, 81 miles S. by W. of Nashville (for location, see map of Tennessee, ref. 7–F). It is in an agricultural and stock-raising region, has flour and planing mills, and contains 2 national banks with combined capital of $120,000, a State bank with capital of $38,600, Martin Female College, and 2 weekly newspapers. Pop. (1880) 2,089; (1890) 2,274; (1900) 2,838.

Pulaski, Casimir, Count (called in Polish Kazimierz Pulawski): soldier; b. in Lithuania, Mar. 4, 1748; son of Count Joseph Pulaski, who in 1768 formed the Confederation of Bar for the preservation of the liberties of Poland; was educated for the law; saw some military service under Charles, Duke of Courland, and in 1769 joined his father and two brothers in the national struggle against the despotism of King Stanislaus Augustus. His father and brothers having perished in the war, Casimir was for some time commander of the insurgents, and made a bold attempt to seize the king in Warsaw. Being outlawed on the failure of this attempt, he escaped to Turkey 1772; participated in a war against Russia; proceeded to France in 1775, where he made the acquaintance of Franklin, and offered his services to the cause of American independence. Arriving at Philadelphia in the summer of 1777, he joined

the army as a volunteer; distinguished himself at the battle of Brandywine, and four days later (Sept. 15) was appointed by Congress brigadier-general, and given command of the cavalry. He took part in the battle of Germantown, and in Mar., 1778, having resigned his command, he formed at Valley Forge an independent corps of lighthorse and infantry called Pulaski's Legion, officered chiefly by foreigners. By a surprise at Little Egg Harbor, N. J., a large part of his infantry were bayoneted, but the legion was again recruited to 350 men. In Feb., 1779, he set out for the South; reached Charleston May 8; made a vigorous but unsuccessful attack upon the British advance guard May 11; accompanied Count d'Estaing to the siege of Savannah, where he was given the command of the French and American cavalry; was mortally wounded in the assault of Oct. 9; was carried on board the U. S. brig Wasp in Savannah, where he died Oct. 11, 1779. He was buried at sea. A monument to his memory was erected by the citizens of Savannah, and the corner-stone laid by La Fayette in 1825. See his *Life* in Sparks's *American Biography*, 2d series, vol. iv.

Pulci, pōōl'chĕe, Luigi: poet; b. in Florence, Italy, Aug. 15, 1432; d. Oct., 1484, probably at Padua. His was a poetic family, his two brothers, Luca and Bernardo, and the latter's wife, Antonia, having all made some name in letters. His relations with the Medici family were close, Cosimo and Piero showing him much favor, while his *Lettere a Lorenzo il Magnifico* (edited by S. Bongi, Lucca, 1886) imply considerable intimacy between the two men. His fame rests upon his *Il Morgante* (1st ed., 23 cantos, 1482), or, as it came to be called after the second and larger edition had appeared, *Il Morgante Maggiore* (28 cantos, Florence, 1483. See Italian Literature.) There is a translation of the poem by Byron. Besides this, Pulci left several lesser works, the most important, a so-called *Confessione*, satiric in character. See J. Hübscher, *Orlando, Die Vorlage zu Pulci's Morgante* (Marburg, 1886). Lucy A. Paton.

Pulkowa: village near St. Petersburg, Russia. Ten miles N. is the famous Nicholas Central Observatory (lat. 59° 46′ 18″ N., lon. 30° 19′ 40″ E.), founded by the Czar Nicholas (1838–39). The staff consists of a director and four astronomers besides assistants, etc. The *Pulkowa Observations* are published by the Academy of St. Petersburg. One of the largest telescopes in the world, a 30-inch refractor, was erected here in 1882.

Pullman, James Minton, D. D.: clergyman; b. Aug. 21, 1836, at Portland, Chautauqua co., N. Y.; graduated at St. Lawrence Divinity School in 1860; pastor of First Universalist parish of Troy, N. Y., same year; ordained in 1862; pastor of the Church of Our Saviour, New York city, from 1867 until early in 1885, when he became pastor of First Universalist Society of Lynn, Mass. He organized the Young Men's Universalist Association of the City of New York in 1869; was secretary of the General Convention of Universalists 1868–77; was chairman of the publication board of the New York State convention of Universalists, having in charge *The Christian Leader* 1869–73; received the degree of Doctor of Divinity from the St. Lawrence University in 1878; founded the Children's Country Week charity in 1882.

Pulmonaria: See Lungwort.

Pulmona'ta, or **Pulmonif'era** [*Pulmonifera* is from Lat. *pulmo*, lung + *ferre*, to bear]: an order of Gasteropod Mollusca in which gills are absent, the animal breathing air by means of a "lung" formed by the ramifications of the blood-vessels upon the surface of the mantle-cavity. It embraces the common snails and slugs, and all its members live either on the earth or in fresh water. Two sub-orders are recognized—the *Stylommatophora*, in which the eyes are placed upon the tips of the tentacles, and these last are capable of being retracted by an inversion like the pushing in of the finger of a glove; and the *Basommatophora*, in which the eyes are at the base of the non-retractile tentacles. Most prominent of the first group is the family *Helicidæ*, embracing the common snails, of which about 5,000 species have been described. Recent authors have divided the principal genus *Helix* into a large number of so-called genera, most of them being based upon totally inadequate characters. The snails are largely vegetarians, and where abundant may cause extensive ravages in gardens, vineyards, etc. The family *Limacidæ* embraces the slugs, in which the visceral hump has undergone degeneration, and the shell has been reduced to a small internal plate. Most of the fresh-water snails of the U. S. belong to the *Limnæidæ* of the sub-order *Basommatophora*. The *Onchidiidæ* embraces some amphibious forms living on the shores of tropical seas. In one species Semper has described numerous eyes scattered over the back, these eyes being formed like those of the Vertebrates. J. S. Kingsley.

Pulo-Kalamantin: See Borneo.

Pulque, pool'kā [the Aztec name]: the fermented juice of various species of *Agave*, but principally the maguey (*A. americana*), which grows wild and is also extensively cultivated on the table-lands of Mexico. (See Agave.) Mexicans consume such quantities that special pulque trains are run on the railways to supply the city markets. Some physicians recommend it for chlorosis and other diseases; others condemn it as unwholesome. Pulque was first made and used by the Aztecs. H. H. S.

Pulsatilla: See Anemone.

Pulse [M. Eng. *puls*, from Lat. *puls*, *pul'tis*, pottage of meal pulse, etc.]: a general name for such seeds of leguminous plants as are used for human food. All kinds of pulse abound in vegetable caseine, and all are highly nutritious; but as a rule they are not easy of digestion, and are best suited for hard-working men. Beans, peas, and lentils are the most important kinds of pulse.

Pulse [(with *-l-* restored from Lat.) < M. Eng. *pous*, via O. Fr. from Lat. *pul'sus*, pulse, liter., beating, deriv. of *pel'lere*, *pulsum*, strike, beat]: the result of the blood-wave sent through the arteries of the body by the ventricles of the heart. Each contraction of these ventricles sends into the arteries 2 to 4 oz. of blood, which entering vessels, already full but contracted, expands, elongates, and uplifts them, and produces a sudden lifting and impulse on the finger applied to them. This impulse is equal in all the arteries of equal size throughout the body, but the physician usually examines it on the thumb-side of the wrist (in the radial artery), because there the vessel is near the surface, resting on bone, and its varying movements can be best appreciated. The frequency of the pulse in a healthy adult, at rest, is 72 to 75 beats in a minute—in women a little more frequent than in men; more frequent while standing than while sitting, least frequent in the recumbent position. But a slow pulse is sometimes found in healthy, strong persons; 40 or 45 is not a very uncommon rate; Heberden and Fordyce have found it as low as 30 and 26, the latter in one instance no more than 20. At birth the normal frequency is 140; in youth, 90; and in old age, 70. Muscular exertion increases the number of heart-beats in a given time in proportion to its amount and duration. Certain mental states, as surprise, anger, or a sudden sense of danger, will produce great increase in its frequency. See Sphygmograph.

The pulse in disease sometimes becomes very frequent, and sometimes very slow. In inflammation of the membranes of the brain in children it has been often found, toward the termination, beating at the rate of 180 per minute for a day or more; it has sometimes reached 200. The condition known as tachycardia (see Heart Disease) not rarely occasions pulsations of 250 or 300 per minute. The latter number can not be easily counted at the wrist; 160 is often with difficulty made out; but the heart-beats can be appreciated by the ear at almost any rate of possible frequency, except in the mere flutter of some conditions of heart disease. In some states of disease of the brain, liver, and of the heart the pulsations are no more than 40, or even 30, in the minute. In the most marked cases of slowing the rate may be but 10 per minute.

The pulse may be small or full, rapid or slow, hard or soft, quick or prolonged; or it may be irregular in various ways, giving a varying number of beats in the different fractions of a minute, the beats tumultuous, frequent, and slow alternately, or sometimes double (*dicrotic*). It is often intermittent; that is, a single beat is lost. This occurs both with and without disease of the heart; it is often caused by the use of tobacco. In some states of imperfect innervation of the heart its pulsations cease entirely, to be resumed after the lapse of a considerable fraction of a minute. An instrument has been invented by which many conditions of the pulse can be inscribed on paper attached to a revolving cylinder. It is called a "sphygmograph." The study of the pulse by the finger or by the sphygmograph reveals to the physician, much more than the mere rapidity of the circulation, the existence of fever, and the like. Above all, he appreciates the condition of the arterial wall itself and the general state of the patient, as well as the probable condition of the heart.

Venous Pulse.—The arterial pulsation reaches the very

small arteries, but is lost in the capillaries, so that the blood returns to the heart in a continuous, steady stream; but when the tricuspid valve is insufficient, a wave of venous blood may be sent back into the venous trunks producing a visible pulsation, mostly in the veins of the neck. Such pulsations will correspond, as those in the arteries do, with the contractions of the ventricles (systole). Hypertrophy of the right auricle of the heart may also produce venous pulsations. So may aneurism of the aorta when it obstructs the current of blood descending through the vena cava, the enlarged artery communicating its pulsation to the blood in the vein. In some instances of difficult breathing the veins of the neck are seen to become distended in a sort of wave, apparently from below, but really from above, because the outlet is obstructed at the heart. This filling occurs in expiration, and the veins are emptied in inspiration. Though this action has been called pulse or pulsation, it is very different from the movement to which the term is commonly applied.

The Pulse in Animals.—Nysten (*Dictionnaire*, etc.) states that the arterial pulsations in the horse are from 32 to 38 in the minute; in the ass, from 45 to 48; in oxen and cows, 35 to 42; in sheep, 70 to 77; in the dog, 90 to 100. These countings were made when the animals were at rest.

Revised by W. Pepper.

Pulsometer: See Pump.

Pulteney, pŭlt'ni, William, Earl of Bath: statesman; b. in England in 1682; educated at Westminster School and at Christ Church, Oxford; entered Parliament as a Whig 1705; took part in the prosecution of Dr. Sacheverell; defended Walpole in the prosecution made in 1712; became, on the accession of George I., privy councilor and secretary of war 1714–17; refused a peerage but accepted an unimportant post under Walpole in 1723; went over to the opposition 1725, becoming the bitterest political enemy of his former friend, against whom he wrote several pamphlets; fought a duel with Lord Hervey, in which both combatants were wounded, 1731; became extremely popular as the leader of the general crusade against Walpole; associated with Pope and the wits of the day, who paid him extravagant compliments for his literary ability; was the real framer of the cabinet of 1742 on the downfall of Walpole, though the Earl of Wilmington was the ostensible head; was created at this time Earl of Bath; lost much political influence by his transference to the Upper House of Parliament, and was premier for two days in Feb., 1746, on the resignation of the Pelham ministry, but was unable to form a cabinet. D. in London, July 8, 1764. He was the author of many political pamphlets, and chief assistant of Bolingbroke in writing the journal *The Craftsman*.

Pu'lu, or **Vegetable Silk**: a richly beautiful fiber produced by tree-ferns of the genus *Cibotium*, growing in the Malay and other Pacific islands. The attempt to manufacture it has not proved successful. It is a very useful styptic, and is considerably used as such by Dutch surgeons.

Puma [= Peruv.]: the common name for *Felis concolor*, a large member of the cat family (*Felidæ*) inhabiting America; also known as panther, mountain lion, lion, tiger, and—in books at least—as cougar and catamount. It is of a general reddish gray, or tawny, above, whitish beneath, end of tail dusky, outside of ears and a spot on either side of the muzzle black. The young, two to five in number, are spotted. Next to the jaguar the puma is the largest cat of the New World, attaining a length of 8 feet and a weight of 200 lb., although individuals of this size are very rare. Few terrestrial mammals have a more extended north and south range. It is found from Patagonia to 60° N. lat., from Maine to California and throughout South America up to a height of 9,000 feet on the Andes. Naturally with such a range there are great variations in size, color, coat, and ferocity. The puma is ordinarily a cowardly animal, but when wounded or brought to bay it is dangerous. It is usually silent and the tales of its "blood-curdling scream" are mostly apocryphal. The creature feeds largely on deer, but smaller animals are eaten, even the Canada porcupine. In South America the aguti, capybara, and rhea are extensively preyed upon, and, when accessible, calves, sheep, and pigs. For a full account of the puma, with numerous references to literature on the subject, see *The Puma, or American Lion*, by F. W. True, Report U. S. Nat. Museum (1889), pp. 591.

F. A. Lucas.

Pumacag'ua, or **Pumacahua**, Mateo Garcia: Indian general; b. near Cuzco, Peru, 1758. He was the chief of a powerful mountain tribe under the Spanish viceroys, and received the military rank of brigadier for taking part in the suppression of the revolt of Tupac Amaru, 1781. In 1814 he headed at Cuzco the first serious rebellion against Spanish rule in Peru. For a time he was very successful; nearly all the southern districts supported him; he occupied Arequipa and had an army of 40,000, but his men were poorly disciplined and badly armed. He was eventually defeated by the Spanish general Ramirez at Umachiri, Mar. 10, 1815; Pumacagua escaped, but was captured soon after and hanged at Sicuani.

Herbert H. Smith.

Pumelo, or **Pomelo**: See Shaddock.

Pumice [Lat. *pumex*]: See Obsidian.

Pumice Foot: See Farriery.

Pump [a word appearing in various Europ. languages: Fr. *pompe*, Dutch, *pomp*, Germ. *pumpe*, but of uncertain source and history]: an hydraulic or pneumatic machine for elevating water or other liquids, or for forcing fluids through a pipe or passage. The height to which water is raised by a pump is called the "lift." Pumps sometimes act not by raising water, but by forcing it into a vessel against a pressure, as in the case of the feed-pumps of steam-boilers. Such pressure may, however, be always represented by a head of water. Pumps for operating on air (see Pneumatics) are known as air-pumps, air-compressors, blowers, etc. Pumps for raising viscous matters, as tar, paper-stock, the slip of potteries, etc., are very strongly built, have large valves and valve-chambers, and move slowly. The necessities of industry and science and the rivalry of inventors and manufacturers have given rise to innumerable varieties of this machine. The accompanying figures are examples of the types in most common use.

Fig. 1 shows the simplest form of pump. It is used for lifts of but a few feet, for draining shallow pits and bailing flat-bottomed boats. As it can be made by a carpenter in a few hours, it is frequently applied where there is but temporary need of a pump. It consists of a square wooden barrel, a foot-valve, *a*, and a piston, *b*. The foot-valve is a leather flap on a wooden seat; the flap has a leaden back to give it due stiffness and weight. The piston *b* is a leather cup attached to a wooden rod. On its downward stroke the water folds it together, and allows it to pass freely. In its upward movement the water distends or bags it out, causing it to press against the interior of the barrel, and making it tight. The water above the piston is simply lifted, while the water follows the piston and flows through the valve *a* in virtue of the atmospheric pressure.

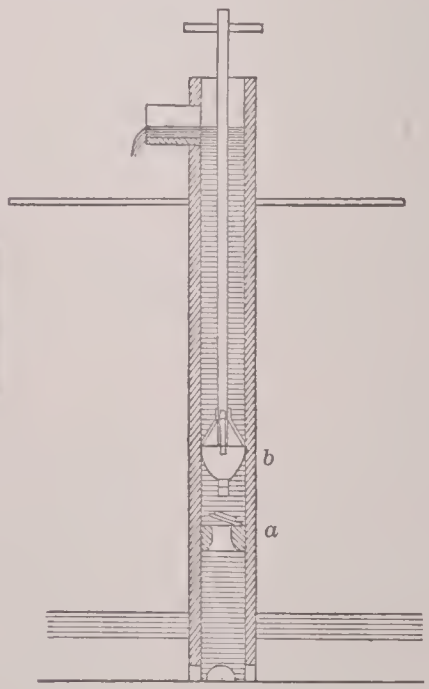


Fig. 1.

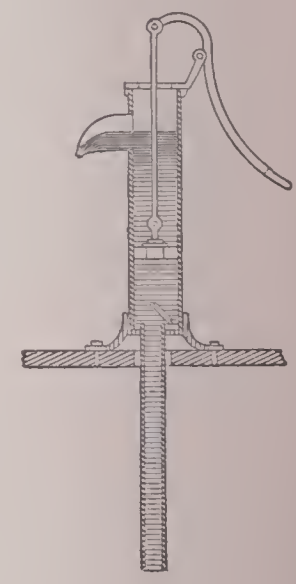


Fig. 2.

Fig. 2 shows an ordinary well or cistern pump. It is not different in principle from Fig. 1, but is arranged for more convenient working and adapted to a higher lift.

Fig. 3 represents a section of a force-pump much used for domestic purposes—as for filling a tank in the upper part of the house. Fig. 6 represents a general view of the same. The valves, the most important organs of the pump, are fully shown here and in Figs. 4 and 5. Fig. 4

represents the valve *m* or *k*, the outer ring of which serves as the joint-packing. The inner circle is the valve or flap. The neck between the two is the hinge. A backing of lead gives weight and stiffness to the flap. The piston-rod passes through a stuffing-box P in the cover *q*, and is moved by a handle, as shown in Fig. 6. The action of

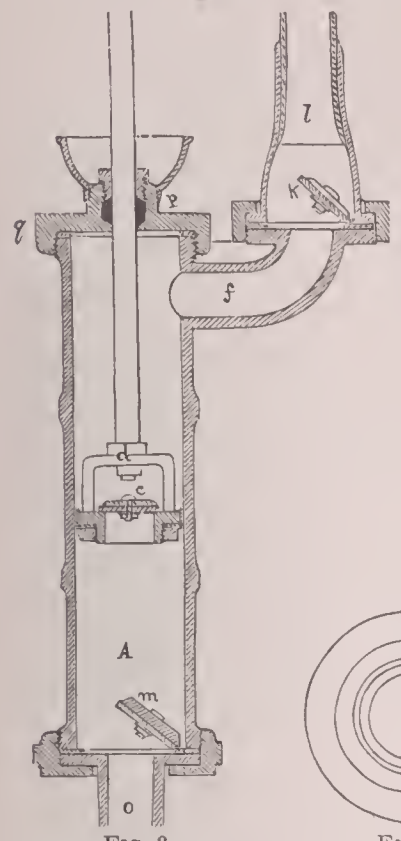


Fig. 3.

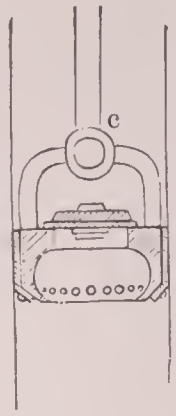


Fig. 5.

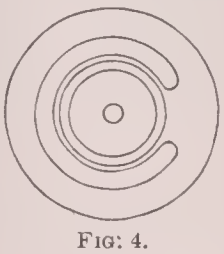


Fig. 4.

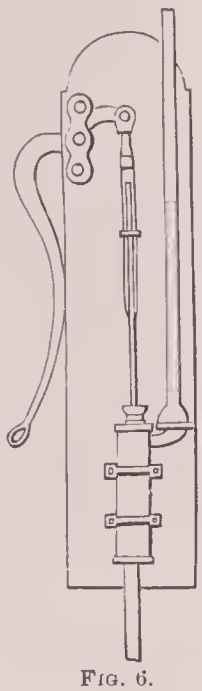


Fig. 6.

the pump is readily understood. During the downward movement of the piston the valves *m* and *k* close, preventing the backward movement of the water. The pressure of the water raises the valve *c* in the piston, and allows the water to pass through the piston as it descends. During the upward movement of the piston the valve *c* is closed. The water above the piston is forced through the branch *f*, raising the valve *k* and passing into the ascending pipe *l*. The atmospheric pressure forces the water through the supply-pipe *o* into the pump-barrel A, raising the valve *m*. This pump differs from the ordinary domestic pump only in delivering the water above the pump. If the cover *q* and the branch *f* were removed, it would be the ordinary suction-pump discharging at *f*. The valve *k* is inserted to relieve the stuffing-box and prevent leakage. It is manifest that the pump would work perfectly well if this valve were removed. The piston of the ordinary suction-pump is more commonly made as shown in Fig. 5. It has a joint at *c*, as the piston-rod does not move in a straight line. The leather packing is also differently applied from that shown at *d*, Fig. 3.

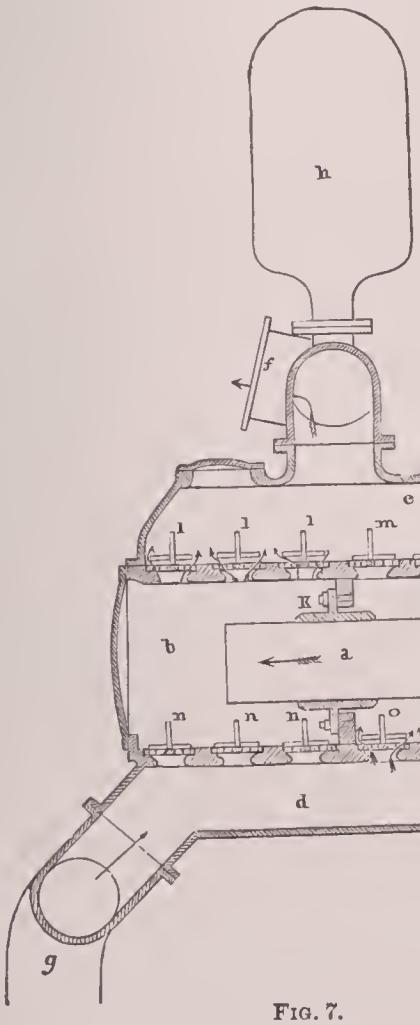


Fig. 7.

It will be noticed that the pumps shown in Figs. 1 and 3 are *single-acting*. They furnish a stream only during the ascent of the piston. Fig. 7 represents a double-acting pump driven by a powerful steam-engine. The plunger *a* moves horizontally through water-tight packing. It is supposed, in the drawing, to be moving as indicated by the arrow. In so doing it diminishes the water-space in the chamber *b*, forcing the water through the valves *l l l* into the chamber *e* communicating with the force-main *f*. At the same time it tends to create a vacuum in the chamber *c*, which tendency causes the water to rise from the pump-well through the pipe *g* and chamber *d*, lifting the valves *o o o* and entering the chamber *c*. During the return stroke the water enters the chamber *b* through the valves *n n n*, and passes from *c* to *e* through the valves *m m m*, the valves *l l l*, *o o o* remaining closed. This is called a *double-acting* pump, because it discharges an unintermittent stream. *h* is an air-chamber communicating with the force-main. This is an appendage usually applied to powerful pumps, especially those which force the water through a considerable length of pipe. Its object is to diminish the shocks due to the sudden starting of a long column of water. Figs. 8 and 9 show the valves of this pump:

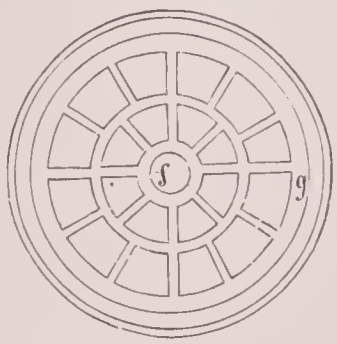


Fig. 8.

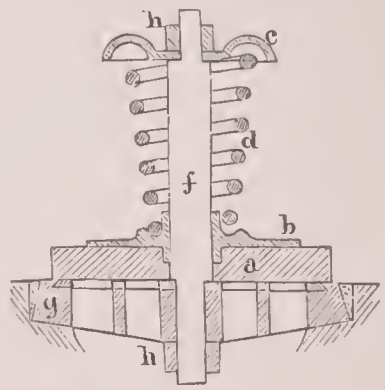


Fig. 9.

g is the valve-seat, of iron with a brass face. It is leaded into a recess in the plate; *a* is the valve, of rubber; *f*, a spindle on which the valve slides in rising and falling; *b*, a plate forming a socket for the valve and a bearing for the spring; *d*, a spiral spring of brass wire; *c*, cap; *h h*, nuts. Each pump has twenty-four valves, there being two rows, only one of which appears in the drawing. This pump is designed to be operated by a "direct-acting" steam-engine, the piston of the engine and plunger of the pump being attached to opposite ends of the same rod. This arrangement of valves is used in the Worthington steam-pump.

Atmospheric pressure plays an important part in the action of pumps. The normal pressure of the atmosphere is 14·7 lb. per square inch, which is equivalent to that of a column of water 34 feet high. The pipe *o*, Fig. 2, being supposed to descend into the water of a well, if the fixed valve is 34 feet or more above the surface of the water, the water can not be raised. Practically the limit of suction is materially less than this. Thirty-four feet implies a perfect vacuum over the column of water, which can not be secured with ordinary pump-valves. Moreover, when the air is entirely removed from the suction-pipe the latter is filled with vapor of water which can not be exhausted, being produced as fast as the pump can withdraw it. The pressure of this vapor is very slight in cold water and increases with the temperature.

The limit of suction at		32°	F. is	33·80	feet.
"	"	60°	"	33·42	"
"	"	90°	"	32·39	"
"	"	120°	"	30·10	"
"	"	150°	"	25·41	"
"	"	180°	"	16·58	"
"	"	212°	"	0·	"

That is to say, water at 212° can not be raised at all by suction, the suction-pipe being constantly filled with vapor of the same tension as the atmosphere.

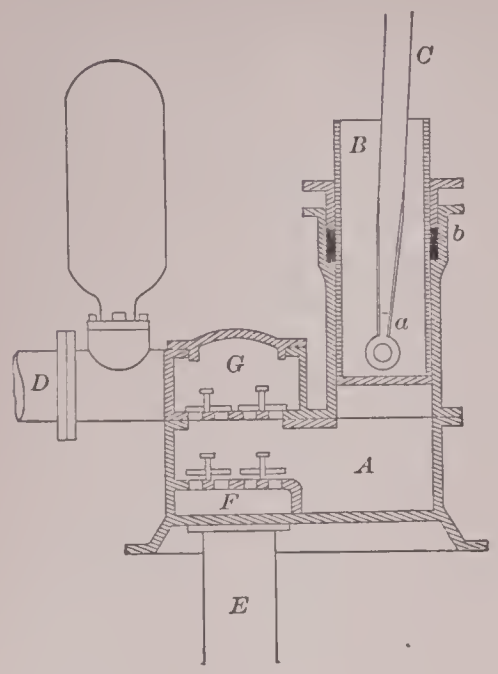


Fig. 10.

Fig. 10 shows a form of pump much used in mills. It is driven by a crank movement. The plunger B is a hollow barrel or bucket open at the top. The connecting-rod or pitman C is jointed near the bottom of the barrel. This barrel moves in an exterior cylinder with a stuffing-box *b*, and requires no other guide in its motion. The opening of the cylinder admits the necessary lateral movement or "play" in the pitman consequent upon the rotation of the crank.

This pump, it will be perceived, is single-acting. The raising of the barrel B causes the lower valves to open, and draws water through the supply-pipe E. The down stroke raises the upper valves, and forces water through the discharge-pipe D. Such pumps are more commonly arranged in groups of three, all driven from the same shaft, the cranks making an angle of 120° with each other. In this case the chambers F and G are common to all the barrels, but each barrel must have a separate chamber A with its set of valves. Arranged in this manner it is a continuous-acting pump, giving a constant stream through the pipes E and D.

This pump, with a single barrel, is well suited to be worked by a windmill, especially when it can be so placed that the suction is one-half the lift, so that the crank exerts the same pressure on the up stroke as on the down stroke. Where the suction is but a small part of the lift the inequality is too great, causing shocks which are injurious. In that case it is better to use two barrels, uniting them by a beam so that one rises as the other falls.

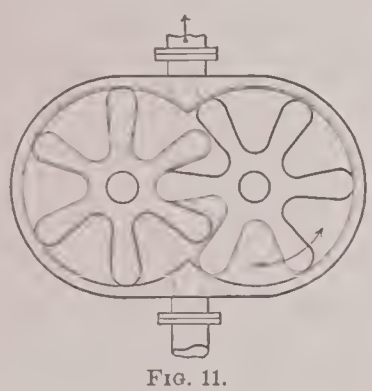


Fig. 11.

Fig. 11 is the typical form of the modern rotary pump. It consists of two gear-wheels with very large and long teeth, very closely fitting each other and the case in which they revolve. They revolve as indicated by the arrow. The water is carried around in the spaces between the teeth. The close meshing of the teeth prevents its return between the gears, and it is forced through the discharge-pipe, entering the case through the supply-pipe under the action of atmospheric pressure. No valves are necessary with this pump, though a valve in the suction-pipe is convenient to prevent the pump from running down.

An engine specially designed for driving a pump, the engine and pump being inseparable, is called a pumping-engine or steam-pump. In the simplest form of pumping-engine the piston or plunger of the pump and the piston of the engine are on opposite ends of the same rod. This is the form contemplated in Fig. 7, in which the rod of the plunger *a* passes through a stuffing-box in the water-cylinder and enters the steam-cylinder through another stuffing-box. This is a cheap and serviceable form of pumping-engine, but it does not use steam in the most economical manner, being ill adapted for expansive working. With two cylinders, one drawing direct from the boiler and exhausting into the other at a lower pressure, it can make some use of the expansive action of the steam. An engine driving a pump through the intervention of a heavy fly-wheel can make full use of the expansive power of steam, and works most economically. Fly-wheel engines are used for pumping where economy of working is more important than economy of first cost. The Cornish pumping-engine, used mainly for draining deep mines, differs from both the above types. The steam acts only to raise the piston with its attachment of heavy rods reaching down into the mine. These descend by their own weight.

Besides the Archimedes's Screw and the Hydraulic Ram (*qq. v.*) there are many devices in use for raising water which can not be classed as pumps, or are more properly described under other headings, as:

The *Noria.*—A water-wheel carrying a series of vessels at its periphery, which fill at its lowest position and discharge at its highest.

The *Chain Pump.*—A series of disks linked together, which being drawn rapidly through a close-fitting pipe draw the water with them.

The *pulsometer*, in which the pressure of steam acts directly on the surface of water in a closed chamber, forcing the water through a pipe to a higher level; then the steam condenses and refills the chamber by suction.

The *jet pump and injector*, in which a jet of water or steam discharged through the center of a pipe draws the surrounding water with it. If an open vertical pipe be two-thirds or three-fourths immersed in water, and air be injected at its lower end, the water will rise and flow from the top in a continuous stream, as long as the supply of air is kept up.

The *centrifugal pump*, in which the centrifugal force developed in a revolving mass of water raises it to a higher level.

This machine is much used in hydraulic constructions requiring the temporary removal of large volumes of water. The water is caused to revolve with great velocity in a circular chamber. The tendency which water, in common with all heavy bodies, has to move in a straight line causes a pressure upon the circumference of the chamber sufficient to make the water rise to a greater or less height, depending on the velocity. The simplest, most efficient, and most reliable form of the centrifugal pump is the one indicated by Fig. 15. It is placed at the lowest point of the pit to be drained, and being once put in position, can not be readily changed. The water receives a rotary movement from arms attached to a vertical shaft within the case. It enters the pump at the center and rises through a pipe at the circumference. The shaft is driven by a steam-engine by means of a belt and pulley at the top. This form of pump requires no valves and is not readily deranged. The height to which the water will rise is theoretically the height from which a body must fall in a vacuum to attain the same velocity as that with which the periphery revolves.

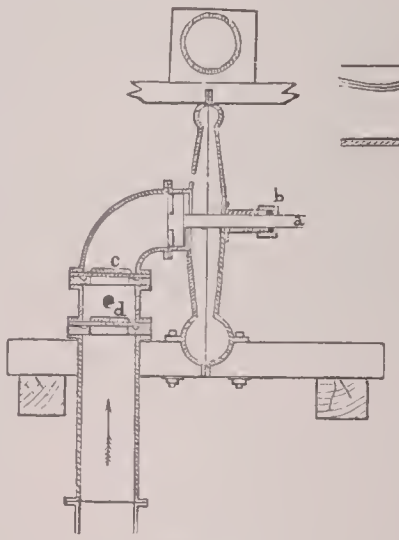


Fig. 12.

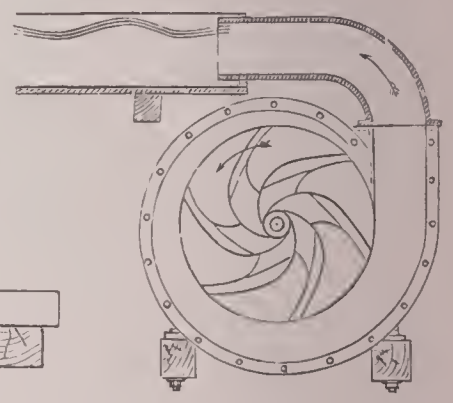


Fig. 13.

It is not always convenient, however, to place the pump at the lowest point of the pit. Some excavations require pumping before reaching the lowest point. Some also require frequent changes of the position of the pump. For such cases a pump has been devised which can be placed at the top of the lift, raising the water by suction. Figs. 12, 13, and 14 show such a pump in detail. The cylindrical shell is made in two halves. Fig. 13 shows one half with the arms. Fig. 12 is a vertical section showing the valves. *a* is the driving-shaft passing through a stuffing-box, *b*, and carrying the arms, which are not shown in the section. The shaft carries a pulley through which it receives motion from a portable steam-engine; *c d* are the valves. They are made

of thick rubber, cut out as shown at Fig. 4, serving as joint packing as well as valves. Fig. 14 is an auxiliary hand-pump attached outside the suction-pipe between the valves, for the purpose of filling the latter and the pump before

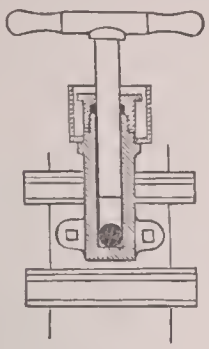


Fig. 14.

starting. It is a single-acting plunger-pump. When the plunger rises, the valve *d* (Fig. 12) is lifted, admitting air or water into the space between the valves. When the plunger falls, *c* rises, etc. This small pump is called the primer. While the pump is in operation the water flows continuously through the valves. These are not essential to the action of the pump while running, but only necessary in filling it and preventing it from emptying when it stops. The length of the suction-pipe is increased as the excavation progresses. This pump is of course subject to the same restriction as all suction-pumps. Its lift can not exceed the height due to the pressure of the atmosphere. In fact it can not work efficiently with more than three-fourths of that lift. The most powerful existing pumping plant is the system of centrifugal pumps built by J. & H. Gwynne, of Hammersmith, England, for draining the Ferrara marshes in Italy. It is said to be capable of raising to a height of 12 feet 2,000 tons of water per minute, being equivalent to a river 100 feet wide and 4 feet deep flowing with a velocity of about 13 miles per hour. The Appold centrifugal pumps have found many applications of this kind, and are much used for emptying dry-docks and for raising the level of water in the great commercial docks of European harbors. For air-pumps, see Pneumatics.

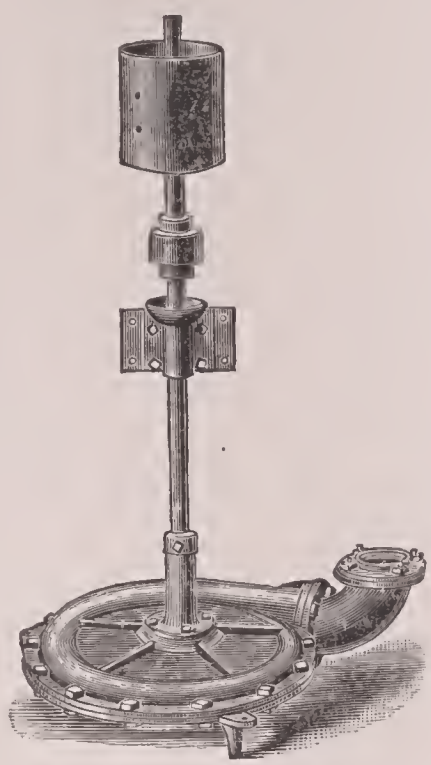


Fig. 15.—Centrifugal pump.

J. P. Frizell.

Pumpel'ly, Raphael, M. N. A. S.: geologist; b. at Owego, Tioga co., N. Y., Sept. 8, 1837; educated at Paris, Hanover, and Freiberg, Saxony, 1854–60; was engaged in mining operations in Arizona 1860–61; was employed by the Government of Japan to explore the island of Yezo 1861–63; by the Government of China to report upon the coal-supply of that empire 1863–64; returned to the U. S. overland through Mongolia, Siberia, and Russia; became Professor of Mining Engineering at Harvard 1866; made a survey of the copper region of the upper peninsula of Michigan 1870–71; was State geologist of Missouri 1871–73; geologist in charge of the Archæan division of the U. S. Geological Survey 1879–92; and vice-president of the international congress of geologists, Washington, 1891. He is the author of numerous articles in scientific journals; of *Geological Researches in China, Mongolia, and Japan* (Washington, 1867); *Across America and Asia* (New York, 1870); of volumes of the *Geological Survey* of Michigan (1873) and of Missouri (1873), each accompanied by an atlas; and vol. xv. of the census reports on *The Mining Industries of the United States* (Washington, 1886).

Pumpkin [dimin. of earlier *pompion*, pumpkin, from O. Fr. *pompon*, for earlier *pepon* < Lat. *pe'po* = Gr. *πέπων*, a kind of melon]: any plant of the genus *Cucurbita*, of the family *Cucurbitaceæ*. There are three species of this genus in common cultivation: *Cucurbita pepo*, with lobed leaves and rough, almost prickly stems and leaf-stalks, a strongly angled fruit-stem, and widely flaring flower with erect and pointed lobes; *C. moschata*, with leaves usually less lobed, grayish pubescent stems and leaf-stalks, fruit-stalks ridged, enlarged next the fruit, and flower much like that of the last, but the lobes broader and the calyx often leafy; *C. maxima*, with rounded large leaves, stems and leaf-stalks not rough and only minutely, if at all, pubescent, the fruit-stalk cylindrical and spongy, and the flower-tubes nearly cylindrical or gibbous, the lobes obtuse and drooping. These species are probably native to the New World. The first one (*C. pepo*) is the pumpkin of North America—the one which is grown in corn-fields and which produces the great reddish fruits commonly used for making pies and also as food for stock. This species is immensely variable. In some forms it is scarcely running. The summer or warty crookneck squashes and the bush scallop and patty-pan squashes are of this species, and here belong, also, the common inedible, ornamental gourds, as this term is understood in the U. S. The second species (*C. moschata*) is the parent of the large, striped winter or Canada crookneck squashes, and the Cushaw pumpkins or squashes. To the third species (*C. maxima*) belong the turban and the true winter squashes, like the Hubbard, Marblehead, Essex, Boston Marrow, etc. The larger type of fruits of this species are known as pumpkins in Europe, while they are called squashes in the U. S. In Great Britain the word gourd is used generically for all three species. It is a common notion that the different species will cross-fertilize when planted near together in the field; but it is now known that the varieties belonging to different species do not cross, with very rare exceptions. There are no crosses or hybrids of *C. pepo* and *C. maxima*, nor of *C. maxima* and *C. moschata*, but *C. pepo* and *C. moschata* can probably be induced to cross, although it is doubtful if spontaneous mixing often occurs.

L. H. Bailey.

Pun [perhaps from the local English *pun*, pound, and the Anglo-Saxon *punian*, bruise]: a kind of play upon words, in which a word is capable of being understood in two or more quite different senses, the combination of which, or the mental change from one to the other, presents an odd idea, generally a ludicrous one. Punning is usually considered the lowest species of wit, being in general purely mechanical in character, and not, like the higher forms of wit, justifying itself by presenting an idea in some new and unexpected form. Not unfrequently the point of a pun lies in the juxtaposition of two or more words similar or identical in sound, but different in spelling and signification, like the Latin *amantes sunt amentes*. The wit in a pun is not unfrequently polyglot—that is, a phrase of one language is used which in sound or spelling closely resembles a phrase in another language, but which has a wholly different meaning. The figure of speech called *paronomasia* by writers on rhetoric, and defined by them as "the use of words in the same connection which are similar in sound, but dissimilar in sense," is simply punning. This was a favorite form of expression among the Hebrews, and the books of the Old Testament, in the original, abound in examples of it, although it is of course usually lost in translating, and thus the precise point of many passages is necessarily missed in our version, unless the paronomasia is pointed out in a note.

Revised by A. R. Marsh.

Pu'na or **Despobla'do**: in Peru and Bolivia any very high, arid, and uninhabitable table-land; synonymous with *páramo*, used in Colombia. In a special sense, a high plain between two subchains of the Cordillera, extending from about lat. 13° S. southward into Bolivia. It consists of flat or rolling, generally stony or sandy lands, from 14,000 to 16,000 feet above sea-level, narrow northward but widening southward to 150 miles or more.

H. H. S.

Puna: a city of India; same as Poona (*q. v.*).

Punch, Punch and Judy, or **Punchinello** [Ital. *pulcinella* or *policinella*; Fr. *polichinelle*]: a kind of puppet-show frequently exhibited in the streets of European cities, especially of Italy. Its origin has been obscurely traced to the Atellan farces of ancient Rome, but in its present popular form the drama is ascribed to Silvio Fiorillo, an Italian playwright who flourished about 1600. The actors in the performance are wooden puppets, of whom the principal are Punchinello (in English Mr. Punch), his wife (called in English Mrs. Judy), and their dog Toby. The puppets are moved by the exhibitor, who puts his hands under the dress, making the second finger and thumb serve for the arms, while the forefinger works the head; he also supplies a comic dialogue, varying his voice to suit the different characters. As usually represented, Mr. Punch is a stout personage with protruding paunch, thin legs, hooked nose, and a chin which turns up so as almost to meet the point of the nose; Mrs. Judy is a thin, shrewish dame, grotesquely attired; and

the dog Toby, who is the embodiment of cunning, and usually wears a hat, plays an important part in the action. The play is a domestic tragi-comedy, in which Mr. Punch is greatly berated by his wife, and finally comes to grief. The French sometimes employ a cat instead of the dog Toby. Various explanations have been given of the origin of the name. The most probable supposition is that it is a diminutive of the Italian *pulcino*, a chicken, applied to a little child, and hence a puppet; but some suppose that it comes from the Latin *pollex*, *pollicis*, the thumb, a common appellation of dwarfs, as in "Tom Thumb"; while others conjecture that the name comes from Puccio d'Aniello, a famous buffoon of Acerra, near Naples, whose humorous eccentricities were in the seventeenth century transferred to the Neapolitan stage. In some of its aspects the show of Punchinello reminds one of the so-called "moralities" of the Middle Ages and of the clown of the later comic drama; and the grotesque faces of the performers have their prototypes in the masks worn by the actors in the ancient Greek and Latin comedies. Puppet-shows of an essentially similar character, but often much more elaborate, are common in China and Japan. A typical version of the modern play by Payne Collier, with colored illustrations by George Cruikshank, was published in 1828. Revised by R. A. Roberts.

Punctuation [from Mediæv. Lat. *punctua're*, punctuate, deriv. of Lat. *punc'tum*, something pricked, point, punctuation mark, deriv. of *pun'gere*, *punc'tum*, prick]: the act or art of dividing literary composition into sentences and parts of sentences to show grammatical or sometimes rhetorical relations, and thus assist the reader in apprehending the writer's meaning. It is also frequently asserted that punctuation is intended to assist the reader by indicating the pauses and inflections required by the sense. This is incorrect, however, although it is evident that punctuation marks, while indicating syntactical relations, may also guide the reader to some extent as to pauses and inflections.

Our present system of punctuation is of modern invention. Ancient manuscripts were not punctuated until after 364 B. C., when it became customary to place a mark of separation after each word. The beginnings of our present system are said to date from the time of Manutius (Manuzio), the first of a famous family of Italian printers, who died in 1515. In English writings a period was first used, though without great regularity, to indicate a break of any sort in the composition. In addition to this, a period on the line or above it, sometimes an inverted semicolon, was used in poetry to mark a metrical rather than a syntactical division. Caxton, the father of English printing, used only an oblique line to indicate the divisions of discourse.

The principal marks of punctuation in modern English are the comma, semicolon, colon, period, interrogation, and exclamation points, of which the last two are mainly rhetorical. Of these the *comma* is most frequently and most variously used. Its offices may be summed up in two general heads: First, the comma marks a syntactical division of the sentence having a certain completeness of its own; next, it may indicate an ellipsis. Under the first head come parenthetical and intermediate expressions, dependent and conditional clauses, relative clauses not restrictive, words or expressions forming a series, nouns in apposition or in the vocative case. Under the second head are included ellipses of verbs, nouns, and conjunctions. The principal uses of the *semicolon* are to mark the divisions of a compound sentence, to separate clauses and expressions with a common dependence, sentences connected in idea but without syntactical dependence, and final clauses of explanation or inference. The *colon* is used to mark the larger divisions in complex sentences, the beginning of long quotations, and a series of particulars introduced by *thus*, *as follows*, *namely*, and similar expressions. The *period* marks the end of a sentence, while it is also used after titles and abbreviations. The marks of interrogation and exclamation indicate respectively a direct question and an exclamation.

Among the more important minor marks of punctuation are the dash, parenthesis, bracket, apostrophe, and quotation marks. The dash is used for a sudden break in the sentence and for parenthetical expressions. For the latter the parenthesis is also used, and for explanatory words not syntactically a part of the sentence the brackets are employed. The apostrophe marks the possessive case and the omission of a letter or letters in words. Quotation marks inclose direct quotations. The apostrophe, as not denoting a syntactical division, is not strictly a mark of punctuation, and there are numerous others of like use sometimes considered under this head, as the hyphen, section and paragraph marks, and marks of reference.

Punctuation is to some extent a matter of taste and judgment, rather than of rigid rule. Certain writers seem to aim at using the largest possible number of points; others try to use the fewest points possible. As might be expected, the best punctuation lies between these two extremes. There is also some room for individual preference in pointing. Whether a parenthetical expression should be set off by commas, by the dash, or by marks of parenthesis, is often to be decided by individual taste. The same may be said of the use of the semicolon, some writers using the comma or the period, according as the separation requires the more or less distinctive mark. In any case punctuation is more largely a grammatical, rather than a rhetorical device. It should aid the reader in gaining the sense, but it should never be depended upon for clearness or precision.

Oliver Farrar Emerson.

Pu'nic Wars: the three great wars between the Carthaginians (*Punici*) and the Romans. The First Punic war lasted twenty-three years (264–241 B. C.). It was a contest for the possession of Sicily, which was finally won by the Romans. The Second war lasted sixteen years (218–202 B. C.). It was initiated by the capture of Saguntum by Hannibal (*q. v.*), who thereupon made his great invasion of Italy. The war was closed by the Roman victory at Zama. The Third war was undertaken by the Romans with the express intention of finally destroying Carthage, her long humiliated and now scarcely dangerous rival. The war lasted three years (149–146 B. C.). Carthage made a most heroic and persistent defense, but was at last utterly destroyed. Polybius, wherever his account is preserved, is our most trustworthy ancient source. The variations from his narrative presented by Livy and Appian are regarded with suspicion. See the histories of Rome by Arnold and Mommsen; C. Neumann, *Geschichte Roms im Zeitalter der punischen Kriege* (Breslau, 1883); T. A. Dodge, *Hannibal* (Boston, 1890).

Revised by G. L. Hendrickson.

Punishment: in criminal law, the suffering or deprivation of the enjoyment of rights which is visited by law upon those who violate the penal law.

The object and the methods of administering punishment for crime among the early or more crudely civilized peoples are based chiefly upon the idea of retribution, or the vindication of the law upon the offender, and the expiation of his crime by reparation to the injured person. Crimes among such peoples are looked upon more as offenses against the individual than against the state, the idea of which is not strongly developed; and the infliction of punishment for crime is frequently or usually intrusted to the person wronged, or to his kin, clan, or tribe. Hence under such a system the distinction between crimes and torts is not well defined; the punishments inflicted are usually characterized by cruelty; the severity of punishment is frequently graded according to the nearness of the time of the infliction of the punishment to that of the commission of the crime; indignities are frequently inflicted upon the body after death; and for the expiation of many or all crimes a pecuniary value is set, by the payment of which to the injured person, or to his family, the offender is made free from liability to further punishment. In many cases a way of escaping punishment is provided by the establishment of cities of refuge, sanctuaries, etc.

With the development of the idea of the state and of the duties of the citizen to the state, crime comes to be looked upon more as a wrong against the community, and the right to inflict punishment is taken from the individual and vested in the state alone; the injured party is left to obtain reparation for the wrong by resorting to his civil remedy; and the primary idea of punishment becomes the protection of society from criminal acts, coupled with the design of reforming the criminal, not merely as a means of preventing crimes, but as an end in itself. Traces of the early theory of punishment, however, survive in the modern code. Thus the husband, among Christian nations, is still permitted to kill an adulterer caught by him *flagrante delicto*, and vindictive features are seen in some of the severities which are still imposed in some modern methods of punishing.

Punishments inflicted for the protection of society may be divided into those which disable or remove wholly or partially the ability of the criminal; those which are intended

to deter him from committing it again; and those which are intended to act as a deterrent to others.

The punishments of the first class include such forms as capital punishment, deportation, mutilation, branding, perpetual imprisonment, etc.

Punishments of the second class include those which may deter the criminal from the repetition of his crime, either by the reformation of the criminal or by inflicting suffering or some other form of punishment dreaded by the criminal, such as public indignity or great cruelty.

Punishments of the third class consist almost wholly in the infliction of cruelty or public disgrace.

It is now generally believed that the deterrent effect of all cruel punishments and of those likely to bring the criminal into public disgrace are more than counterbalanced by the brutalizing and hardening effect upon the criminal and upon the public itself; and consequently public executions, public whipping-posts, branding, mutilation, etc., have either been entirely abolished or are rapidly disappearing from the different codes of criminal law.

The principal forms of criminal punishment now in use among civilized nations are as follows: Death, perpetual imprisonment with or without hard labor, imprisonment for determinate periods, enforced labor in mines, galleys, etc., banishment to penal settlements, pecuniary fines, and in certain cases the infliction of the lash.

The criminal is also often deprived of political or civil rights belonging to citizenship, such as the electoral franchise, capacity to testify in courts of justice, or to hold office, etc.

For various forms of punishment now discarded among civilized nations or used only among semi-civilized peoples, see PILLORY, TORTURE, etc.

The whole history of criminal punishment is a history of cruelties and horrors, but inflicted for the ends of justice. The reformation of the criminal law in England is due chiefly to John Howard and Sir Samuel Romilly. Howard introduced the changes which made capital punishment less frequent, and Romilly, seconded by Sir James MacIntosh, introduced laws which gradually did away with the barbarous character of the criminal laws and the use of the penalties.

The law of England, however, is still more severe than that of the U. S., but it is on the whole just and tolerant. The existing criminal law of both countries now consists principally of a great number of statutes meant to provide for the punishment of acts which formerly for some reason or other were not provided for by the law or are now supposed not to have been punished with sufficient severity by the former laws, such as stealing wills, malicious mischief, statutory burglary, etc. Of the different forms of punishments above mentioned, capital punishment is gradually being abolished among Christian nations. For a fuller treatment of the specific forms of punishment, see CAPITAL PUNISHMENT, IMPRISONMENT, PRISON, GALLEY, TRANSPORTATION, WHIPPING-POST, etc.

LITERATURE.—See Beccaria's *Treatise on Crimes and Punishments*; Maine's *Ancient Law* (ch. ii.); Bentham's *Theory of Penalties and Rewards, Treatise on Civil and Penal Legislation*; Proal, *Le Crime et la Peine* (Paris, 1892); Garofalo's *Studio sul delitto, sulle sue cause, e sui mezzi di repressione* (Turin, 1890); Ryland's *Crime, its Causes and Remedy* (London, 1889); Bentley's *Principals of Penal Law* (Philadelphia, 1889); Lombroso's *L'uomo deliquente* (Turin, 1889); Cherry's *Lectures on the Growth of Criminal Law in Ancient Communities* (London, 1891); and Stephen's *History of the Criminal Law of England.*

F. STURGES ALLEN.

Punjaub' [from Hind. *Panjāb*; *pānch*, five (< Sanskr. *pañca*) + *āb*, water (< Sanskr. *āpas*). So called from its five rivers]: a territory of Northwestern Hindustan, bounded N. and N. E. by Cashmere, S. E. and S. by the Sutlej, and W. by the Suliman Mountains, and since 1849 belonging to British India. Area, 110,667 sq. miles. The northern part of the country is mountainous, covered with spurs of the Himalayas, from 17,000 to 20,000 feet high, and inclosing deep valleys. The southern and western part is a great plain around the Indus and its five powerful affluents, hot, dry, and treeless, consisting of a hard clay or loam which in many places becomes sandy and arid. The heat of summer rises to 112°; the winter is cool, with frequent frosts. Rain is rare, but the large and numerous streams can easily be used for irrigation, and there is a large network of canals for this purpose. Wherever the soil is well cultivated its productiveness is very great. Sugar, rice, cotton, wheat, and indigo are raised in large crops and of superior quality. The manufacturing industry of the country is highly developed in the large cities of Amritsar, Lahore, Multan, etc. In 1845 occurred the first Sikh war, which ended with Great Britain appropriating the territory on the left bank of the Sutlej; in 1848 followed the second Sikh war, which ended with the conquest by the British of the whole country. Pop. (1901) 22,449,484, consisting of Afghans, Tibetans, and different Hindu races, such as Jats, Sikhs, etc.; about one-half are Mohammedans. Revised by C. C. ADAMS.

Pu'no: the southeasternmost department of Peru; between Bolivia on the E. and Moquegua, Arequipa, and Cuzco on the W.; area vaguely estimated at 20,000 sq. miles. It embraces the Peruvian portion of the Collado or high basin of Lake Titicaca, part of the lake, the Andes to the E. of the basin, and their eastern forest-covered slopes (Montaña), where the river Madre de Dios takes its rise. Nearly all the inhabitants are gathered in the Collado, and most of them are Aymara Indians. The Montaña is rich in cinchona, etc., and its gold washings were formerly very productive; but the region is nearly abandoned, owing to the difficulty of communication; the department is now one of the poorest in Peru and has hardly any exports. Pop. about 275,000.—PUNO, the capital and largest town, is in a valley near the western extremity of Lake Titicaca, 12,550 feet above the sea (see map of South America, ref. 5–C). It is a bishop's see and has a fine cathedral. It is connected by rail with Arequipa and Mollendo, and the trade from Bolivia to the Peruvian coast passes through it. During the colonial period rich silver mines were worked in the vicinity; they are now nearly abandoned. Pop. about 9,000.

HERBERT H. SMITH.

Punshon, WILLIAM MORLEY, LL. D.: clergyman and author; b. at Doncaster, England, May 29, 1824; became a local Wesleyan preacher in 1840; studied at the Wesleyan College, Richmond; became one of the most popular preachers in England; preached in London 1858–68; labored in Canada 1868–73; in 1873 returned to England, and was president of the British Conference 1874; wrote sermons and discourses, *Life Thoughts* (1863); *Sabbath Chimes*, in verse (1867); the *Prodigal Son* (1868). D. in London, Apr. 14, 1881. See his *Life* by Frederic W. Macdonald, (New York, 1888). Revised by A. OSBORN.

Punt, or **Pun-t**: a land on the Red Sea, from which the Egyptians made imports, at first indirectly and afterward directly, during a large portion of their history, extending from the early dynasties down to Ptolemaic times. During a part of the time regular tribute was rendered in kind to the Pharaohs. Its exact location has been disputed, some, as Brugsch, claiming that it was in Arabia, the "land of the East"; others, as Mariette, that it was on the African side of the sea on account of the nature of the objects of import; and again others, as Lieblein and Dümichen, arguing that it lay on both sides of the sea. The question is difficult of determination, but the weight of argument seems to favor the view that it lay on the west side of the Red Sea, or on the south side of the Gulf of Aden on the Somali coast, especially as Punt is often classed in the monuments with Ethiopia or Cush. It was ordinarily reached from Egypt by way of the caravan route from Koptos to Kosseir through the HAMMAMAT (*q. v.*) valley, and thence by ship. The mural representations at Deir el-Bahari, however, represent the vessels of HATASU (*q. v.*) as sailing from Punt and arriving at Thebes, thus giving the impression of a continuous navigable waterway. There are many references to commercial and other intercourse between Egypt and Punt, the most extensive and minute of which are those of Hatasu. These represent the inhabitants as a mixed race, the rulers being of a light color, approximating that of the Egyptians or Libyans (with whom they may originally have been closely allied), while their subjects vary from red to black. The name "Negro," applied by the Egyptians to all the inhabitants of Eastern Africa, is not distinctive enough for ethnological purposes. The predominating racial types, however, point to the Somali coast. The men look much like Egyptians, but the women are represented as abnormally and grotesquely fat. The products of the land are also mainly African; sycamore trees in tubs ready for shipment, various sorts of wood, such as ebony, also ivory, mother-of-pearl, incense, balsam, myrrh, gold, silver, and other metals, two species of ape, giraffes, greyhounds, and leopard skins. See W. Max Müller, *Asien und Europa*

(Leipzig, 1893, pp. 106–120); Mariette, *Deir el-Bahari* (Leipzig, 1877); Dümichen, *Flotte einer aeg. Königin* (Leipzig, 1868); Hoskins, *Travels in Ethiopia* (London, 1835); Lieblein, *Handel und Schiffahrt auf dem rothen Meere in alten Zeiten* (Christiania, 1886); Meyer, *Gesch. des alten Ægyptens* (Berlin, 1887); Krall, *Das Land Punt* (Vienna, 1890). CHARLES R. GILLETT.

Punta Arenas, Chili: See MAGALLANES.

Puntare'nas: the principal Pacific port of Costa Rica, on the eastern side of the Gulf of Nicoya (see map of Central America, ref. 8–I); a terminus of the Costa Rican railway system. The harbor is shallow. The climate is warm but generally healthful. Pop. about 4,500. It is the capital of a *comarca* of the same name, which embraces two-thirds of the Pacific coast of the republic. H. H. S.

Pupa [from Lat. *pu'pa*, girl, doll, puppet]: one of the three stages of those insects which undergo a metamorphosis. See ENTOMOLOGY.

Pupillometer: See RECORDING APPARATUS, PSYCHOLOGICAL, in the Appendix.

Puppets: See MARIONETTES.

Puracé, poo-raă-sā': the highest active volcano of the Andes of Colombia, E. S. E. of Popayan, Cauca; in the Central and near the junction of the Eastern and Western Cordilleras; altitude (Reiss and Stübel), 15,420 feet. Severe eruptions have several times occurred. It is impossible at any time to enter the crater, owing to the hot and suffocating vapors. H. H. S.

Purānas: eighteen old traditional stories, chiefly in Sanskrit verse, compiled by an ancient sage named *Vyāsa*, the supposed founder of the Vedanta philosophy. They contain the history of the gods interwoven with every variety of legendary tradition in other subjects. Six of them relate to Brāhma, six to Vishnu, and six to Siva. Each is supposed to treat of only five topics—the creation of the universe, its destruction, the genealogy of the gods and patriarchs, the reigns and periods of the Manus, and the history of the solar and the lunar kings. See SANSKRIT LITERATURE, DEVALOKA, and Monier-Williams's *Indian Wisdom*. R. L.

Purcell, HENRY: composer; the most eminent and most original of English musicians; b. at Westminster, England, in 1658; was appointed organist of Westminster Abbey in 1680; organist of the Chapel Royal in 1682. Had it not been for the overshadowing greatness of Handel (who made England his home so soon after this period) it is probable that Purcell's fame would have been still greater and more largely spread abroad. D. Nov. 21, 1695, and was buried in Westminster Abbey. In many respects he must have been looked upon with more or less doubtful eyes as an innovator, not to say "heretic." His sacred works have held their own, commanding the admiration of modern critical opinion. His dramatic and chamber music is also admittedly the work of real genius, despite the change of style, etc., which the centuries have brought about. See Grove's *Dictionary of Music and Musicians* (London, 1881). DUDLEY BUCK.

Purchas, SAMUEL: author; b. at Thaxted, Essex, in 1577; educated at St. John's College, Cambridge; took orders in the Church of England; was presented by James I. to the vicarage of Eastwood, Essex, Aug., 1604; subsequently obtained the rectory of St. Martin's, Ludgate, London, and became chaplain to Archbishop Abbot. D. in London in Sept., 1626. Compiler of *Purchas his Pilgrimage; or, Relations of the World*, etc. (folio, 1613), and *Purchas his Pilgrimmes* (4 vols., folio, 1625), a celebrated collection from the works of many hundreds of travelers, and author of *Microcosmos, or the History of Man* (1619), and *The King's Tower and Triumphant Arch of London* (1623).

Purchase: See TITLE.

Purdue University: an institution at Lafayette, Ind.; founded as the Indiana Institute of Technology by act of legislature accepting the national land grant for agricultural and mechanical colleges. The location was fixed at Lafayette in 1869, when the name was changed to Purdue University in honor of John Purdue, who made the institution a gift of $150,000. It was formally opened in Sept., 1874, with seven professors and sixty-four students.

Purdue University sustains schools in agriculture, in science, in civil, mechanical, and electrical engineering, and a school of pharmacy. The U. S. agricultural experiment station for Indiana located there in 1887. The university has a farm and campus of 189 acres, twenty good buildings, and property, including annuities, to the value of $1,700,000. The register of 1899–1900 shows a faculty numbering 71 and 908 students. A new mechanical laboratory and equipment, valued at $180,000, was destroyed by fire in Jan., 1894, but was immediately restored, with improvements. The income is derived from land-grant endowment, the Morrill fund, and annual appropriation by the State of Indiana. J. H. SMART.

Purgatives [from Lat. *purgati'vus*, deriv. of *purga're*, purify, purge; *pu'rus*, pure + *a'gere*, make, do]: in medicine, substances that produce more or less fluid discharges from the bowels. Very many drugs are purgative in sufficient dose, but those available in medicine as cathartics, and in common use, are castor oil, rhubarb, aloes, and calomel, forming a group of comparatively mild agents, causing only fluid feculent stools; certain salts, producing watery discharges, of which the most prominent are magnesium citrate and sulphate, sodium phosphate, acid potassium tartrate, and potassium and sodium tartrate; and, finally, a group of vegetable nature, likewise producing watery stools, but also being more or less irritant to the intestines. These are senna, jalap, podophyllum, scammony, colocynth, gamboge, croton oil, and elaterium. Setting aside senna, the others last mentioned are commonly spoken of as the *drastic* cathartics, from their highly irritant properties. Besides the foregoing, there are many substances which have a very mild effect upon the bowels, and are called *laxatives*. The more prominent of these are magnesia and magnesium carbonate and sulphur among inorganic substances, and cascara sagrada, manna, purging cassia, tamarinds, prunes, figs, and other fruits among vegetable. Purgatives operate partly by quickening the muscular contractions of the intestines, whereby the contents of the latter are hurried down to the rectum, and partly, especially with those causing watery stools, by determining an abundant pouring out of fluid into the intestinal canal. They are used for the primary object of emptying the bowels, and also to relieve congestion of distant organs and to induce the absorption of dropsical collections of fluid. Revised by H. A. HARE.

Purgatory [from Lat. *purga're*, purify. See PURGATIVES]: according to the Roman Catholic and Oriental Churches, a place in which the souls of those who died in the state of grace suffer for a time, either on account of venial sin or on account of the temporal punishment due to mortal sin already forgiven. Purgatory is not a place of probation, but of expiation. The Roman Catholic Church has committed herself to only two statements about purgatory: (1) that there *is* a purgatory, and (2) that the souls detained there are helped by the prayers of the faithful, and especially by the sacrifice of the Mass. See Council of Florence, *Decree of Union*, and Trent, *De Purgatorio, Sess. XXV.* Further the Roman Catholic Church does not go, but the theologians discuss many other points, as the character of the sufferings, the situation of purgatory, the number of its inmates, etc. JOHN J. KEANE.

Purging-flax: the *Linum catharticum*, an annual plant resembling the common flax on a small scale. It is a native of Europe. It has been considerably used in medicine as a gentle hydragogue cathartic.

Purim [Heb. *pūr*, plur. *pūrim*, a lot. So called from Haman's casting lots for the destruction of the Jews (Esth. iii. 7)]: a Jewish feast, lasting two days, which falls on the 14th and 15th of the month Adar (February and March), in commemoration of the deliverance described in the book of Esther. The festival was in former times, as still in many places, celebrated in a noisy and tumultuous manner, with loud expressions of hatred at the reading of Haman's name in the synagogue.

Purinton, DANIEL BOARDMAN, A. B., A. M., LL. D.; educator and author; b. in Preston co., Va., Feb. 15, 1850: educated at George's Creek Academy, Pennsylvania, and at the West Virginia State University, where he graduated in 1873. He has held the following positions: Instructor George's Creek Academy, professor and vice-president West Virginia State University; since Dec., 1889, has been president of Denison University, Granville, O. For seven years he was president of the West Virginia Baptist General Association. He has published *Christian Theism* (1889) and *The Contest of the Frogs*, a poem (1888). Besides these he has written hymns and music, both sacred and secular, and about forty of his pieces have been published. W. H. WHITSITT.

Puritans [irreg. from Lat. *pu'ritas*, purity, deriv. of *purus*, pure]: in general, persons who are scrupulous and strict in their religious life; in particular, a body of Christians which arose in England in the sixteenth century. The Reformation in England under Henry VIII. was unsatisfactory to many, because, in their view, it accomplished only a partial elimination of the corruptions and abuses of the Church of Rome. Through the ecclesiastical alternations of the reigns of Edward VI. and Queen Mary these recusants grew in numbers and influence. Many of them fled to Geneva, and there came under Calvin's influence. They returned on Mary's death with new notions upon theology and polity. They gave Queen Elizabeth no little trouble, and were in turn greatly harassed by the efforts made, through the high commission court, to force them to conformity. It was during her reign that they came to be called in derision *Puritans*, because they were ever calling for a simpler, purer form of worship and insisting on a stricter, purer life. They, however, supported her most heartily when, after the destruction of the Spanish Armada (1588), she threw herself decidedly upon the Protestant side. They stood forth as a distinct party, leading the opposition to the despotic claims for the royal prerogative asserted by the first two Stuarts, and their influence culminated in a triumph when royalty was overthrown and the Commonwealth was established. The genuine Puritans were mostly of the commoners of England, men of strong minds, good judgment, and sterling character. They adopted the Calvinistic creed, and rigidly conformed their lives to its principles. This gave an aspect of precision to their manners and stern severity to their lives, but it made them strong in their integrity and persistent in the struggle for liberty and right. Much as they have been ridiculed and maligned, England owes to the Puritans some of the best features of her free constitution; and never before had her power in Europe been felt as it was under the Commonwealth, when, through Cromwell, they controlled the Government. The influence of the Dutch upon the Puritans, in toning them up and suggesting the reforms they advocated and, when able, instituted in Church and state, is now generally recognized. During the struggle with the Stuarts many Puritans emigrated to New England.

The term Puritans is applied loosely to embrace all who objected to the ceremonies of the Established Church, and advocated holy living, and resisted the royal prerogative. But, especially with reference to the early history of the U. S., a distinction of two classes should be recognized. The Puritans proper adhered to the Church, striving to mould it to their own views. The Independents, originally called Separatists and Brownists, despairing of accomplishing the needed reform in that way, insisted on an absolute separation from the Church for a new organization. The Pilgrims who established the first colony in New England at Plymouth were Independents. Those who subsequently established themselves on Massachusetts Bay were Puritans. Neal, *History of the Puritans*, ed. Choules (2 vols., New York, 1844); L. Bacon, *The Genesis of the New England Churches* (1874); G. E. Ellis, *The Puritan Age in Massachusetts* (Boston, 1888); D. Campbell, *The Puritan in Holland, England, and America* (New York, 2 vols., 1892). Also see ENGLAND, CHURCH OF, and INDEPENDENTS.

Revised by S. M. JACKSON.

Purlin: a beam or girder which connects two roof trusses, and upon which rafters are placed to support the covering of the roof. See ROOF.

Purneah: town; in the presidency of Bengal, British India, on both sides of the river Kosi, in lat. 25° 45′ N. and lon. 88° 23′ E. (see map of N. India, ref. 6–H). It occupies an area of 9 sq. miles, mostly single houses surrounded with gardens, orchards, and indigo plantations. Pop. about 20,000.

Purple of Cassius: a substance which is formed by adding a tin solution to a dilute solution of gold chloride. The tin solution must contain both stannous and stannic chloride. Analyses of this substance made by different chemists have not given the same results. From recent work it appears highly probable that the substance contains gold in the metallic state. The purple can be made by treating a solution of gold chloride with tin filings. When dry and powdered, the purple of Cassius has a metallic luster. It is used in manufacturing artificial gems, and for imparting a red, rose, or pink color to porcelain or enamel. I. R.

Purple, Tyrian: See TYRIAN PURPLE.

Purple Wood: a beautiful plum-colored wood from Guiana, of great strength and capable of a very smooth finish. It is the product of the leguminous trees *Copaifera bracteata* and *C. pubiflora*. It is adapted to a wide range of uses. L. H. B.

Purpura [Mod. Lat., from Lat. *pur'pura*, purple-fish]: a genus of marine gasteropods. This genus furnished a part of the Tyrian purple dye of antiquity, whence the name. There are numerous living and extinct species.

Purpura [from Lat. *purpura*, the purple-fish, purple dye or color, from Gr. *πορφύρα*, purple-fish, the dye obtained from the purple-fish]: a condition in which spots of deep purple color appear in the skin, produced by the escape of blood from the vessels. Purpura is not a disease, but merely a symptom, like cough, which may occur in many diseases. The immediate cause of the hæmorrhage in the skin is generally either a disorganized condition of the blood or a disease of the blood-vessel. Among the blood diseases producing purpura are leukæmia, progressive pernicious anæmia, scurvy, and the like. Among the causes which influence the blood-vessels are to be counted certain poisons, but in these the blood itself is also altered. A number of causes appear to affect both the blood and the vessel walls. Among these are the infectious fevers, like typhus and smallpox, poisoning by phosphorus, snake bite, etc. The treatment of purpura requires, first of all, a consideration of its cause. After this symptomatic treatment is useful. Iron, arsenic, quinine, or other tonics are useful, and styptics may be necessary to control hæmorrhage. WILLIAM PEPPER.

Purpurin: a substance whose formula is $C_{14}H_6O_5 = C_{14}H_5(OH)_3(O_2)''$. It exists in madder in the form of a glucoside, distinct from ruberythric acid, which is the alizarin glucoside. It is extracted from madder by the same processes as alizarin, and is usually separated from it by its greater solubility in a solution of alum. F. de Lalande converts alizarin into purpurin by treating it with sulphuric acid and arsenic acid or manganese dioxide; pours into water, and purifies the precipitate by alum, etc.

Purpurin appears as a red powder, in red feathery crystals (by sublimation), and in orange-red needles (from boiling alcohol). It is slightly soluble in boiling water, giving a rose-colored solution. It dissolves in alcohol, ether, benzene, glycerin, concentrated sulphuric acid, and acetic acid. Its solution in sulphuric acid may be heated to 400° F. without decomposition, the purpurin being thrown down unchanged on pouring the solution into water. It dissolves in a boiling alum solution to a pink fluorescent liquid, and does not separate on cooling, even from concentrated solutions. It dissolves in alkaline hydrates and carbonates, forming cherry-red or poppy-red solutions, from which acids reprecipitate it in orange-yellow flocks. The solutions in alkaline hydrates lose color on standing in the air, the purpurin being oxidized and destroyed. Boiling nitric acid converts purpurin into phthalic and oxalic acids. With bases it forms compounds; those with the alkalies are soluble in water. The basic, calcic, and aluminic lakes are soluble in boiling solutions of sodium carbonate.

Application to Dyeing and Calico-printing.—With alumina mordants purpurin produces bright reds; with iron, grayish violet. These tints resist cleaning with soap and nitro-hydrochloride of tin tolerably well, but are not so permanent as those produced by alizarin, nor do they resist light as well. There is a difference of opinion as to the part played by purpurin when madder, garancin, etc., are used in dyeing calico. Some think the purpurin of little importance; others consider it essential to certain pinks and reds. On account of its high price, this dyestuff is but little used.

Revised by IRA REMSEN.

Pur'ree, or **Indian Yellow** [*purree* is from Hind. *peori*, yellow]: a yellow coloring-matter brought from India and China in lumps weighing 3 or 4 oz., brown on the outside and deep orange-yellow within. It is made almost exclusively at Monghyr, in Bengal, from the urine of cows fed on mango leaves. When the urine is heated the coloring-matter separates. One cow produces on the average 2 oz. of purree a day. It is used for the preparation of Indian yellow, a fine, rich, durable yellow color, much used by artists, and often adulterated with chrome yellow. It consists mainly of the magnesium and calcium salts of euxanthic acid. Revised by IRA REMSEN.

Purslane Family: the *Portulacaceæ*, a family of succulent dicotyledonous herbs and shrubs, all harmless and

many of them with gay flowers. The purslanes (*Portulaca*), the calandrinias, and the claytonias, include a few ornamental species. Common purslane (*Portulaca oleracea*) is a well-known annual weed of fields and gardens in the U. S. (where it is colloquially called *pusley*). It was introduced thither from Southern Europe, where it is freely eaten as a pot-herb. C. E. B.

Pur'suivant of Arms: the lowest order of officers in heraldry. See HERALDRY and HERALDS' COLLEGE.

Purús, poo-roos': one of the most important tributaries of the Amazon, on its southern side; rises within the confines of Peru near lat. 11° S., thence passes through a small part of Bolivia, flowing N. E. through Brazil, and joining the Amazon (after receiving some of its water through several chanels, near lon. 61° 30′ W.). It is entirely a river of the forest-covered plains, and extremely crooked. Though the distance in a direct line between its source and mouth is only 900 miles, the channel is nearly 1,900 miles long. It was first explored in 1864–65 by the English traveler Chandless. He ascended it in a canoe until he found it reduced to a mere brook, and up to that point it was unobstructed by rapids. The Purús has many affluents. It is much frequented by rubber-gatherers, and steamers ascend regularly during the rubber season; but the few small settlements on the banks are near the mouth. See Chandless, *Ascent of the River Purús* (in *Journal* of the Royal Geographical Society, 1866). HERBERT H. SMITH.

Pūrva-mīmāṁsā: See HINDU PHILOSOPHY and MĪMĀṄSĀ.

Purves, GEORGE TYBOUT, D. D.: Presbyterian minister and professor; b. in Philadelphia, Pa., Sept. 27, 1852; graduated at the University of Pennsylvania 1872, and at Princeton Theological Seminary 1876; pastor at Wayne, Pa., 1877; at Baltimore, 1880; at Pittsburg, 1886; and Professor of New Testament Literature and Exegesis in Princeton Theological Seminary 1892. Called to Fifth Ave. Presbyterian Church in 1899. Besides articles in theological reviews, he has published *The Testimony of Justin Martyr to Early Christianity* (the Stone Lectures (Princeton), New York, 1889).

Pus: See SUPPURATION.

Pu'sey, EDWARD BOUVERIE, D. D., D. C. L.: theologian; b. at Pusey, Berkshire, England, in 1800; a nephew of the first Earl of Radnor; was educated at Eton and Christ Church, Oxford; graduated with high honors 1822; became a fellow of Oriel College 1823; studied in Germany, and in 1828 became Regius Professor of Hebrew at Oxford and one of the canons of Christ Church. His contributions to the *Tracts for the Times* (1835, *seq.*), of which series he wrote Nos. 18, 66, 67, and 69, gave to the Tractarian movement the name of "Puseyism." Newman's celebrated tract, No. 90, was in 1841 defended by Dr. Pusey in a published letter which excited much controversy. (See TRACTARIANISM.) He was suspended from preaching in the university for three years (1843–46) in consequence of the supposed utterance of heretical doctrine in a sermon on the real presence. Among the most important of his works are: *On the Benefits of Cathedral Institutions* (1833); *On the Royal Supremacy* (1850); *On the Real Presence* (1855, 1857); *History of the Councils of the Church* (1857); *Commentary on the Minor Prophets* (1860, *seq.*); *Daniel, the Prophet* (1864); *Eirenicon*, etc. D. at Oxford, Sept. 16, 1882.

Dr. Pusey's first publication (1828) was *An Historical Enquiry into the probable causes of the Rationalistic Character lately Predominant in the Theology of Germany*, in answer to Hugh James Rose's *Discourses on the State of Protestantism in Germany*. Both writers agreed that German theology was in a bad state, but differed as to its causes, Rose approaching the subject from the polemical, Pusey from the historical side. Each replied to the other, Pusey having the final word (1830), here first showing his hand as a religious controversialist. Later on, however, the book did not satisfy Pusey, and he withdrew it from circulation. He had taken in it a position more rationalistic than he was afterward willing to maintain. His next publication appeared in 1833, and was occasioned by Lord Henley's plan for the abolition of cathedral institutions. Pusey stood forth strongly in their defense, and looked at both their prospective and their past benefits in the promotion of sound religious knowledge. In this book the author's standpoint fully reveals itself. He had long been accustomed to hear the confessions of men and women who went to him for spiritual advice, and insisted that the Church of England allowed both confessions to its people and absolution through its priesthood. The disputes over the confessional led to his famous letter to W. Upton Richards, in 1850, entitled *The Church of England leaves her Children free to whom to open their Griefs*, which made a great impression at the time. He was also mainly instrumental in fostering the growth of conventual institutions in the Church, and in establishing voluntary penitentiaries for women. Canon Thomas Thelluson Carter's work at Clewer and Rev. Dr. John Mason Neale's work at East Grinstead were the outgrowth of his teachings. In 1865 came a new departure. Cardinal Manning, in a *Letter to an Anglican Friend*, challenged him to show that the Church of England was the Catholic Church, or any part of it, or in any divine or true sense of the word a Church at all. This was the occasion of Dr. Pusey's famous letter to John Keble entitled *The Truth and Office of the English Church*, in which he set forth the terms of an eirenicon between the Anglican and Roman Churches. This volume drew forth a friendly response from Rev. Dr. Newman, to which he replied in two successive pamphlets as large as the original work, the last of which appeared in 1870.

Personally, Dr. Pusey was an humble and holy man. His piety was of the ascetic or monastic type. His theology was essentially Catholic, consequently he was opposed to Romanism in many important questions—such as mariolatry, the infallibility of the pope, etc. It has truly been said of him that he was the moral, as Newman was the intellectual, and Keble the poetic, leader of the Anglo-Catholic movement. The acknowledged revival of the English Church dates from the Oxford movement, and is largely due to the loyal devotion to Anglicanism and the scholarly defense of its Catholicity which have made the name of Pusey famous. His *Life* was undertaken by Canon Henry Parry Liddon, who left it unfinished at his own death in 1890. It was then completed and published by Rev. John Octavius Johnston and Rev. Robert James Wilson (4 vols., London and New York, 1893–95). Revised by W. S. PERRY.

Pushkin, or **Ponchekin**, ALEXANDER SERGEIEVITCH: poet; b. in Moscow, Russia, May 26, 1799; studied at Tzarskoe Selo; entered in 1817 as clerk in the Government office of foreign affairs, but was discharged in 1820 for an *Ode to Liberty*, and banished to his estates; was recalled in 1825 by the Emperor Nicholas, who restored him to his office, charged him with writing the history of Peter the Great, and gave his widow a pension of 10,000 rubles when he was killed in a duel at St. Petersburg, Jan. 29, 1837. By his countrymen he is considered the greatest poet Russia ever produced, and those of his works which have been translated into German, French, or English have attracted great attention. He wrote romantic epics—*Ruslan and Liudmila* (1820), *Kawkázskij Plehnnik* (1822), etc.; one drama—*Boris Godunow*; several novels, under the pseudonym of *Belkin*, of which some were translated into English in 1875 by Mrs. J. Buchan Telfer in *Russian Romance*. His collected works in twelve volumes were published in St. Petersburg in 1839; a translation of his *Poems* in New York (1889).

Pushtu Language: See AFGHAN LANGUAGE AND LITERATURE.

Pusley: See PURSLANE FAMILY.

Pustule, Malignant: See ANTHRAX.

Putamen: See DRUPE.

Puteoli: See POZZUOLI.

Putnam: town; Windham co., Conn.; on the Quinnebaug river and the N. Y. and New England Railroad; 26 miles S. by W. of Worcester, Mass., 33 miles N. by E. of Norwich (for location, see map of Connecticut, ref. 7–L). It is noted for its manufactures, which include silk, cotton, and woolen goods, boots, shoes, and slippers, steam-heaters, cutlery, and carriages. There are several lumber-yards and wood-working plants, 2 national banks with combined capital of $225,000, 2 savings-banks with deposits of over $2,000,000, and 2 weekly newspapers. Pop. (1880) 5,827; (1890) 6,512; (1900) 7,348.

Putnam, FREDERICK WARD: anthropologist; b. at Salem, Mass., Apr. 16, 1839; was educated by his father until 1856, when he entered the Lawrence Scientific School under Prof. Agassiz, with whom he remained until 1864, when he returned to Salem; took an active part in the Essex Institute as superintendent of its museum. On the foundation of the Peabody Academy of Science in 1867 he was elected director of the museum, which position he held until Oct., 1875, when he succeeded Prof. Wyman as curator of the

Peabody Museum of Archæology and Ethnology at Cambridge. He was one of the founders of *The American Naturalist*; was elected permanent secretary of the American Association for the Advancement of Science; was appointed in Dec., 1875, civilian assistant on the U. S. surveys W. of the 100th meridian (in charge of Lieut. Wheeler), being intrusted with the special duty of reporting on the archæological and ethnological material that had been collected; and in 1876–78 had charge of the Agassiz collection of fishes at the Museum of Comparative Zoölogy; in 1886 was appointed Professor of American Archæology and Ethnology at Harvard; was chief of the department of ethnology, etc., at the World's Columbian Exposition 1893.

Putnam, George Haven: See the Appendix.

Putnam, George Palmer: publisher; b. at Brunswick, Me., Feb. 21, 1814; became a bookseller's clerk in Boston 1826, and in New York 1828; prepared in early youth *Chronology, or an Introduction and Index to Universal History, Biography, and Useful Knowledge* (New York, 1833), republished in 1850 and in later editions as *The World's Progress, a Dictionary of Dates*; visited Europe in the employ of John Wiley 1836–38, with whom he became a partner 1840; resided in London 1840–47; wrote *The Tourist in Europe* (1838) and *American Facts* (1845); and prepared a *Pocket Memorandum-book in France, Italy, and Germany* (1848). Returning to New York in 1847, he began business on his own account in 1848, and founded *Putnam's Magazine*, which ran from 1853 to 1856, was re-established in 1868, and merged with *Scribner's Monthly* in 1870. He held the position of collector of internal revenue in New York 1863–66; became one of the founders and honorary superintendent of the Metropolitan Museum of Art, and was chairman of the committee on art in connection with the universal exposition at Vienna. D. in New York, Dec. 10, 1872.

Revised by H. A. Beers.

Putnam, Israel: soldier; b. at Salem (that part now the town of Danvers), Mass., Jan. 7, 1718. With only a very rude education, his natural, vigorous mental endowments enabled him to exercise a wide influence upon the exciting events of his time, while his strong physical powers and daring disposition were displayed in the many romantic adventures related of him. In 1739 he married and removed to Pomfret, Conn., where he became a successful farmer and a large wool-grower. By various daring adventures he established a reputation for courage—a reputation he subsequently maintained in the French war, in which he commanded a company of Connecticut troops with distinction at Crown Point and Ticonderoga. In Aug., 1756, while in command of a party, he was captured by the enemy and bound to a tree, where during the continuance of the action he was frequently exposed to the fire of both friend and foe, but escaped unhurt. He was, however, borne away by the enemy in their retreat, and at night the fire had been lighted to burn him alive when he was saved by the intervention of a French officer, Molang. Taken to Ticonderoga, and subsequently to Montreal, he was, by the influence of Col. Schuyler, himself a prisoner at the latter place on Putnam's arrival, exchanged in 1759 and promoted to be lieutenant-colonel. He returned to his farm on the restoration of peace. The news of the battle of Lexington reached him while plowing, and leaving his plow he mounted his horse and rode rapidly to Cambridge. After a brief consultation he returned to Connecticut, when he was made brigadier-general by the Legislature, of which he was a member, and a week later was on his way back to Cambridge at the head of a regiment which he had raised. Spurning the offers of rank and money made to him by the British, he entered with zeal upon the struggle for independence, and soon conducted several successful expeditions. At the battle of Bunker Hill he displayed his usual energy and bravery throughout the day, as well as in the subsequent endeavor to rally the overpowered and retreating troops. Washington, upon his arrival to assume command (July 2), bestowed upon Putnam one of the four major-generals' commissions he bore from Congress, but the other three were not then delivered. Upon the evacuation of Boston, Putnam was ordered to take command at New York, and after the battle of Long Island and evacuation of New York was sent to Philadelphia to complete the fortification of that city; subsequently stationed at Crosswicks and Princeton, N. J., he was in May, 1777, assigned to command the army in the Highlands of New York. Owing to the dissatisfaction created by the surprise and loss of Forts Montgomery and Clinton in the summer of 1777, Putnam was removed from his command, although a subsequent court of inquiry acquitted him from blame for their capture, and he was restored to command. His success as a general, however, was not equal to his reputation for enterprise and daring. While on a visit to his home in Connecticut in 1779 he was stricken with paralysis, from which he only partially recovered. D. at Brooklyn, Conn., May 19, 1790.

Revised by C. K. Adams.

Putnam, Mary Traill Spence (*Lowell*): author; sister of James Russell Lowell; b. in Boston, Mass., Dec. 3, 1810; was early distinguished as a linguist; was married in 1832 to Samuel R. Putnam, a merchant of Boston (d. 1861); resided in Europe 1851–57; published a *History of the Constitution of Hungary and its Relations with Austria* (1850); *Records of an Obscure Man* (1861); *The Tragedy of Errors*, and *The Tragedy of Success* (1862), the latter two a dramatic poem in two parts, illustrative of slavery; a memoir of her son, William Lowell Putnam (killed at the battle of Ball's Bluff, 1861); *Fifteen Days* (1866); memoir of Charles Lowell (1885); contributed largely to *The North American Review* and *The Christian Examiner*, and translated from the Swedish Frederica Bremer's novel *The Neighbors*. D. in June, 1898.

Revised by H. A. Beers.

Putnam, Rufus: soldier; b. in Sutton, Mass., April 9, 1738; a millwright by trade, he abandoned his occupation to serve as a private in the French war of 1757–60; resuming his business on the return of peace, by study during spare time he attained proficiency in mathematics and surveying; in 1773 visited Florida, and was appointed deputy surveyor of that province. In the war of the Revolution, as lieutenant-colonel of a regiment, he superintended the defenses of Roxbury, Mass.; was appointed chief engineer with rank of colonel, and charged with the defense of New York by fortifications; constructed the fortifications at West Point in connection with his cousin, Israel Putnam; commanded a regiment in Wayne's brigade until the close of the war; in Jan., 1783, was appointed a brigadier-general; was frequently a member of the Massachusetts Legislature; was aide to Gov. Lincoln during Shays's rebellion 1787; formed a land company, which purchased large tracts of land in what is now Ohio and founded Marietta, the first permanent settlement in the Northwest; was judge of the Supreme Court of the Northwest Territory 1789; appointed brigadier-general 1792, he accompanied Gen. Wayne's army to Detroit against the Indians, and subsequently as U. S. commissioner negotiated an important treaty with numerous tribes; from 1793 to 1803 U. S. surveyor-general. D. at Marietta, O., May 1, 1824.

Putrefaction: See Fermentation.

Putty [from O. Fr. *potee*, calcined brass, tin, etc., putty, deriv. of *pot*, pot, the substance formerly called putty resembling putty-powder and being often made from the metal of old pots]: a cement used by glaziers for fastening window-glass in place, and by painters for filling holes in wood over nail-heads, etc. It is composed of whiting (calcium carbonate) and linseed oil, often colored with pigment.

Putty-powder: oxide of tin, or a mixture of this oxide with oxide of lead, used for polishing glass, etc. It is prepared by calcining tin or a mixture of tin and lead. For the optician's use it is prepared by precipitating a solution of tin in aqua regia with ammonia, washing, drying, and igniting the product.

Putumayo: See Içá.

Puvis de Chavannes, pü'vĕcs'de-shăă'văăn', Pierre: historical painter; b. in Lyons, France, Dec. 14, 1824; pupil of Henry Scheffer and of Couture; awarded medal of honor 1882; commander of the Legion of Honor 1889. He was one of the greatest artists of the French school, and his mural paintings in the Panthéon, the New Sorbonne, and the Hôtel de Ville in Paris, the museum at Amiens, and other public buildings in France, placed him at the head of modern decorative painters. His works are especially remarkable for their grand style, dignity of composition, and delicate schemes of coloration. D. in Paris, Oct. 25, 1898.

William A. Coffin.

Puy-de-Dôme, pwee' de-dōm': a central department of France; area, 3,070 sq. miles. The surface is high and on the W. covered with branches of the Cevennes and the Auvergne mountains, whose conical peaks and their extinct craters (*puys*), together with the large masses of lava and basalt, show the volcanic character of the country. The

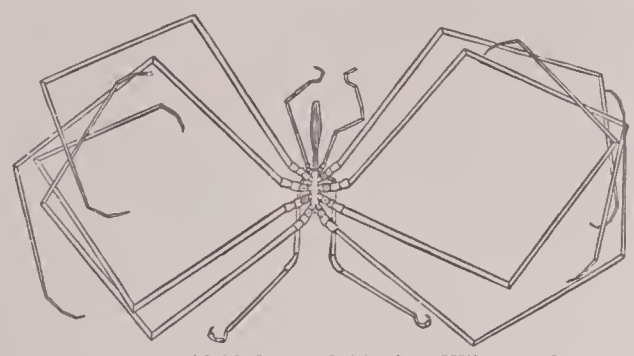
highest of these mountains is Puy-de-Sarcy (6,188 feet); on the E. are the Forez Mountains, reaching 5,380 feet. The chief rivers are the Allier and the Dordogne. The soil is generally fertile, but agriculture is not in an advanced state. Wheat and wine are produced: on the fine pastures of the mountain plateaus cattle and sheep are reared. Iron, lead, and silver are found in small quantities; marble, granite, and millstones are quarried. The manufacturing industry is not much developed. Pop. (1896) 555,078.

Puy, Le, or **Le Puy-en-Velay**, *le-pwee'ăañ-ve-lā'*: capital of the department of Haute-Loire, France; 70 miles S. W. of Lyons (see map of France, ref. 7–G). It is picturesquely built in terraces near the left bank of the Loire, on the slopes of Mt. Anis, on the summit of which is a basaltic mass called Mt. Corneille, crowned by a figure (53 feet high) of the Virgin, made of Russian cannon brought from Sebastopol. It has celebrated bell-foundries and manufactures of yarn, laces, linen, and woolen fabrics and cloth. Pop. (1896) 20,793.

Puzzolana: same as POZZUOLANA (*q. v.*).

Pyæ'mia: See BLOOD-POISONING.

Pycnogon'ida [Mod. Lat., from Gr. *πυκνός*, close + *γόνυ*, knee]: a group of marine arthropods of uncertain position. The common name sea-spiders alludes to their resemblances to the true *Arachnida*. They have a small jointed body terminated by a proboscis in front and a short abdomen behind, and upon this are borne, typically, six pairs of appendages, four of which are used by the animal in its slow motions over seaweeds and hydroids. In the male a seventh pair is present, and upon this the eggs are carried until they hatch. In other forms the number of legs may be reduced until only four pairs of appendages are present. The nervous system is on the regular arthropod plan; the four eyes (ocelli) on the first body-segment are peculiar in structure; circulatory organs are present, but those of respiration are lacking. The alimentary canal sends pouches into the legs. After hatching, the young of some species form galls upon hydroids, recalling the galls upon plants. By the older naturalists the *Pycnogonida* were regarded as *Crustacea*; more lately the tendency is to place them among the *Arachnida*. See Wilson, *New England Species*, Report U. S. Fish Commission for 1878; Morgan, *Development and Position*, Studies Biol. Lab. Johns Hopkins, v. (1891).



A deep-sea pycnogonid (*Colossendeis*) after Wilson. One-quarter natural size.

J. S. KINGSLEY.

Pygmalion (in Gr. *Πυγμαλίων*): a king of Cyprus, who fell in love with an ivory statue of a maiden which he himself had made. He prayed to Aphrodite to endue the statue with life; his prayer was granted, and the animated statue became his wife and bore to him Paphus. J. R. S. S.

Pygmy, or Dwarf, Tribes [*pygmy* is from Lat. *pygmæ'us* = Gr. *πυγμαῖος*, about a foot long, a *πυγμή* in length, deriv. of *πυγμή*, fist, the length of the forearm with the fist closed]: peoples much under average stature, found in small numbers in Southern India and Madagascar, constituting a large part of the inhabitants of the Andamans, and spread widely over the southern half of Africa. Their origin is unknown, but all seem to pertain to the Negro or Negrito families. They have been chiefly studied in Africa. Their existence has been known since the dawn of history, but when the world repudiated many statements of the earliest geographers it rejected also the pygmy tribes of whom Homer, Herodotus, Hekatæus, and other ancients wrote, and they were not rediscovered until the second half of the nineteenth century. The pygmy tribes of Africa have been distributed into four great groups: (1) The dwarfs of West Africa; (2) those of the central regions; (3) the East African dwarfs; and (4) the tribes that live S. of the Congo basin.

The first group (Obongo, Akoa, Babongo) live chiefly among the forests between the Gabun, Ogowe, and Congo rivers, where they are scattered among various Bantu tribes. The height of the adult male Obongo is 4·3 to 4·7 feet, while that of the women is less.

The second group (Akka, Wambutti, Batua) are the most important tribes of pygmies. They inhabit the vast forest-region S. of the upper part of the Mobangi-Makua tributary of the Congo, and are found also far S. along the Lomami, Chuapa, Bussera, and other southern tributaries of that river. They range in height from 4·3 to 4·8 feet, the Akkas being the smallest known people. The pygmies in groups one and two greatly resemble one another in appearance and mode of living. They are skillful, nomadic hunters, building rude temporary huts wherever game is plentiful, killing even the largest game with spears and poisoned arrows, or by means of pitfalls and traps, and supplying the Bantu tribes with flesh and skins in exchange for vegetable food, spears, knives, and other articles. They never engage in agriculture. They are usually lighter in color than the Bantus and many have slight beards. They often intermarry with other peoples and speak the languages of surrounding tribes. They have rarely been induced to speak their own languages in the presence of strangers.

The third group are the Dokos and other tribes living E. of the Nile and S. of Kaffa, and the river Omo. No explorer (1894) has visited them, but there is abundant evidence as to their existence. They are similar in size, appearance, and habits to the pygmies of the Upper Nile and Congo regions.

The Bushmen and their relatives, comprising the fourth group, are from 4 to 4·5 feet in height and subsist by the chase and on the roots and fruits of the Kalahari desert.

These groups, though separated by wide territories inhabited by many tribes of different origin, have so many similarities that their relationship is regarded as proven. Very little is yet known of their languages, but some words collected in the various groups are identical. The assumption that these tribes are remnants of the original population of Africa is plausible on several grounds. The Andaman islanders are from 4·6 to 4·9 feet high, are more pleasing to look upon than the African dwarfs, and differ from them in other respects. Very little is known of the Kimo of Madagascar except that they exist. See *The Pygmy Tribes of Africa*, by Dr. Henry Schlichter, *Scottish Geographical Magazine* (June and July, 1892); *Ueber Zwergvölker in Afrika und Süd-Asien*, by H. Panckow, *Zeitschrift der Gesellschaft für Erdkunde zu Berlin* (No. 2, 1892); *Les Pygmées*, by M. Quatrefages (1887); articles by Prof. Flower on the Akkas and the pygmy races of men in *Journal of the Anthropological Institute of Great Britain* (1889); and the works of Schweinfurth, Stanley, Junker, Lenz, Wissmann, Du Chaillu, Casati, and François. C. C. ADAMS.

Pygop'odes [Mod. Lat., from Gr. *πυγή*, rump + *πούς*, *ποδός*, foot; in allusion to the position of the feet]: a name given to an order of birds containing the loons (*Urinatoridæ*), the grebes (*Podicipidæ*, or *Colymbidæ*), and the auks (*Alcidæ*), all having the legs far back and only to a small extent free from the body. These birds are all expert divers. They are often placed together, but the order thus made rests chiefly on similarity of habits. F. A. LUCAS.

Pyle, HOWARD: See the Appendix.

Py'lus (in Gr. *Πύλος*): town of Messenia, on the promontory of Coryphasium; one of the last towns taken by the Spartans in the Second Messenian war. In 424 B. C. the Athenians built a fort on the site of the town, which became very famous in the Peloponnesian war. The present name, *Navarino*, is a corruption of *Avarino*, the Avars having settled here in the sixth century. J. R. S. S.

Pym, JOHN: b. at Brymore, Somersetshire, England, in 1584; spent some years at Pembroke College, Oxford, 1599–1602, but did not graduate; studied law at one of the inns of court; was elected to the Parliament of 1621, in which he became one of the leaders of the opposition to the royal encroachments on parliamentary rights, and suffered imprisonment for three months on the dissolution of the Parliament. In the first Parliament of Charles I. he was actively engaged in the impeachment of the Duke of Buckingham, 1626. He was the recognized leader of the "Short Parliament" of 1640 and of the "Long Parliament," which assembled in 1641; managed the impeachment of Strafford and the trial of Laud; presented the "grand remonstrance," which set forth all the evils endured from the beginning of

the reign of Charles I.; was the chief of the "five members" whose attempted seizure by the king (Jan., 1642) made reconciliation with Parliament impossible; was the real head of the provisional executive established at London after the king's flight; issued a manifesto in 1643 defending himself in moderate language from the king's accusation of treasonable dealings with the Scots; was appointed lieutenant of the ordnance in November. D. suddenly at Derby House, London, Dec. 8, 1643. He was buried with pomp in Westminster Abbey, and having impoverished himself in the cause of his country, £10,000 was voted by the House of Commons to pay his debts. By the royalists he was nicknamed "King Pym," and Clarendon testifies that at the opening of the Long Parliament he was "the most popular man in that or any other age." He was possessed of a peculiar eloquence, terse and vigorous, and was a perfect master of parliamentary law. See Foster's *Arrest of the Five Members* (1860), *The Debates on the Grand Remonstrance* (1860), and *Statesmen of the Commonwealth* (1864); Goldwin Smith's *Three English Statesmen* (1867); J. R. Green's *Short History of the English People* (1875); and Gardiner's *History of England from the Accession of James I. to the Outbreak of the Civil War* (1887). Revised by F. M. Colby.

Pynchon, Thomas Ruggles, D. D., LL. D.: educator; b. at New Haven, Conn., Jan. 19, 1823; was educated at the Boston Latin School and at Trinity College, Hartford, where he was graduated in 1841, M. A. 1844; was tutor 1843–47; ordained deacon at New Haven June 14, 1848, and priest at Boston July 25, 1849; rector of Stockbridge and Lenox, Mass., 1849–55; elected Scovill Professor of Chemistry in Trinity College, Oct. 2, 1854; received the degree of D. D. from St. Stephen's College, New York, in 1865, and LL. D. from Columbia College, New York, 1877; president of Trinity College Nov. 7, 1874–83; is still (1901) a professor in that institution; author of *Introduction to Chemical Physics* (New York, 1869; 2d ed. 1874), and of various sermons, scientific papers, and pamphlets. Revised by W. S. Perry.

Pynchon, William: colonist; one of the original patentees of the Massachusetts Bay Company; b. at Springfield, Essex, England, about 1590; emigrated to New England in 1630 with Winthrop and other patentees, and settled at Roxbury; in 1636 removed to Connecticut river and founded Agawam, renamed Springfield, after his birthplace; published a book opposing the Calvinistic view of the atonement, entitled *The Meritorious Price of Man's Redemption* (London, 1650). In consequence of the disfavor with which this book was received, and the persecution to which it subjected him, he returned to England in Sept., 1652. D. Oct. 29, 1662. He was also author of a treatise on the Sabbath and other works.—He left one son, John (1621–1703), to whom he bequeathed all his vast landed estate in the valley of the Connecticut river. The latter was an assistant under the first Massachusetts royal charter, and during 1686–1703 was several times councilor.

Pyramid [from Lat. *py'ramis*, *pyra'midis* = Gr. πυραμίς, πυραμίδος, pyramid]: a polyhedron having any polygon for a base, the remaining faces being triangles meeting at a common point called the *vertex*. The triangular faces taken together make up the *lateral surface* of the pyramid. A spherical pyramid is a portion of a sphere bounded by any spherical polygon, called the *base*, and by corresponding sectors of great circles. The vertex is at the center of the sphere.

Pyramidal Numbers: See Figurate Numbers.

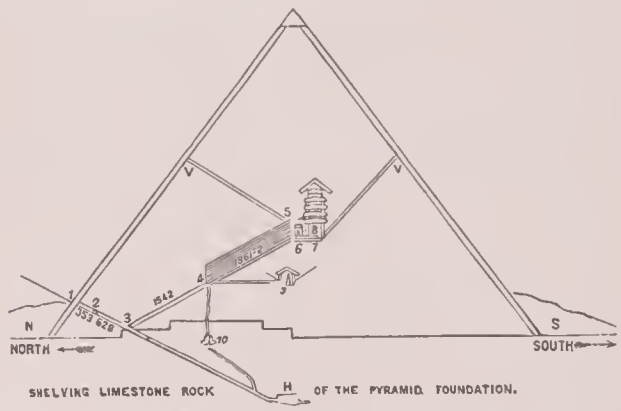
Pyramid Lake: a body of water in Western Nevada, near the Nevada-California boundary. It is 30 miles long and from 5 to 12 miles broad. It is without outlet, and varies both in depth and in extent with the seasons and with secular changes of climate. In Sept., 1882, its area was 828 sq. miles and its maximum depth 361 feet. It is fed principally by Truckee river, which rises in Lake Tahoe, and is remarkable for the purity of its waters. The inflow is counterbalanced by evaporation, and the waters have been concentrated until they contain about 3·5 parts per 1,000, of saline matter in solution. The waters are too alkaline to drink, but are inhabited by trout and other fishes in great numbers. The lake occupies one of the lower depressions in the bed of a former sea named Lake Lahontan, which flooded many of the valleys of Nevada in Pleistocene times. Immense deposits of calcium carbonate precipitated from the waters of the former lake occur in the form of castles and towers about the border of its modern representative.

Israel C. Russell.

Pyramid of Cestius: See Cestius, Pyramid of.

Pyramids: structures built in the form of a geometrical pyramid by several ancient nations. Of these the Egyptian are the most important. These are usually square at the base, and were erected as tombs of the Pharaohs down to the twelfth dynasty at least, their number being formerly much larger than now. Natural decay, fanatical zeal, and building activity in Cairo have reduced their number and mass. Like the Mastaba (*q. v.*), their purpose was that of a permanent tomb for the mummy of the royal builder. Their location, uniformly surrounded by tombs and cemeteries, their contents, whether funereal remains or magical and ritual texts, their close resemblance to the plans of the tombs of contemporary nobles—all point to the one reasonable explanation of their purpose. Theories which find in them occult mysteries of a mathematical or astronomical sort are entirely fanciful. Their orientation (which was connected with the native religious beliefs of the builders), upon which so much stress has been laid, while showing considerable knowledge of astronomy, is not always exact.

The number of those in the region near Memphis, now existing in greater or less degree of dilapidation, amounts to seventy-five, and they are arranged in several groups. The area which they cover is about 25 miles long, extending southward on the west side of the Nile from Abu Roâsh, opposite Cairo, to Dahshûr. They were oriented with more or less care, though some of them are considerably out of a correct alinement. Investigation shows that the ratio of height to base is approximately 7 to 22. They were built on the same general plan, though not without some variations of detail, and, like the mastaba, had certain essential features: the chamber for the reception of the mummy, or several chambers when more than the mummy of the king was to be deposited inside; the passageways more or less complicated, and the chamber of offerings, which was an integral part of the plan though actually located outside of the pyramid itself. The entrance was almost invariably on the north



Section of the Great Pyramid: 1, Entrance; 2, descending passage leading to (H) a rough, subterranean chamber; 3, passage leading upward through grand gallery (4) and anteroom (6) to king's chamber (8), containing (7) sarcophagus; 9, queen's chamber; 10, subterranean grotto with small passages leading to galleries above and below; V V, ventilating shafts; N S, *débris*. Dimensions are given in inches.

side, and opened into a descending passageway ending in a subterranean chamber. Another gallery midway of the first branched off upward and led to the sepulchral chamber near the center of the mass. In the Great Pyramid of Cheops at Gîzeh there were two sepulchral chambers, one below, presumably for the queen, and a second for the king on a higher level. A peculiarity of structure is seen in this case, in that hollow spaces, the top one triangular in cross-section and the others rectangular, were left above the king's chamber to reduce the weight of the superincumbent mass.

No theory of the method of construction is entirely satisfactory. Petrie's theory of the origin of the pyramidal form is that it was developed out of the mastaba by repeated additions, and has much in its favor. The older theory of Lepsius had long currency, and is still accepted by many. A rocky site was chosen and leveled to form a foundation, a portion of the rock being left in the center for a core. After the subterranean passages and chamber had been excavated the building was begun about the core and was completed so far as to make a finished whole, though perhaps of small size. It contained all the essential features, and only lacked its later gigantic size. During succeeding years more layers of stone were added, and the longer the reign of the building Pharaoh the larger his tomb. These added layers have been fitly compared to the rings which mark the growth of

a tree. When the structure was large enough to suit the ambition of the king, or after the builder's death, it was covered by triangular stones which rested on the successive steps, and was made to present a smooth outward surface. The stones for the building were brought from various quarries, principally from the opposite side of the Nile, and dragged to their places up an inclined causeway, which was raised as the work progressed. Remnants of these causeways are still visible in some places. The testimony of ancient and mediæval writers goes to show that in some cases the exterior was covered with hieroglyphic writing which was undoubtedly of a religious nature. The statement of Herodotus (ii., 125) that they recorded the amounts of provisions consumed by the workmen while the pyramid was building is very unlikely, and probably he was deceived by his guide. Destruction began with the limestone coverings, which were stripped off and burned in the kiln. Further destruction was due to the use of the inner blocks in building the city of Cairo. The earliest depredations go back to an early Pharaonic date; the Persians broke into the pyramids of Gîzeh, and probably into many others, in the fifth and fourth centuries B. C., and later the Romans did the same. In the first part of the ninth century A. D. the Arabs also entered the Great Pyramid of Gîzeh at least.

Taking the pyramids in their geographical order, beginning at the north, the first remains are those of *Abu Roâsh*. Only ruins survive, but these suffice to show that one of the buildings was 350 feet square at the base. An inclined passageway of 160 feet led to a subterranean chamber 43 feet long. The date of this pyramid is unknown. To the E. are the remains of a mile of causeway designed for the carriage

The pyramids of Gîzeh.

and elevation of material. Six miles S. are the three immense pyramids of Gîzeh, with several smaller companions. The largest is the oldest, having been constructed by Khufu or Cheops, the second king of the fourth dynasty. The name of the builder was found in red on one of the stones in the triangular chamber mentioned above. It is 755 feet square and 451 feet high, and was originally about 775 feet square at the base and 481 feet high. At the top is a flat space 30 feet square. It is estimated to contain 85,000,000 cubic feet of stone. It still contains the broken red granite sarcophagus of Cheops. The next largest pyramid was that of Khafra or Chefren, the successor of Cheops, though it does not contain his name. It measures 700 feet square at the base and is about 450 feet high. The sepulchral chamber is 46½ by 16⅓ by 22½ feet. It was opened and explored by Belzoni in 1816. The third pyramid of Gîzeh belonged to Menkara or Mycerinus, the fourth king of the same dynasty. The statement of Manetho that it belonged to Nitocris is undoubtedly incorrect, as the sarcophagus of Mycerinus was found inside by Col. Vyse in 1837. It is conjectured that it was left unfinished and completed by a later ruler. It was built on a sloping rock, is 350 feet square, and 210 to 215 feet high. Three smaller pyramids are near by, one of which contains the name of Mycerinus on the ceiling. About 3 miles southward are the pyramids of *Zâwyet el-'Aryân*, one of which has been almost entirely destroyed. The other must have been a large structure, as its remains are now nearly 300 feet square. At *Abusir*, about 3 miles farther S., are remains of fourteen pyramids built by Pharaohs of the fifth dynasty, only three of which were of any considerable size. One of these was built by Sahura, second king, and measures 117 feet high and 217 feet square. Another is 165 feet high, and 324 feet square at the base; builder unknown. Next are the pyramids of *Saqqarah*, of which that known as the Step Pyramid is the most noteworthy. It is supposed to have been built by Ata, the fourth king of the first dynasty, though its date can not be fixed. At all events, it is supposed to be older than the pyramids at Gîzeh. It rises by six steps which vary from 38 to 29½ feet in height, separated by ledges from 6 to 7 feet wide. The north and south sides are 352 feet long, and the east and west sides 396 feet; the height is 197 feet. It is not well oriented. A short distance to the S. W. is the pyramid of Unas, the last king of the fifth dynasty. It is 62 feet high and 220 feet square. When explored by Maspero in 1881 the sarcophagus and bones of Unas were found inside. In view of the uninscribed condition of the pyramids previously explored, it was a startling discovery to find the walls of two chambers and of two corridors covered with ritual prayers and religious texts. (See Egyptian Language and Literature.) Similar was the pyramid of Teta, the first king of the sixth dynasty, a little to the N. E. of the Step Pyramid. It is 59 feet high, 210 feet square, and has a platform at the top 50 feet square. It also contained texts in hieroglyphs which were painted green. Farther to the S. is the pyramid of Pepi I., the second king of the sixth dynasty, which was opened in 1880. It is 250 feet square and only 40 feet high. The sarcophagus of Pepi was found broken, surrounded by pieces of the mummy. This pyramid was also inscribed with similar texts. The name given to it was Men-nefer, pleasant dwelling, the original of the name of Memphis (*q. v.*). Near by is the Mastaba Far'ûn (mastaba of Pharaoh), which was supposed by Mariette to have belonged to Unas of the fifth dynasty. Ruins of several other pyramids are found in the group of Saqqarah. At *Dahshûr*, 3½ miles farther S., there are six pyramids, four of stone and two of brick. Two of the former are of immense size, rivaling those of Gîzeh, being respectively 700 and 620 feet square and 326 and 321 feet high. The latter is known as the Blunted Pyramid, on account of a break in the original angle of construction. The brick pyramids are respectively 350 and 343 feet square, and 90 and 156 feet high. Originally they were covered with a facing of stone. There are also some structures of less importance at *Lisht*, a few miles farther S. The False Pyramid of *Mêdûm* is so called because, unlike the rest, it rises in three sections, 69, 20½, and (originally 32) now about 25 feet high. It was never completed. Recent excavations show that it was constructed by Snofru (Gr. Soris, *q. v.*), the first king of the fourth dynasty, making it the oldest dated pyramid. Connected with it was the oldest Egyptian temple known to us, dating from the same reign. The pyramid at *Illahûn*, at the mouth of the Fayum, was the work of Usertasen II. (Sesostris of Manetho), the third king of the twelfth dynasty. Another at *Hawâra*, a little to the W., was erected by Amenemha III., the fifth king of the same dynasty. At *El-Kulah*, near Esneh above Thebes, is a pyramid which has the appearance of steps, owing to the decay of the coating material. It is undated and is of small importance, having a base of only 55 feet square and a height of 30 feet. The pyramids of *Ethiopia* (see Meroë) were simply late imitations of Egyptian structures. The literature of the subject is extensive, but somewhat scattered. Following are some of the important works: Maspero, *Egyptian Archæology*, translated by Edwards (London and New York, 1887); Perring, *Pyramids of Gizeh* (3 vols., London, 1839–42); Vyse, *Operations at the Pyramids of Gizeh* (2 vols., London, 1840–42); Petrie, *Pyramids and Temples of Gizeh* (London, 1887); *Season in Egypt* (London, 1888); *Hawara* (London, 1889); *Kahun* (London, 1890); *Illahun* (London, 1891). Guide-books, such as those of Baedeker, Murray, and Meyer, contain much detailed information. See Mexican Antiquities.

Charles R. Gillett.

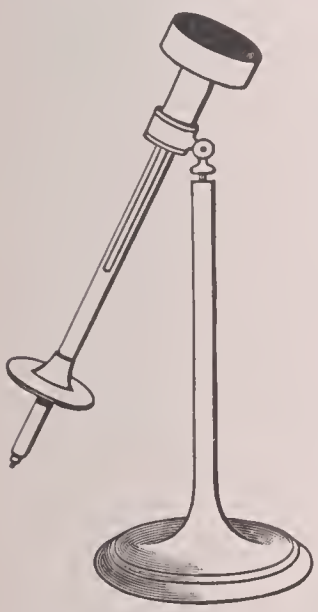
Pyrene, or **Phenylene-Naphthalene** [*pyrene* is from Gr. πῦρ, fire]: a solid hydro-carbon, whose formula is $C_{16}H_{10} = C_{10}H_6(C_6H_4)$. It occurs with chrysene in the last portions of the distillate obtained in distilling coal-tar to coke. The two bodies are separated by means of carbon disulphide, which dissolves the pyrene and leaves the chrysene. The carbon disulphide is distilled off, and the residue is repeatedly extracted with warm alcohol, and the cooled solution is mixed with an alcoholic solution of picric acid as long as a crystalline precipitate of pyrene picrate is produced. The precipitate is washed with alcohol, decomposed by am-

monia, washed with water, and recrystallized from alcohol till the melting-point is constant at 142° to 144° C. Pyrene crystallizes from hot alcohol in laminæ resembling those of anthracene. It is usually yellow from impurities, but may be decolorized by exposing the solution in benzene to sunlight. It is very soluble in benzene, ether, and carbon disulphide. It melts at 142° C., and distills at a temperature considerably above 360° C. Revised by IRA REMSEN.

Pyrenees [from Lat. *Pyrenæ'i* (sc. *mon'tes*, mountains), masc. plur. adj., Pyrenean, the Pyrenees, deriv. of *Pyre'ne* = Gr. Πυρήνη, the Pyrences]: a lofty mountain system, chiefly granite, overlaid by sedimentary strata, which forms the boundary between France and Spain, and stretches from the Mediterranean to the Bay of Biscay. Its entire length is 240 miles, its average breadth is about 75 miles. It is broadest and highest about midway, where the two almost parallel ranges of which the mountains consist are connected by a number of wild, towering peaks, of which the highest are Pic de Nethou, 11,168 feet; Mont Perdu, 10,997 feet; Vignemale, 10,820 feet; and Pic du Midi, 9,540 feet. In their eastern course, toward the Mediterranean, the Pyrenees fall rapidly to an average height of 2,000 feet, while the western part retains an average height of 5,000 feet, with many peaks rising 8,000 feet. Northward, toward France, the Pyrenees slope gradually, sending out forest-clad offshoots which inclose beautiful valleys; southward, toward Spain, they present steep, abrupt, and barren but bold and picturesque slopes. There are seven passes at an elevation of over 7,000 feet, making the Pyrenees notable for the great height of its passes in proportion to the height of the mountains. Revised by C. C. ADAMS.

Pyrenomyce'teæ [Mod. Lat.; Gr. πυρήν, stone of a fruit + μύκης, plur. μύκητες, mushroom]: an order of ascomycetous parasitic and saprophytic plants commonly known as the black fungi. Their ascospores are produced in sacs (*asci*), in usually hard-walled cavities (*perithecia*); conidia are produced singly or in clusters upon superficial threads. The common PLUM-KNOT (*q. v.*; *Plowrightia morbosa*) is a good example. See FUNGI. CHARLES E. BESSEY.

Pyrheliometer [Gr. πῦρ, fire + ἥλιος, sun + μέτρον, measure]: an instrument invented by Pouillet for measuring the heat received at the earth's surface from the sun. The requisites for such a determination are a surface of known size, the absorption coefficient of which is also known, together with a calorimetric device for measuring the energy thus transformed. Pouillet's instrument consisted of an inverted thermometer, the bulb of which was surrounded by a flat cylindrical closed vessel of silver foil. This contained a known quantity of water. Its upper surface was blackened by a coating of lampblack so as to raise its absorbing power to the highest point. The pyrheliometer was mounted (see illustration) so that its axis could be set parallel to the sun's rays. The lower disk (to the left in the illustration) was designed to facilitate this adjustment, since it was only necessary to bring it entirely within the shadow of the cylinder. E. L. NICHOLS.



Pyridine (C_5H_5N): an oily base found in bone oil, shale oil, peat-tar, coal-naphtha, and the products of the destructive distillation of cinchonine. It was discovered by Anderson, together with a number of other similar bases, in 1851, in bone-oil. It occurs in tobacco-smoke. It is produced artificially by the dehydration of amyl nitrate, by heating piperidine with nitrobenzene, and together with other similar substances by heating glycerin with ammonium sulphate and sulphuric acid. In medicine it has been used in the treatment of asthma by placing a few minims on a warm shovel or metal plate so that it is volatilized in the air of the room at some distance from the patient. The patient should not be exposed to the fumes for more than twenty minutes, three times a day. Revised by IRA REMSEN.

Pyri'tes [Lat. = Gr. πυρίτης, flint, a stone that strikes fire, deriv. of πῦρ, fire]: in its widest sense, a native mineral, massive or crystalline, composed of a metallic sulphide or arsenide, or both. Iron, copper, nickel, and cobalt pyrites are the ones generally mentioned. Iron pyrites is often found crystallized in cubes or in other forms. It is sometimes massive, and occasionally globular. From its bright-yellow color it is sometimes mistaken for gold. It is a more or less pure iron bisulphide. It is of great value for the manufacture of sulphuric acid and the sulphates and other commercial sulphur compounds. It also yields not unfrequently a considerable amount of silver, copper, or gold. Chemical reagents derived even remotely from it are apt to contain appreciable amounts of arsenic. Copper pyrites is an impure double sulphide of iron and copper. It is extensively employed, not only as a source of sulphuric acid, but of metallic copper.

Pyro-acetic Spirit: See ACETONE.

Pyrogal'lol, called also **Pyrogallic Acid** [*pyrogallic* is from Gr. πῦρ, fire + Eng. *gallic*]: a substance discovered by Scheele by subliming gallic acid of gallnuts, but considered by him to be identical with it. Leopold Gmelin and Braconnot proved it to be a peculiar substance. It forms a beautiful mass of snow-white crystals, extremely light and feathery. As it has been shown to belong to the class of bodies known as PHENOLS (*q. v.*), its name has been changed from pyrogallic acid to pyrogallol. Its formation from gallic acid by the action of heat is represented thus:

Gallic acid. Pyrogallol.

$$C_7H_6O_5 = C_6H_6O_3 + CO_2.$$

Pyrogallol is a useful reagent in the laboratory, by reason of the fact that in the presence of alkaline substances it unites readily with atmospheric oxygen at ordinary temperatures; it was therefore proposed by Liebig as an agent in analysis of gaseous mixtures containing oxygen, a method since in universal use. Revised by IRA REMSEN.

Pyr'ola [Mod. Lat., properly *Pir'ola*, dimin. of Lat. *pi'rus*, pear-tree; named from the aspect of its leaves]: a genus of *Pyroleæ*, a tribe of the *Ericaceæ* or HEATH FAMILY (*q. v.*), characterized by a calyx free from the ovary; the corolla polypetalous; anthers extrorse in the bud; seeds with a loose and translucent cellular coat much larger than the body. The species are nearly herbaceous and evergreen, with broad leaves. The tribe contains also *Moneses* and *Chimaphila*, the latter including the pipsissewa. CHARLES E. BESSEY.

Pyrolig'neous Acid [*pyroligneous* is from Gr. πῦρ, fire + Lat. *lig'num*, wood]: a name often applied to impure acetic acid produced by the distillation of wood. It contains empyreumatic tarry matter, which gives it a dark color and peculiar smell. These impurities, however, may be completely removed.

Pyrom'eter [from Gr. πῦρ, fire + μέτρον, measure]: an instrument for the measurement of high temperatures. The term is applied particularly to apparatus for the determination of the temperature of furnaces and flues. Pyrometry, which has to do with the range of temperatures lying above the red heat, involves great experimental difficulties, and, in spite of the large amount of labor expended upon it, remains in an unsatisfactory state. Pyrometers may be classified in general as *expansion pyrometers* and *electrical pyrometers*. The acoustical pyrometer, suggested by Preston (*Philos. Magazine*, July, 1891) and described in modified form by Sanford (*Physical Review*, p. 140), may furnish a third type, but it is an instrument about which no experimental data are as yet to be had. The only substances available for expansion pyrometers are (1) highly refractory solids and (2) gases inclosed in a refractory and gas-tight bulb or reservoir. The best-known instruments of the first class are the pyrometers designed by Josiah Wedgwood (1782) for the measurement of kiln-temperatures in his celebrated potteries, and by Daniell. The Wedgwood pyrometer, which depended upon the changes in a clay cylinder when subjected to the heat of the furnace, was unreliable, except, possibly, as an arbitrary indicator of the approximate degree of incandescence. Daniell used the relative expansions of a platinum and an earthen bar, and obtained more consistent results.

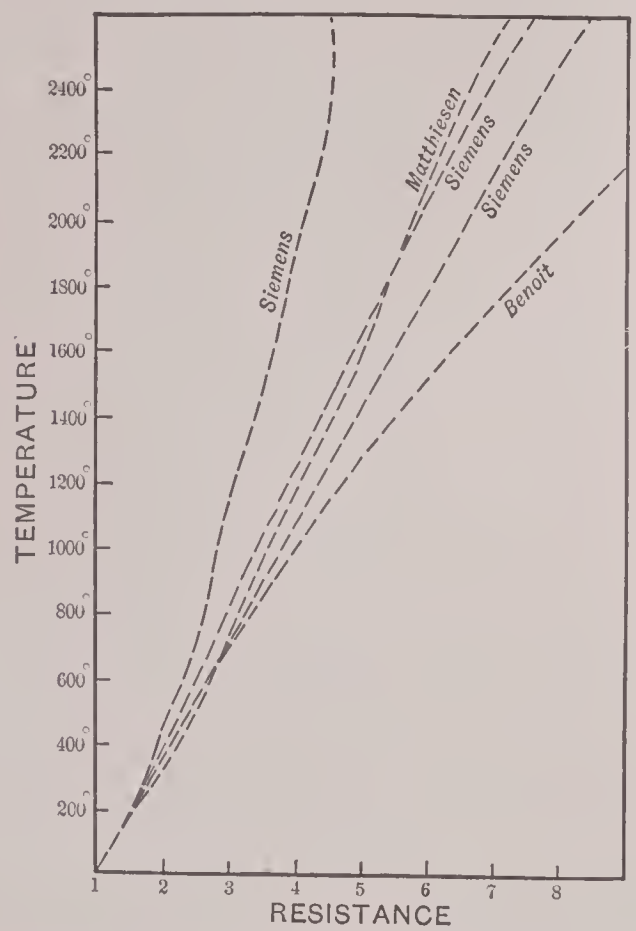
Various gas-thermometers have been used for high temperature measurements, and it is by means of this class of instruments that the most satisfactory absolute determinations have been made. Hydrogen, air, mercury, and iodine are among the gases and vapors thus employed; copper, iron, platinum, and porcelain among the materials for bulbs and reservoirs. Experience has shown that nearly all sub-

stances, with the possible exception of porcelain, become porous at extremely high temperatures, and this fact constitutes an almost insuperable difficulty in the execution of pyrometric measurements with the air-thermometer.

Some observers with pyrometric gas-thermometers have followed methods analogous to those in vogue for the measurement of ordinary temperatures. Others have employed various ingenious indirect methods for the determination of the contents of the bulb. Thus Regnault, working with a reservoir of hydrogen in the computation of furnace-temperatures, passed the gas over cupric oxide and determined the amount of water thus produced. The mercury in his mercury-vapor thermometer the same investigator estimated by weighing the mercury condensed within the cooled bulb. Deville, also, determined the amount of iodine vapor contained in a porcelain bulb at a high temperature by subsequent weighings.

The laborious character of operations with the air-thermometer has led later investigators to adopt the more manageable methods of pyrometry based upon thermo-electricity and the influence of temperature upon electrical resistance. The only metals available for either of these methods are platinum and the rare metals belonging to the same family. Iron is excluded on account of its oxidizability, even in many measurements in which its melting-point would be outside the range of experimentation.

The influence of temperature upon the resistance of platinum was exhaustively studied by C. W. Siemens with a view to the use of this property in pyrometry. The results were not altogether encouraging, it being evident that no general law could be laid down which would be applicable to all specimens, even when every ordinary care was taken with reference to the purity of the metal. The diagram,



constructed from the measurements of Siemens and others, is intended to show graphically the wide divergences which would arise from the attempt to use any single empirical formula for different specimens of platinum.

The diagram, the abscissas of which are resistances, while the ordinates are temperatures, is plotted from formulas obtained by Benoit and by Matthiesen, and from three separate results obtained by Siemens with different samples of platinum. It will be seen that the discrepancies amount to many hundreds of degrees. Later experience in the production of platinum has made it possible to eliminate some of the impurities to which the differences are due, but accuracy is still to be secured only by the direct calibration of each specimen.

Thermo-electric couples consisting of platinum and one of the alloys of platinum with one of the kindred metals, such as iridium or rhodium, afford a means of measuring high temperatures which is probably less open to objection than any other as yet devised. Couples containing commercial platinum will, it is true, show variations similar to those which characterize the curves of temperature and resistance, but modern methods of purifying platinum have made it possible, as Barns has demonstrated, to produce the metal and its alloys in such condition that the curve for electromotive force and temperatures remains virtually a straight line up to the melting-point of platinum.

The wide discrepancies between the results obtained by different observers and in the use of the different methods would leave the subject of pyrometry in confusion were it not that the melting temperatures of the metals afford fixed points of reference by which we can institute rigorous relative comparison of the above methods with other more indirect determinations—e. g. those based upon the constancy of the specific heat of copper or of platinum, or upon assumed laws of radiating power as a function of the temperature.

By means of such comparisons certain very different methods are found to give concordant results, while others, the claims of which, taken by themselves, would seem to be quite as strong, are not accordant. Thus there has gradually been established a set of values running up to the melting-points of silver, gold, and copper upon which great weight is laid. Above 1,100° C., however, pyrometry is still very far from being an exact science. See further, Barns, *Measurement of High Temperatures*; Guillaume, *Thermométrie de Précision*: Becquerel, *Comptes Rendus*. Deville and Troost, *Annales de Chimie*, vol. iii., 58; Regnault, *ibid.*, vol. iii., 63; Daniell, *Quarterly Journal of Science*, 11 (1821); Wedgwood, *Phil. Transactions*, 72, 74, and 76.

E. L. Nichols.

Pyr'ope [from Gr. πυρωπός, a kind of red bronze, liter., adj. fiery-eyed; πῦρ, fire + ὤψ, ὠπός, eye]: the precious garnet, a fine dark-red garnet, much used in jewelry, and incorrectly called hyacinth, ruby, and carbuncle. It comes from Ceylon, Germany, Scotland, etc. See Garnet.

Pyroph'ori [Mod. Lat.; Gr. πῦρ, fire + φέρειν, bear]: a term applied generally to some substances which kindle spontaneously and enter into combustion when exposed to the air, the term being confined, however, to solid substances, and not applied to spontaneously inflammable liquids. Carbon, phosphorus, and many easily oxidable metals may be made pyrophoric by preparation in a state of extreme division. "Homberg's pyrophorus" is formed by mixing intimately alum and sugar, drying and charring first in an open pan, then igniting in a closed vessel. Phosphorus, when left by evaporation of its solutions in very volatile liquids, like bisulphide of carbon, is pyrophoric. Iron may be obtained in pyrophoric form by many methods, even by simple reduction of the oxide with hydrogen gas at a minimum temperature. A lead pyrophorus is obtained by charring dry tartrate of lead in a close tube. If, after cooling, the tube be crushed, a beautiful shower of fire, metallic lead and carbon in combustion, makes its appearance. Some common lignites, very finely pulverized and thoroughly dried by heat, are pyrophoric when warm. Numerous other cases are described in chemical works.

Pyrophosphates: See Phosphoric Acid.

Pyrophosphoric Acid: See Phosphoric Acid.

Pyro'sis [Mod. Lat., from Gr. πύρωσις, burning, inflammation, deriv. of πυροῦν, to burn, deriv. of πῦρ, fire]: an affection of the stomach characterized by the regurgitation of a considerable quantity of liquid when the stomach is empty of food. The liquid expelled may be insipid to the taste or saltish, and it is sometimes acid. It is not vomited, but regurgitated, and the regurgitation is not accompanied by the sense of nausea which usually attends acts of vomiting. The popular name for the affection is water-brash. The regurgitation takes place especially in the morning, before food has been taken. A sensation of burning is generally felt in the region of the stomach, and frequently in the throat during and after the passage of the liquid. This burning sensation is implied in the name *pyrosis*. The regurgitation in pyrosis is to be distinguished from that of food or drink which has been taken into the stomach in other cases of dyspepsia. The liquid regurgitated in pyrosis is the morbid product of secretion from the glands of the stomach, the abnormality as a rule consisting in excessive acidity of the gastric juice. The affection occurs oftener in

women than in men, and is somewhat dependent on disturbance of the nervous system. Persons living on a poor, insufficient diet are more likely to suffer from it than those who live well or generously. It is not a grave affection, nor does it denote a tendency to any important disease in the stomach or elsewhere. It is generally relieved very speedily by the carbonate or subnitrate of bismuth in doses of from 20 to 30 grains, given twice or thrice daily. The treatment, in other respects, embraces the use of tonic remedies, nutritious alimentation, and hygienic influences to invigorate the system. Revised by W. PEPPER.

Pyrotechny [Gr. πῦρ, fire + τέχνη, art]: the art of making fireworks for the purpose of amusement or for signals. The methods in use have been developed almost independently of the direct aid of science, and largely "by rule of thumb." Fireworks are said to have originated in the East. It is certain that there were firework displays in China centuries before their introduction into Europe, and the Chinese and Japanese still excel in some branches of the art. The subject of pyrotechny covers both the mechanical and chemical branches. For the purposes of this article it is only necessary to treat briefly of the chemical features. All fireworks contain a substance or mixture of substances capable of burning, and therefore called the *fuel*, and a substance or substances rich in oxygen. Among the substances used as fuel the following may be mentioned: Sulphur, charcoal, shell-lac, resin, pitch. The chief supporters of combustion, or oxygen compounds, employed are saltpeter (potassium nitrate) and chlorate of potash (potassium chlorate). For the production of colored lights and stars different substances are introduced into the filling. The accompanying table gives the names of the substances and the proportions in which they should be mixed to produce red, green, blue, yellow, and white:

SUBSTANCES.	Red.	Green.	Blue.	Yellow.	White.
Potassium chlorate	2	..	5	4	..
Sulphur	2	1	2	..	4
Charcoal	1	..	..	..	..
Shell-lac	..	3	1	1	..
Calomel	..	..	2	..	..
Magnesium filings	2	2	2	1	2
Strontium nitrate	8	..	..	..	..
Barium chlorate	..	12	..	..	..
Copper oxychloride	..	..	2	..	..
Sodium oxalate	..	..	..	2	..
Potassium nitrate	..	..	..	..	12
Antimony sulphide	..	..	..	..	1

Iron-filings are frequently introduced into the mixtures to cause brilliant scintillations; long filings or those made with a coarse file are preferred. The famous Bengal lights are made with niter, 7 parts; sulphur, 2; antimony sulphide, 1. Rocket and Roman-candle stars are compressed portions of the powder. They usually contain the same constituents as ordinary gunpowder, the proportion of charcoal being somewhat reduced; steel-filings are sometimes added. Camphor, gum benzoin, and storax are frequently mixed with the powders to give an aromatic odor and mask the unpleasant odors arising from the firing of the mixtures without such addition. See Thorpe's *Dictionary of Applied Chemistry*, vol. iii. Revised by IRA REMSEN.

Pyroxene: See AUGITE.

Pyroxylic Spirit: See METHYL ALCOHOL.

Pyrox'ylin [Gr. πῦρ, fire + ξύλον, wood]: the technical name for guncotton. (See EXPLOSIVES.) When cellulose (cotton) is treated with concentrated nitric and sulphuric acids, it undergoes changes of the same kind as those effected in glycerin by the action of these acids. Different products are obtained, according to the strength of the acids, the temperature, and the time. The final product is the *hexanitrate*, $C_{12}H_{14}(NO_3)_6O_4$. Other products are the *pentanitrate*, $C_{12}H_{15}(NO_3)_5O_6$, the *tetra-*, *tri-*, and *di-nitrates*. The hexanitrate is the most explosive and is the true guncotton. It is made by treating dried cotton for twenty-four hours at 10° C. with a mixture of 1 volume nitric acid (sp. gr. 1·5) and 3 volumes sulphuric (sp. gr. 1·845). The lower nitrates are used for making COLLODION (*q. v.*) for photographic purposes. These are principally the tetra- and pentanitrates, which are made by using less concentrated nitric acid and a somewhat higher temperature than in the manufacture of guncotton. Among the directions given for its preparation is the following: Add 1 part cotton to a mixture of 20 parts saltpeter and 31 parts sulphuric acid (sp. gr. 1·830–1·835), the temperature of the mixture not above 50° C. The whole is allowed to stand twenty-four hours at 28–30° C., and then washed with water. The product dissolves in a mixture of 7 to 8 parts ordinary ether and 1 part alcohol. It is mainly the tetranitrate. "The pyroxilin made from tissue-paper for the celluloid manufacturers is made by taking 50 cubic cm. of nitric acid of 1·47 specific gravity, 100 cubic cm. nitric acid of 1·36 specific gravity, and 100 cubic cm. of sulphuric acid of 1·84 specific gravity. In this mixture 18 grammes of the finely shredded tissue-paper are immersed at a temperature of 55° C. for one hour. The paper gains about 40 per cent. in weight in the nitration" (*Sadtler*). IRA REMSEN.

Pyrrha: See DEUCALION.

Pyr'rhic Dance (in Gr. Πυρρίχη ὄρχησις): a Grecian war-dance in full armor. It originated in Dorian Crete, where its prototype was the dance instituted by the Curetes to drown the cries of the infant Zeus, though the Spartans referred it to Castor and Pollux, and the Athenians to Dionysus and Athene. It was a mimic fight, intended to illustrate the art of attack and defense. It became popular in imperial Rome. J. R. S. STERRETT.

Pyrrho of Elis: Greek philosopher 365–275 B. C.; founder of the skeptical school of philosophy and still used as a type of the doubting spirits. Nothing left in writing. See Ch. Waddington, *Pyrrhon et le pyrrhonisme* (Paris, 1877).

Pyrrhus [= Lat. = Gr. Πυρρός, liter., fire-colored, red-headed, deriv. of πῦρ, fire]: 1. Another name for Neoptolemus, the son of Achilles and Deidamia. 2. A king of Epirus, who claimed descent from Achilles through Neoptolemus. He was born in 318 B. C. of Æacides and Phthia. Æacides was banished when Pyrrhus was two years old, but trusty servants saved Pyrrhus and brought him to the court of Glaucias, King of the Taulantians. In 307 Glaucias succeeded in placing the boy on the throne, but in 302 he was banished, fled to Demetrius Poliorcetes, distinguished himself in the battle of Ipsus in 301, betook himself to Egypt, married the stepdaughter of Ptolemy, received money and troops from Ptolemy, and in 295 once again became King of all Epirus. He then embarked with varying fortune in wars against the neighboring princes, including Demetrius, King of Macedonia. In 287 he became King of Macedonia also in the stead of the fallen Demetrius, but soon lost it to Lysimachus. In 281 he espoused the cause of the Tarentines against Rome, and in 280 landed in Tarentum with 25,000 troops and 20 elephants, won in the battle on the Siris, advanced upon Rome, and won again at Asculum in 279. But when Rome and Carthage combined against him he abandoned Italy and applied himself to the conquest of Sicily, where at first he was received with joy and fought with success, but when he encountered the firm resistance of the Carthaginians at Lilybæum, the fickle Sicilians abandoned his cause for that of Carthage. In disgust he evacuated Sicily and returned to Italy in 276, after his fleet had been defeated by the Carthaginians, and in 275 he was utterly defeated by M. Curius Dentatus at Beneventum. Collecting the remnants of his army, he returned to Epirus in 274, leaving at Tarentum a garrison. He then attacked Antigonus of Macedonia and actually annexed a large part of that kingdom. In 272 he undertook the conquest of the Peloponnesus at the call of Cleonymus, King of Sparta; he attacked Sparta, was repulsed, retreated to Argos, where he was met by the forces of Antigonus of Macedonia; a fight ensued in the streets of Argos; Pyrrhus was knocked senseless by a brick hurled from a housetop by the mother of a man whom Pyrrhus was about to kill. He was then dispatched by one of the soldiers of Antigonus in 272 B. C.
J. R. S. STERRETT.

Pyrus: a genus of rosaceous trees and shrubs of some fifty species, among which are the APPLE, PEAR, and QUINCE (*qq. v.*).

Pythag'oras: a Greek philosopher, supposed to have been born at Samos about 582 B. C.; to have been the son of Mnesarchus; his earliest teacher to have been Pherecydes the Syrian, from whom he may have received Egyptian and Zoroastrian lore; his next teacher to have been Anaximander, who taught that the principle (ἀρχή) of things is the unlimited or indefinite (ἄπειρον); in early life to have traveled through Ionia, Phœnicia, and Egypt, where he was initiated into the mysteries by the priests. Some would have it that he was even carried away to Babylon, with other Egyptian prisoners, by Cambyses, who made his raid on Egypt in the year 525 B. C.; but the weight of authority

favors the view that he repaired to Crotona, in Lower Italy, 529 B. C., and there established a society with ethical, political, and philosophic tendencies. His school was allied with the aristocratic party, and consequently incurred the animosity of the democratic party. This occasioned (about 510 B. C.) the retirement of Pythagoras to Metapontum, where he died soon after. His school spread rapidly, and, after the manner of Oriental systems, was semi-ethical and religious, semi-political and social, tending to produce a fusion of state and hierarchy. It has bequeathed to us a multitude of philosophemes on mathematics, music, and astronomy, as well as on ethics. The doctrines of metempsychosis, of the cyclic return of events, of contraries (*ἐναντίαι*) —according to which he added to the principle of his master, Anaximander (which was "the unlimited"), its opposite, the limiting (*περαίνοντα*)—indicate Persian or Egyptian influence. This Oriental tendency may have had another origin than those named (his teachers or his travels), so far as the writings of his school are concerned (for no writing of the master has come down to us), in the Crotonian school of medicine, of whom Democedes, the celebrated physician, had resided at the Persian court under Darius. What belongs to the disciples and what to the master can not be told. Pythagoras is said to have anticipated the Copernican doctrine, making the sun the center of the cosmos; also to have discovered the numerical ratio existing between musical tones of the gamut (either by length of strings or by their degrees of tension). He is famous, according to Aristotle and subsequent writers, for his doctrine that "number is the principle of all things, and that the organization of the universe is an harmonic system of numerical ratios"; but this may be the doctrine of the Pythagoreans rather than of the founder of the school. There is, however, less doubt as to the fact that he sought to establish a new ethical basis for society in place of the unconscious use and wont that had prevailed up to his epoch. He laid the greatest stress on the discipline of the will into obedience, temperance, silence, self-examination, simplicity in personal attire, and self-restraint in all its forms. The original sources of information regarding him are Aristotle (*Met.*, i., 5; *Phys.*, iii., 4; *De Cœlo*, ii., 13 and 9; *Eth. Nic.*, v., 8), the writings of Aristotelian commentators, Herodotus (ii., 81; iv., 94–96, etc.), and the (mostly spurious) writings of his disciples, Philolaus, Ocellus Lucanus, Timæus Locrus, Archytes of Tarentum, Epicharmus, and the Neo-Platonists Iamblichus and Porphyry; Diodorus Siculus and Diogenes Lærtius are to be added to this list. W. T. Harris.

Pytheas (in Gr. *Πυθέας*): 1. An Athenian orator and antagonist of Demosthenes. 2. A native of Massilia (Marseilles), a geographer and navigator, who in the time of Alexander the Great made two voyages of discovery along the western and northwestern coasts of Europe from Gibraltar to Iceland. His accounts of his travels were received by the ancients with incredulity and disgust as being fables, but it is now known that they were in the main correct. His books, the chief of which was *τὰ περὶ ὠκεανοῦ*, are known only from the adverse criticism of later writers.

J. R. S. Sterrett.

Pyth'ia (in Gr. *Πυθία*): the priestess of the Pythian Apollo in Delphi. In early times this priestess was a virgin, but later on she was a married woman, more than fifty years of age, dressed as a virgin. There were two regular priestesses with an assistant, who acted as priestess in case of emergency. Clothed in long rich robes and with golden ornaments in her hair, the Pythia, after prayer, sacrifice, and the required purifications had been duly performed, took her seat upon the sacred tripod, which stood over the Castalian spring. The vapors that ascended from this spring, sacred to Apollo, were supposed to inspire her answer. The response of the god through the Pythia was usually couched in hexameters, though official versifiers stood ready to turn the answers into verse in case the Pythia made use of prose. In later times the response of the god was given regularly in prose. J. R. S. Sterrett.

Pythian Games [Gr. *τὰ Πύθια*, deriv. of *Πυθώ*, Pytho or Delphi]: festivals held late in August of the third year of each Olympiad at Delphi, in Phocis, in honor of Apollo, who established them in commemoration of his victory over the Python, a frightful dragon that lived on Mt. Parnassus. Originally the contests were purely musical, and consisted of songs accompanied by the lyre and by the flute, together with contests on the flute alone. After the sacred war (355–346 B. C.) the festivals were conducted under the direction of the Amphictyonic Council. A day devoted to athletic sports similar to those held at Olympia was added and by degrees various forms of horse races and chariot races were introduced. See Delphi, Olympian Games, and Mommsen, *Delphika*. B. B. Holmes.

Pyth'ias: See Damon and Pythias.

Python: See Boa.

Pyx [from Lat. *py'xis* = Gr. *πυξίς*, box, liter., a boxwood box, deriv. of *πύξος*, boxwood]: (1) a sacred vessel, having usually the form of a covered cup with a foot, used in the Roman Catholic Church to contain the sacred wafer when preserved after consecration; (2) the strong box used in the mint for the safe keeping of coins set apart from each successive coinage to be examined by a commission of experts for the purpose of testing their accuracy as to weight and fineness.

The examination of these reserved coins is called the "trial of the pyx," and in Great Britain this trial takes place "at least once in every year in which coins have been issued from the mint" before a sworn jury of at least six goldsmiths. Should the coins have been found accurate in weight and fineness within the limits allowed by law, commonly called *tolerance* or *remedy*, no further proceedings are taken; but in case the coinage in either or both these respects be found inexact, the officers of the mint are liable to censure or more serious penalties.

In the U. S. it is provided that a trial of the pyx shall be made at the mint in Philadelphia on the second Wednesday in February, annually. This takes place before the judge of the district court of the U. S. for the eastern district of Pennsylvania, the comptroller of the currency, the assayer of the New York assay-office, and other persons designated by the President. A majority of the commissioners constitute a competent board. Their examination is to be made in the presence of the director of the mint. The reserved coins from the coinage of other mints besides that at Philadelphia are transmitted quarterly to the Philadelphia mint; and in addition to these the director may at pleasure take any other pieces as tests. If the coins are within the limits of tolerance in fineness and weight, their report is simply filed; but if deviation in either or both respects is discovered, exceeding the limits of tolerance, the fact is to be certified to the President of the U. S., and "if, on a view of the circumstances of the case, he shall so decide, the officer or officers implicated in the error are thenceforward disqualified from holding their respective offices."

Q

: the seventeenth letter of the English alphabet.

Form.—The form is derived through the Latin alphabet from the Greek koppa Ϙ. This letter was used in the older Greek writing to indicate the velar or back-guttural sound of *k* occurring before the vowels *o* and *u*. From about 525 B. C. onward it was gradually displaced by kappa, and finally passed entirely out of use except as a numeral sign (= 90). The Semitic form of the letter was ϕ.

Name.—The Greek name koppa or qoppa (Ϙόππα) is an adaptation of the Semitic name *Qoph*, meaning head, back of head. This name was doubtless chosen analogously with the other letter-names, both because of the fancied resemblance of the letter to the human head and neck and because the sound of the letter was initial in the name. The English name *kyoo* (i. e. *kyū*), of which the variant *kyoof* occurs, is successor to O. French *cu*, Lat. *qu*.

Sound.—The letter occurs in English only in the combination *qu*, which generally has the sound *kw*, as in *quite*, *queen*, *equal*. This is a labialized guttural explosive, a single sound in which the *k*-position and the *w*-position are formed simultaneously and not successively; cf. *tw* in *twice*. The digraph *qu* stands for simple *k* in many late loan-words from the French, as *coquette*, *etiquette*, *piquant*, *grotesque*, *critique*, *bouquet*.

Source.—When it has the value *kw* the digraph *qu* commonly represents either (1) O. Eng. *cw* < Indo-Europ. *g* (velar-guttural); thus *queen* < O. Eng. *cwene*, cf. Sanskr. *gnā*, Gr. γυνή; *quick* < O. Eng. *cwic*, cf. Lat. *vivus*, Sanskr. *jivá-*; or (2) O. Fr. *qu* in loan-words which entered English before the French *qu* became *k*; thus *quart*, *quit*, *quarrel*, *quest*, *bequest*.

Symbolism.—Q = Quintus, question, farthing (*quadrans*); Q. d. = as if he should say (*quasi dicat*); Q. e. = which is (*quod est*); Q. E. D. = which was to be proved (*quod erat demonstrandum*); Q. v. = which see (*quod vide*).

BENJ. IDE WHEELER.

Qua-bird, or **Quawk**: the NIGHT-HERON (*q. v.*).

Quadrages'ima [= Lat., fortieth]: a name for LENT (*q. v.*), or for the first Sunday in Lent.

Quadrant [from Lat. *qua'drans*, *quadran'tis*, a fourth part, fourth of a whole, deriv. of *quat'tuor*, four]: in its common signification, a quarter of the circumference of a circle, or ninety degrees; in navigation and astronomy, an instrument for measuring angles, having a limb divided to ninety degrees. Astronomical quadrants of large dimensions were employed by the early observers for measuring meridian altitudes, being for this purpose firmly fixed in the plane of the meridian, but they were superseded by the mural circle, which, in its turn, has given way to the transit circle. In navigation the quadrant is superseded by the sextant. (See SEXTANT.) The invention of the quadrant is commonly ascribed to John Halley, a friend of Newton, on the ground that the instrument was first described by him in a paper read before the Royal Society in 1731, but the invention was independently made in 1730 by Thomas Godfrey, of Philadelphia, whose description was given to the same society in 1732; and the society decided the honor of the invention to belong equally to both. The real originator, however, of the ingenious idea on which the invention is founded was Sir Isaac Newton, who so early as 1727 communicated it to Halley, then astronomer-royal, in a paper which came to light only after the death of the latter in 1742.

Revised by S. NEWCOMB.

Quadratic Equation [*quadratic* is from Lat. *quadra'tus*, squared, deriv. of *quadra're*, make square, (in math.) square, deriv. of *quat'tuor*, four]: an equation of the second degree, containing but one unknown quantity. Every quadratic equation may be reduced to the form

$$x^2 + 2px = q, \qquad (1)$$

in which expression p and q represent known quantities; and when it has been so reduced the two roots of the equation are

$$-p + \sqrt{q + p^2}, \text{ and } -p - \sqrt{q + p^2}. \qquad (2)$$

If $q < p^2$, the roots are both real; if q is negative, and numerically equal to p^2, the two roots are equal; if q is negative, and numerically greater than p^2, both roots are imaginary. If p is equal to 0, the equation is said to be incomplete, and its roots are then numerically equal with contrary signs; in this case the roots are real when q is positive and imaginary when q is negative. The following properties are common to all quadratic equations, after being reduced to the form (1): (1) Every quadratic has two roots and only two. (2) If all the terms are transposed to one member, that member can be resolved into two factors of the first degree with respect to the unknown quantity, the first term of each factor being the unknown quantity and the second terms being the two roots, each taken with a contrary sign. (3) The algebraic sum of the two roots is equal to the coefficient of the second term with its sign changed. (4) The product of the two roots is equal to the second member with its sign changed. (5) If the second term is negative, and numerically greater than the square of half the coefficient of the second term, both of the roots are imaginary. See EQUATION and IMAGINARY QUANTITIES.

Quadrature [from Late Lat. *quadratu'ra*, deriv. of *quadra're*, make square, reduce an area to a square]: the operation of finding an expression for the area bounded by a line or lines, straight or curved, on a plane. See MENSURATION.

Quadrature of the Circle: the geometrical problem of finding a square whose area shall be rigorously equal to that of a given circle. It is one of four celebrated problems vainly attacked by the ancients, the other three being (1) the duplication of the cube, or the construction of a line the cube of which shall be double that of a given line; (2) the trisection of an angle; and (3) the insertion of two geometric means between two given lines. All of these problems are shown by modern mathematics to be unsolvable in the ancient sense; that is, it is shown that they can not be constructed by the ruler and compass, as problems in elementary geometry are required to be constructed by Euclid's postulates. The reasoning is very simple: No quantities can be constructed from given quantities except those which can be formed from them algebraically by the solution of quadratic equations; if the algebraic solution appears as the root of an equation of the third or higher degree, unsolvable by quadratics, then it can not be constructed geometrically.

The problem of the quadrature of the circle may be expressed in two different ways, according as an analytical or geometrical solution is required. The geometrical solution would, as we have already said, consist in constructing, by the ruler and compasses, a square which shall be equal to a given circle. The algebraic solution would consist in finding some numerical expression for the ratio between the diameter of a circle and the side of a square equal to it in area. Since the area is known to be equal to the rectangle contained by half the diameter and half the circumference, this problem amounts to the same thing as constructing a line which shall be equal in length to the circumference of a circle whose diameter is given. The question of its possibility could be settled only by showing that the numerical representation can not be made by solving a series of quadratic equations. That this is impossible has long been recognized, but never rigorously proved until the year 1882, when Lindemann, of Königsberg, showed that the ratio of the diameter to the circumference, commonly represented by the symbol π, could not be represented as the root of any algebraic equation whatever with rational coefficients.

The arithmetical solution may be expressed in two ways: (1) to construct an expression which shall represent the number π; (2) to express π to any extent by decimals. As to the first form, no expression which shall be at the same time rational and finite is possible, a result which follows at

once from Lindemann's theorem; but there are a number of infinite series which are equal to π, among which we may mention the following:

$$a = \frac{1}{2} - \frac{1}{3\cdot 2^3} + \frac{1}{5\cdot 2^5} - \frac{1}{7\cdot 2^7} + \text{etc.}$$

$$a' = \frac{1}{5} - \frac{1}{3\cdot 5^3} + \frac{1}{5\cdot 5^5} - \frac{1}{7\cdot 5^7} + \text{etc.}$$

$$a'' = \frac{1}{8} - \frac{1}{3\cdot 8^3} + \frac{1}{5\cdot 8^5} - \frac{1}{7\cdot 8^7} + \text{etc.}$$

$$\pi = 4(a + a' + a'')$$

$$b = \frac{1}{5} - \frac{1}{3\cdot 5^3} + \frac{1}{5\cdot 5^5} - \frac{1}{7\cdot 5^7} + \text{etc.}$$

$$b' = \frac{1}{239} - \frac{1}{3\cdot 239^3} + \frac{1}{5\cdot 239^5} - \text{etc.}$$

$$\pi = 16b - 4b'$$

If we attempt to represent the number π as a decimal fraction the decimals will go on without end. The practical question is simply that of computing any number of them. Various computers since the sixteenth century have made the computation to a great number of decimals, among whom the following are worthy of mention: In 1590 Ludolph von Keulen, of Leyden, computed it to thirty-five decimals. This work led to the term Ludolphean number, which the German mathematicians frequently use for π. In 1719 Lagny, a French mathematician, carried the computation to 121 decimals. During the nineteenth century Dr. Clausen, of Dorpat, calculated 250 decimals. In 1844 Dase, of Vienna, carried the computation to 200 figures. Dr. Rutherford, of London, and Shanks, of Durham, then entered into a competition in the matter, and the latter carried the computation to 607 decimals, as follows:

$\pi = 3{\cdot}14159$ 26535 89793 23846 26433
83279 50288 41971 69399 37510
58209 74944 59230 78164 06286
20899 86280 34825 34211 70679
82148 08651 32823 06647 09384
46095 50582 23172 53594 08128
48111 74502 84102 70193 85211
05559 64462 29489 54930 38196
44288 10975 66593 34461 28475
64823 37867 83165 27120 19091
45648 56692 34603 48610 49432
66482 13393 60726 02491 41273
72458 70066 06315 58817 48815
20920 96282 92540 91715 36436
78925 90360 01133 05305 48820
46652 13841 46951 94151 16094
33057 27036 57595 91953 09218
61173 81932 61179 31051 18548
07446 23798 34749 56735 18857
52724 89122 79381 83011 94912
98336 73362 44193 66430 86021
39501 60924 48077 23094 36285
53096 62027 55693 97986 95022
24749 96206 07497 03041 23669
29133 32 +, etc.

The effect of omitting the decimals which follow the six-hundredth is so slight that if the number as given were used to calculate the circumference of the entire visible universe the error would be inappreciable in the most powerful mieroseope. Revised by S. Newcomb.

Quadriga'rius, Quintus Claudius: a Roman historian of the first century B. C., who displayed a greater critical faculty than most of the early annalists. Beginning his history with the capture of Rome by the Gauls, because authentic documents for the early period were lacking, he continued it down to the time of Sulla in at least twenty-three books. For the fragments, see Peter, *Hist. Rom. Frag.*, pp. 136–151 (Leipzig, 1883). M. W.

Quadrilateral, The: the name commonly applied to the four Italian strongholds of Peschiera, Mantua, Verona, and Legnago, or to the trapezoidal-shaped territory the angles of which are indicated by these four towns. The Mincio forms its western and most important defensive line, and the Adige the eastern. From Peschiera to Verona is 15 miles, and from Mantua to Legnago 21 miles. This quadrilateral has formed the base of all military operations against Italy during almost a thousand years; its possession has been supposed to assure control of the peninsula. It has constantly been strengthened with utter disregard of expense. Austria's possession of it was a standing menace to the unification of Italy, but the alliance of the latter power with Prussia forced Austria to withdraw after the disastrous defeat at Sadowa (1866). In like manner Rustchuk, Silistria, Shumla, and Varna, form the quadrilateral of the Balkan peninsula, and were considered the main defense of Constantinople and of the Ottoman possessions in Europe until the Russo-Turkish war of 1877. It was then flanked, and the Ottoman empire conquered, although the Russians had been unable to reduce either of the four strongholds. The third or Asiatic quadrilateral was formed by Batum, Ardahan, Kars, and Baiezid at the northeast of the Ottoman possessions in Asia. All but Batum were captured by the Russians in 1877. The Treaty of Berlin ceded Batum, Ardahan, and Kars to Russia, leaving only Baiezid to the Ottomans. The four were a defensive, almost impregnable, line of fortresses rather than a real quadrilateral, though so called. E. A. Grosvenor.

Quadru'mana [Lat., four-handed; *quattuor*, four + *manus*, hand]: a name employed by Blumenbach (in 1791) as an ordinal designation for the monkeys, lemurs, and related types, man having been isolated as the representative of a peculiar order named *Bimana*. The views thus expressed were for a long time predominant, but a closer study of the structure of the forms indicated by those names has convinced almost all naturalists that they were erroneously separated, and the two types are now generally combined in one order named *Primates*, under which head man and the monkeys are combined in one sub-order (*Anthropoidea*), and contrasted with the lemurs, which constitute another sub-order (*Prosimiæ*). See Primates.

Revised by F. A. Lucas.

Quæstor [Lat. *quæstor*: Oscan, *kvaìsstur*: Umbrian, *krestur*, an ancient Italic official title, commonly associated with *quæ'rere*, search, investigate]: a magistrate of ancient Rome, appointed originally, the name would seem to imply, to assist the consuls in the detection of crime and the administration of justice, and later serving as their assistants in various capacities. Their number increased with the growth of Rome from four in 421 B. C. to twenty in the time of Sulla, and was raised to forty by Julius Cæsar, but reduced again to twenty by Augustus. The quæstorship, as being an office subordinate to a superior magistracy, was the lowest in the series of public offices (*cursus honorum*). At first it would seem that quæstors were chosen by the consuls, but from a comparatively early time (which can not be exactly determined) they were elected by the people. The duties of the quæstors may have been originally as extensive and manifold as those of the consul whom they served, but in the course of time certain special spheres of activity were assigned to them. At Rome they were charged with criminal jurisdiction (jurisdiction in civil suits falling to the prætor), with the management of the public finances and of the state archives. In the provinces the duties of the quæstor consisted in the management of financial affairs for his superior officer, at whose request or command he might also perform other tasks. Election to the quæstorship carried with it admission to the senate. G. L. Hendrickson.

Quagga: See Zebra.

Quahog, kwaw'hog, or **Quahaug** [of Am. Ind. origin]: the hard clam, *Venus mercenaria*, of the eastern coast of the U. S. See Clam.

Quail [from O. Fr. *quaille*, from Mediæv. Lat. *qua'quila*, from Dutch *kwakkel*, so called from its cry < *kwaken*, quack]: the popular name for various small gallinaceous birds, but strictly speaking belonging to the common quail (*Coturnix communis*) of Europe, Asia, and Northern Africa, a member of the sub-family *Perdicinæ*, and a near relative of the Partridge (*q. v.*). The European quail is 7 inches long, brownish or reddish gray above, marked with streaks of buff; below, general pale buff, fading into white on the belly. It is believed to be the quail mentioned in Exodus, but that bird may have been the sand-grouse (*Pterocles arenaria*). The great majority of European quails winter in Africa, and vast numbers are taken for market in Southern Europe during their migrations. Other members of the genus occur in Asia, Australia, and New Zealand. In the U. S. the name is commonly bestowed on the well-known bob-white (*Colinus virginianus*), the "partridge" of the Southern States, but is often extended to other species, such as the California quail (*Callipepla californica*). The New World birds belong in the sub-family *Odontophorinæ*.

F. A. Lucas.

Quain, Richard, F. R. C. S., F. R. S.: anatomist and surgeon: b. at Fermoy, Cork, Ireland, in 1800; studied at the Windmill Street and Aldersgate schools of medicine, London; in 1825 went to Paris to study; in 1828 became a demonstrator and in 1832 Professor of Anatomy in the Uni-

versity of London; in 1834 became assistant surgeon and in 1850 surgeon to the North London Hospital; retired in 1866. He held a number of official positions in the Royal College of Surgeons, being its president in 1868. In 1869 he delivered the Hunterian oration, his subject being *Some Defects in General Education*. He was surgeon extraordinary to the Queen. His elaborate treatise on the *Anatomy of the Arteries of the Human Body* ranks as a classical work. Among his other publications are *Diseases of the Rectum* (London, 1854) and *Clinical Lectures* (London, 1884). He edited, with others, the fifth edition of *Quain's Anatomy*, originally written by his brother, Jones Quain (1796–1865). D. in London, Sept. 15, 1887.—His cousin, Sir Richard Quain, LL. D., b. at Mallow, Ireland, Oct. 30, 1816, became in 1857 a fellow, and in 1889 was vice-president of the Royal College of Physicians. He was physician extraordinary to the Queen and edited the *Dictionary of Medicine* (1883; 2d ed. 1894). D. Mar. 30, 1898. S. T. Armstrong.

Quakers: See Friends, Society of.

Quaking-grass: any grass of the genus *Briza*. The spikelets are ovate, and have such delicate stalks that a light wind sets them quaking and rattling. *B. maxima* and *B. media*, from Europe, are cultivated in gardens, and the latter is partly naturalized in the U. S. In Europe it is considered a good pasture-grass for poor mountain lands. Its seeds lose their vitality in a short time after their ripening.

Quang-See: an old spelling of Kwangsi (*q. v.*).

Quang-Tong: an old spelling of Kwangtung (*q. v.*).

Quantin, kaǎn'tăn', Albert Marie Jérôme: printer; b. at Bréhémont, Indre-et-Loire, France, Jan. 19, 1850; studied law in Paris; became director of the Claye printing-establishment, at Tours, in 1873; moved to Paris; became printer to the Chamber of Deputies; published *Bibliothèque de l'Enseignement des Beaux-Arts* (to comprise 100 vols.) and special *Annuaires*, and wrote *Origines de l'Imprimerie et son Introduction en Angleterre* (1877).

Quantity (in meter): the time consumed in uttering syllables, or the duration of syllables. It is, of course, relative. The duration of a short syllable in slow utterance may be as great as that of a long syllable in rapid utterance.

Quantity and quality (nature, timbre) are often confounded. When the first *o* in "co-operate" is called "long" and the second one "short," these terms should be understood only of the quality. The confusion is increased, or rather the error is emphasized, by the use of quantity marks (–, ⏑) to indicate these sounds. The same remark applies also to *e* and *u*. Difference of quantity is, no doubt, often associated with difference of quality, but the latter does not constitute the former.

Among the ancient Greeks there was a dispute between the so-called rhythmists (*ῥυθμικοί*) and the metricians (*μετρικοί*) concerning quantity. The rhythmists held that syllables had a great variety of lengths. To illustrate this, some of them assumed the short vowel as a fixed unit, regarded a long vowel as equal to two short ones, and counted each consonant added to a vowel as equal to half a short vowel; hence they placed, for instance, $\epsilon = 1$, $\epsilon\nu = 1\frac{1}{2}$, $\epsilon\nu\tau = 2$, etc., $\eta = 2$, $\eta\nu = 2\frac{1}{2}$, $\eta\nu\tau = 3$, etc. The metricians, on the other hand, held that short syllables had a uniform length, and that long syllables were just twice as long. One writer, Aristoxenus, appears to have seen that syllables had no fixed length nor definite relation to each other, but were vaguely divisible into longer and shorter, with some doubtful cases. In constructing rhythm the long syllable was given twice the length of a short one, while the doubtful syllables were made either long or short, and were called "common." In particular cases any syllable, however long, could be shortened into an irrational (*ἄλογος*), so as to count as a short. Such syllables are not to be confounded with the "common" ones. Also in special cases a syllable could be made equal to three short ones, or four, or even more; but such prolongation, especially within a word, was confined, for the most part, to poetry intended to be sung.

While the ancient languages had great variety of quantity, that of each particular syllable was more fixed than with us. This may be seen by applying English analogy to ancient words. All pronounce "amicus," "amavi" with the second syllables long; but in "amicitia," "amavisti" many make those same syllables short, whereas they were just as long as in the former words. To the Roman ear āmăbāmŭs would have been as barbarous as "āmăbam."

In Greek and Latin, syllables are long "by nature" (*φύσει*, *natura*) when their vowel element is a long vowel or a diphthong; and long "by position" (*θέσει*, *positione*, i. e. by convention) when a short vowel is followed by a double consonant (*ζ*, *ξ*, *ψ*), or two or more consonants; but certain mutes followed by certain liquids do not necessarily lengthen a syllable. It will thus be seen that, while in syllabication we follow the musicians and connect as many consonants as possible with the vowel following, as *κλέ-πτω*, in prosody we connect as many as possible with the preceding vowel, as *κλέπτ-ω*. In fact, in speaking, it is the vowel before several consonants, rather the one after them, that is felt to drag. In singing, consonants are reduced to a minimum and carried forward.

It has often been denied that there is any consciousness of quantity in English. It is true that we do not feel any definite relation of long syllables to short ones in reading or speaking as we do in singing (and, indeed, this was the case with the ancients); but that there is sometimes difference of quantity can be perceived by comparing "furrow" with "furlough," "bonnie" with "spondee," "tory" with "turnkey," etc. In reading verse, however, we merely make the feet approximately equal without feeling or perceiving exactly how it is accomplished, just as in singing we can give the voice a definite pitch without any consciousness of the vibrations that determine the pitch.

Milton W. Humphreys.

Quantity, Imaginary: See Imaginary Quantities.

Quanza: See Cuanza.

Quarantine [liter., a space of forty days, from O. Fr. *quarantaine*: Ital. *quaranti'na*, a forty of anything, deriv. of *quaran'ta*: O. Fr. and Fr. *quarante*, forty]: the time (formerly forty days) during which vessels and their passengers, cargo, etc., are detained and isolated on entering a port when they carry or are suspected of carrying contagion. The term is also used to denote such detention and isolation and, collectively, all the means employed therein.

History of Quarantine Regulation.—The necessity for quarantine, as now understood, arose out of the development of commerce, and it is generally believed that the earliest quarantine regulations were those promulgated about the beginning of the fifteenth century by Venice (then the greatest sea mart of the world) as a protection against the plagues of the East—the black plague and the Egyptian plague. As early as 1348 the household goods of those that died were destroyed, and health officers were appointed; the first lazaretto was established in 1403, and suspected incoming vessels, with their passengers and cargoes, were detained and isolated for forty days. Later, and especially in the eighteenth century, lazarettoes were established and maintained at most of the Mediterranean ports. These early lazarettoes, together with the sanitary cordons established about nearly all the principal cities, were directed only against the plague. Their measures taken for protection were often needlessly harsh, owing to the lack of scientific knowledge of the cause of the malady and of the means by which it spread. In the latter part of the eighteenth century efforts were made by John Howard and others to improve the lazarettoes and hospitals and to combat foolish superstitions and practices, and in the early part of the nineteenth century a call was made for an international congress to consider quarantine measures. By this time the plague had waned in power and had invaded Europe as an epidemic for almost the last time. Since the year 1821 quarantine regulations have, in the main, been directed against the yellow fever and cholera, although they are intended to act likewise as barriers to the ingress of all contagious or infectious maladies.

Quarantine Regulations in the U. S.—The present U. S. quarantine laws and regulations, the latter promulgated Apr. 26, 1894, are designed to obviate the detention of incoming vessels and passengers in so far as this is compatible with the practically absolute exclusion of infectious diseases, which is, of course, their paramount aim. As a means both to prevent delay and to exclude contagion, quarantines have been established by the U. S. Government at all foreign ports of departure, and every vessel leaving such a port for that country must have a bill of health from the proper U. S. officer, consular or medical, "setting forth the sanitary condition and history of the vessel, and that it has in all respects complied with the rules and regulations." There must be a personal inspection by the officer of "all vessels from ports at which cholera prevails, or at which yellow fever, smallpox, or typhus fever prevails in epidemic form,"

and "all vessels carrying steerage passengers." It is also required that all vessels shall be thoroughly clean before receiving cargo, crew, or passengers; that the bedding for steerage passengers must be renewed or disinfected before being used on the voyage; and that, if there were any case of infectious disease on the last voyage, all parts of the vessel that could possibly have been infected must be disinfected. The regulations as to the cargo vary according to its character.

The treatment of passengers is somewhat different according as they belong to the cabin or steerage class; but no one with cholera, smallpox, yellow, typhoid, or scarlet fever, measles, or diphtheria is allowed to ship, nor should any be received from an infected port. The weekly reports of the consular officers keep the Government well informed as to the exact sanitary condition of all ports of departure and the districts adjacent thereto or in direct communication with them.

Cabin passengers from ports or districts where cholera or other infectious diseases are prevalent are subject to inquiry as to their place of abode for the five days immediately preceding departure, and may be detained as long as the inspecting officer thinks best, and may also be required to have their baggage disinfected if there is any suspicion of exposure to infection. Steerage passengers and members of the crew from cholera-infected districts must be detained five days, those who have been exposed to typhus fever fourteen days, in suitable quarters, "the said periods to begin only after the bathing of the passengers, disinfection of all their baggage and apparel, removal of all food brought with them, and isolation from others not so treated." The same rules are applicable to those from districts where plague, smallpox, or yellow fever is prevailing and epidemic, and if any one of these five diseases should appear among those thus detained there must be a second isolation for the prescribed time, disinfection, etc., the new detention counting from the removal of the last case from the detention-barracks. Every passenger must have an inspection-card bearing the stamp of the proper officer, the name of the passenger, ship, and port of departure, and date of the latter, and all baggage must have labels with similar data (excepting passenger's name), and with statement and date of inspection or disinfection.

Under the terms of the statute the President has power, whenever existing conditions appear to justify it, "to prohibit, in whole or in part, the introduction of persons and property from such countries or places as he shall designate, and for such periods of time as he shall deem necessary."

The regulations require during the voyage a daily inspection, free ventilation, and thorough cleanliness of the vessel, isolation of the sick, etc., and at the port of entry the only delay required is that which will enable the proper officials to inspect the ship, crew, passengers, baggage-labels, ship's bill of health, physician's record, etc.

The Government provides for the maintenance of this inspection service at every port of entry under its jurisdiction throughout the year, and it applies to all vessels from foreign ports, all vessels with sickness on board or in which sickness has appeared since leaving the port of departure, and vessels from domestic ports where cholera or yellow fever prevails or where smallpox or yellow fever is epidemic. To these requirements the proper State or local authorities may add such others as may seem to them to be advisable or necessary.

The inspection being completed, and everything proving satisfactory to the inspecting officer, he fills out his certificate, which, together with the bill of health from the officer at the port of departure, must then be given to the collector of customs of the port, and without these two papers no vessel is permitted to disembark any of its passengers or cargo. Should there be any evidence or belief that there is possibly infectious matter on board, the inspector orders the vessel to proceed at once to the nearest national or other quarantine station, there to undergo treatment.

The following extracts from the regulations indicate the vessels that are to be remanded to quarantine at once by the inspecting officer of the port of entry: A. Those with quarantinable disease on board, the quarantinable diseases for the purposes of these regulations being cholera (cholerine), yellow fever, smallpox, typhus fever, and leprosy. B. Those having had such on board during the voyage or within thirty days next preceding arrival; or, if arriving in the quarantine season, having had yellow fever on board after Mar. 1 of the current year, unless satisfactorily disinfected thereafter. C. With some exceptions, those from ports infected with cholera, or where typhus fever prevails in epidemic form, coming directly or viâ another foreign port, or viâ United States ports, unless they have complied with the United States quarantine regulations for foreign ports: also vessels from non-infected ports, but bringing persons or cargo from places infected with cholera, yellow fever, or where typhus fever prevails in epidemic form. D. With some exceptions, those from ports where yellow fever prevails, unless disinfected in accordance with these regulations, and not less than five days have elapsed since such disinfection. Certain exceptions, with respect to vessels that would otherwise be quarantined on account of yellow fever, are made to rules C and D in consideration of (1) the time of arrival, as vessels arriving from Nov. 1 to May 1 may be admitted to entry: (2) the port of destination, as vessels with clean bills of health, etc., bound for ports in the U. S. N. of the southern boundary of Maryland, provided they have been five days from last infected or suspected port; (3) the nature of the cargo, as vessels engaged in the fruit-trade from ports declared safe, etc.

"No case of leprosy will be landed, and vessels arriving at quarantine with leprosy on board shall not be granted pratique until the leper with his or her baggage has been removed to the quarantine station"; and if the leper is an alien, measures are to be taken to have him returned to his native country.

In addition to the foregoing, all persons on vessels that have had smallpox on board during the voyage, and all but first and second cabin passengers on other vessels, must show evidence of recent vaccination or of a previous attack of smallpox, or be vaccinated, or be detained in quarantine for at least fourteen days.

There are a number of quarantine stations, more or less completely equipped, along the Atlantic and Gulf coasts of the U. S., and three on the Pacific coast, eleven being national and the rest maintained by the States in which they are located, or by the cities which they are designed to protect.

The treatment of a vessel, passengers, and cargo at quarantine is governed very materially by the disease which has caused its detention, cholera and yellow fever demanding the most prompt and energetic action. With either of these maladies the vessel is at once dispatched to the anchorage for infected vessels, and must remain there till she has been thoroughly purified and disinfected; the passengers in the meanwhile having been transferred to the lazaretto and barracks for suspects, or to other quarters where they may be isolated during the period of detention and observation, and such part of the cargo as may be necessary being removed, disinfected, and stored.

Within the barracks the passengers and others are separated into convenient groups, each of which is inspected twice daily by the physician, receives a separate water and food supply, and the individuals of which may not communicate with members of other groups except through the quarantine officer. Should a new case occur in any of the groups, the patient is immediately conveyed to the lazaretto, the other members of the group bathed, their clothing again disinfected, etc., and the whole group transferred to other quarters and sleeping apartments. There is the same isolation and segregation into groups in case of yellow fever, but infection by other diseases does not warrant so severe treatment. The duration of detention for cholera and yellow fever is five days after the last opportunity for infection and after the last disinfection of all articles taken by passengers into barracks; for smallpox the detention is extended to fourteen, and for typhus fever to twenty days.

The cargo and infected baggage are disinfected as far as practicable at the wharf or *in situ* in the vessel by means of steam, sulphurous acid gas, and strong corrosive sublimate solution. As to the vessel, nothing is thrown overboard if the infection is from cholera, though ballast may be discharged at sea, and ballast-tanks refilled with sea-water. A certificate from the quarantine officer, stating that the vessel has thoroughly complied with the regulations, and that he believes her to be free from infection, is necessary before the vessel may leave quarantine. She is then said to be granted free pratique.

To secure the U. S. against the entrance of infection by way of the Canadian and Mexican frontiers, the regulations provide that, "when practicable, alien immigrants arriving at Canadian and Mexican ports destined for the United States shall be inspected at the port of arrival by the United States consular or medical officer, and be subjected to the

same sanitary restrictions as are called for by the rules and regulations governing United States ports; and where such immigrants are not inspected at the port of arrival, they shall enter the United States only at certain designated points on the frontier, and then only after such inspection, detention, disinfection, vaccination, etc., as may be necessary or required by the officers there stationed."

Inland Quarantine has practically the same object as that of maritime quarantine, viz., the prevention of the transference of infectious disease from one locality to another, and the defining of certain portals through which all persons and things capable of conveying infection may be compelled to pass and undergo the necessary inspection, detention, etc. Such quarantine is in most cases invoked to limit the extension of epidemics, and depends for its efficacy upon two main features—the *sanitary cordon* and *camps of probation*.

The former "consists of a line of guards, military or civil, thrown around a district or locality, either to protect the same from the surrounding country when infected or to protect the surrounding country from the infected district or locality." The line may be a double one, in which case the innermost one encircles as much as possible of the area known to be infected, while the other includes all probable or possible cases. Of course, as soon as the zone between the two lines can be shown to be free from the particular infection, the necessity for the outer line vanishes, and it may be withdrawn; but as long as either exists, to be of any utility whatsoever, it must be so complete as to prevent all ingress or egress through it except at certain specified points—the camps of probation. The camps of probation must be distinguished from *camps of refuge*, which are "simply residence camps established to receive the population of an infected community when it has been determined to depopulate the infected district."

It may also be advisable at times to establish a *railway quarantine* at certain points, where all baggage and freight from a suspected district may be disinfected, and all passengers from the infected locality or without the requisite certificate from some authorized health officer may be remanded to the nearest camp of probation, and detained under observation the necessary length of time. See Hygiene.

Seneca Egbert.

Quarles, Francis: poet; b. near Romford, Essex, England, in 1592; was educated at Christ's College, Cambridge; studied law at Lincoln's Inn; afterward secretary to Archbishop Usher in Dublin; driven from Ireland, with the loss of his property, by the rebellion of 1641; espoused the royal cause in the great rebellion, joining King Charles I. at Oxford, and suffered sequestration of his property. D. in London, Sept. 8, 1644. Author of *Divine Emblems* (1635); *The Enchiridion of Meditations* (1641); and other moral works filled with quaint conceits, and of *The Loyal Convert* (1644), a defense of the royal cause, besides a number of poetical works: *Feast for Worms, or the History of Jonah* (1620); *Argalus and Parthenia* (1621); *The Shepherd's Oracles* (1644); etc.

Revised by H. A. Beers.

Quartan: See Fever and Chill.

Quarter-crack: See Farriery.

Quarter Evil: See Black Quarter.

Quartering: See Heraldry.

Quartermaster-general: a military officer who has, in the U. S. army, the rank of brigadier-general—in the British army that of major-general or colonel. He is at the head of the quartermaster's department, which is charged with the duty of transporting troops and materials of war, of clothing, feeding, and sheltering troops, of constructing and repairing roads, military telegraphs, railways and bridges, docks and wharves, and generally with all disbursements attending military operations not expressly assigned by law or regulation to other staff departments. He has a number of assistants, and there is for each regiment of the line a regimental quartermaster, selected from among the lieutenants of the regiment, who is assisted in his duties by a quartermaster-sergeant.

Quartley, Arthur: marine painter; b. of English parents in Paris, France, May 24, 1839. He was self-taught; was taken to the U. S. when a child and passed the early years of his professional life in Baltimore, Md.; National Academician 1886; member of the Society of American Artists 1881; member of the American Water-color Society. D. in New York, May 19, 1886. A shore view, *Off the Isles of Shoals*, is in the Union League Club, New York; *Low Water, Long Island Shore*, in the collection of T. B. Clarke, New York.

William A. Coffin.

Quartz [from Germ. *quarz*]: a very abundant and important mineral, including a great variety of precious and semi-precious stones, all of them being essentially silica (oxide of silicon) more or less pure. These minerals may be divided into four groups—the crystalline varieties, the crystalline with foreign inclusions, the cryptocrystalline, and the amorphous, or non-crystalline. The first are more or less transparent, as also the second, the leading varieties being amethyst, rock-crystal, etc. The third group comprises the chalcedonies, agates, etc., which are translucent (see Chalcedony); and the fourth, the jaspers, which are opaque (see Jasper). The principal varieties of the crystalline group, or quartz proper, are the following, all of them having a hardness of 7, and usually crystallizing in hexagonal prisms with pyramidal terminations:

Amethyst is a transparent purple variety, owing its color to oxide of manganese. It was much used by the ancients in engraving and in jewelry. Superb deep-purple gems that change to red by artificial light are found near Mursinka, in the Ural Mountains, and single gems sell for several hundred dollars. Oriental amethyst is a purple variety of corundum or sapphire, and is a far more valuable gem than the ordinary amethyst. See Amethyst.

Cairngorm stone, citrine, false topaz, Saxon topaz, Scotch topaz, and *Spanish topaz* are names given to transparent quartz colored by oxide of iron or by carbonaceous matter, and having various shades of yellow to brown. The yellow and brown are produced by heating smoky quartz (see below), which is partially decolorized by high temperature. Much that is called topaz is this yellow quartz, which is quite different from true topaz (see Topaz), and less valuable as a gem. Oriental topaz is the yellow variety of sapphire.

Prase is a deep-green quartz, sometimes crystallized. It is somewhat rare, but is not much valued or used by the moderns.

Rock-crystal is the purest form of quartz, transparent and colorless, and exhibits the properties of the mineral in the most perfect degree. It is widely distributed, but is brought chiefly from Brazil, Madagascar, and North Carolina. It is wrought, especially by the Japanese and Chinese, into the polished "crystal balls" and other articles of elegant ornament. Superb coupes, ewers, caskets, etc., made in Italy, Austria, and Germany from the sixteenth to the eighteenth century, adorn the collections of the Louvre, the South Kensington Museum, the Dresden Green Vaults, the Imperial Museum at Vienna, etc. What are known as "Rhine stones," "Lake George diamonds," etc., are not quartz or rock-crystal, as generally believed, but only paste or lead-glass.

Rose-quartz is a pink or rose-tinted variety, rarely found crystallized, exceedingly beautiful if of pronounced color. Although occasionally employed for ornamental work, it is little used, owing to its liability to fade by long exposure to light. It is found in Maine, Moravia, and elsewhere.

Smoky quartz and *smoky topaz* are brown to almost black and probably are colored by carbonaceous matter. The lighter shades are occasionally cut for ornament, and are beautiful stones, but of little value. The finest crystals of smoky quartz from Mt. St. Gothard, in Switzerland, are now in the museum at Berne. It is also found at Pike's Peak, Col. The black quartz is called *morion*. By heating, smoky quartz is partially decolorized, yielding paler shades and yellows which then are called cairngorm stone, Spanish topaz, etc. (see above).

The varieties containing inclusions are as follows:

Aventurine, called also *gold-stone*, a brown ferruginous quartz containing spangles of mica or göthite, is found at Aventura, in Spain, and in Asiatic Russia. The artificial gold-stone, a brown glass filled with minute crystallized crystals of copper, is handsomer than the natural stone; it is made in Venice and is used for inlaid work, etc.

Cat's-eye quartz: See Cat's-eye.

Thetis's hair-stone, Venus's hair-stone, Sagenite, and *Flèches d'Amour* are names given to quartz penetrated by needle-like crystals of hornblende, rutile, göthite, and similar minerals. Quartz of this variety is occasionally cut and mounted.

There are many other semi-precious varieties of quartz, but they are rare, and of little importance save to collectors and students of mineralogy.

George F. Kunz.

Quasi-Contract: an obligation imposed by law for the enforcement of which the law gives the action resorted to for breach of contract. The distinction between a contract and a quasi-contract is as marked as is the difference between *assent* and *dissent*. While the assent—as that term is used in law—of the party to be charged is necessary to the existence of a contract, a quasi-contract may exist notwithstanding the dissent of the defendant. A contract is an obligation created by act of the parties. A quasi-contract is an obligation imposed by law. Although the source of the obligations is different, the remedy given to one seeking to enforce a quasi-contractual obligation is the action given for a breach of contract, the action of assumpsit, hence the use of the term quasi-contract in our law. The fact that the contractual remedy is used where an action is brought on a quasi-contract has given rise to the expression "contract in law," and this expression is too often abbreviated into the expression "implied contract." The use of the term "contract implied in law" is unscientific, since a contract depends upon the act of the parties, and can not exist without assent, and is therefore something which the law can not imply. The term means, however, nothing more than obligation imposed by law. The use of the term "implied contract" to represent quasi-contractual obligations is not only unscientific, but is misleading, and has caused great confusion. There is an "implied contract," but it is a genuine contract, not a quasi-contract, and differs from the ordinary simple contract, usually called an express contract, only as to the evidence by which its existence is proved. The express contract is so called because its existence is proved by the language used when the contract was entered into, while the implied contract is proved by circumstantial evidence. Implied and express contracts are genuine contracts, while a quasi-contract, as the term implies, is no contract at all. (*Steamship Co.* vs. *Joliffe*, 2 Wall. 450; *Louisiana* vs. *New Orleans*, 109 U. S. 285; *Dusenbury* vs. *Speir*, 77 N. Y. 144.) The terms "implied" and "express," when used properly with reference to contracts, are terms of evidence and not of contract. (*Marzetti* vs. *Williams*, 1 B. & Ad. 415; *Dusenbury* vs. *Speir*, 77 N. Y. 144.) If A should say to B "lend me $100 and I will repay it in one month," and B should lend the money, there would be an express contract, for the reason that A has used the language of promise, has promised in words. If A should say to B "C is pressing me for the payment of $100 which I owe him; if I send him to you please pay him that amount," and B should do so, there would be a contract on A's part to reimburse B, but it would be an implied contract, because words of promise can not be found, and the understanding of the parties is left to inference and must be gathered from the circumstances. The circumstances, however, leave no one in doubt as to the intention of A. Because of the use of the phrase "contract implied in law," it is usual to describe genuine contracts which are not created by the use of words of promise, as "contracts implied in fact."

It may be asked why not treat a quasi-contract as a tort if it differs so radically from a contract? The obligation giving rise to a right of action in tort is an obligation imposed upon persons in general, not upon any particular individual, to respect the inherent right which every man has to his person and property. This obligation is usually performed simply by refraining from interfering, by remaining inactive. In the case of a quasi-contract the obligation usually, if not always, exists in favor, not of the world at large, but of some particular person, and arises out of a relationship existing, or dealings had, between the plaintiff and the defendant. Furthermore, the obligation imposed by a quasi-contract requires the obligor to act. It can not be discharged simply by a failure or refusal to act.

The source of the quasi-contractual obligation is threefold:

1. Obligations of record.
2. Statutory, official, or customary obligations.
3. Obligations resting upon the doctrine that no one shall be allowed to enrich himself unjustly at the expense of another.

The typical obligation of record is a judgment, and it needs no argument to establish that an obligation which is created by law without regard to the will of the obligor, and in most cases notwithstanding his dissent and protest, has none of the elements of a contract, and is therefore quasi-contractual, and it is so regarded. (*Biddleson* vs. *Whytel*, 3 Burr 1545; *State of Louisiana* vs. *New Orleans*, 109 U. S. 285; *O'Brien* vs. *Young*, 95 N. Y. 428.) As a statutory obligation exists without regard to the assent or dissent of the defendant, such an obligation is, and must be, regarded as quasi-contractual. (*Steamship Co.* vs. *Joliffe*, 2 Wall. 450; *Louisiana* vs. *New Orleans*, 109 U. S. 285; *Inhabitants of Milford* vs. *Commonwealth*, 144 Mass. 64; *McCoun* vs. *R. R. Co.*, 50 N. Y. 176.) An example is the obligation imposed upon the owner of a vessel without a pilot to pay half pilotage fees in the event of his refusing to accept a pilot who tenders his services. Of the same character, it is submitted, are customary duties where the obligation is imposed regardless of the will of the party charged with the duty, as the duty of an innkeeper to receive guests, of a carrier to receive goods. An example of a quasi-contractual obligation founded on an official duty is the obligation of a sheriff to levy execution and pay the proceeds of the sale thereunder to the judgment creditor. (*Speake* vs. *Richards*, Hobart 206.) The great and important source of the quasi-contractual obligation, however, is the equitable principle that no one shall be allowed to enrich himself unjustly at the expense of another. But for this principle there would be a gross failure of justice in many cases, as, for example, where money has been paid under mistake as to the existence of an indebtedness, not to create but to extinguish an obligation; where a person has committed a tort and has enriched himself thereby, and yet the remedies in tort have, in the absence of statute, been lost because of the death of the tort-feasor. It is proposed to consider briefly some of the cases showing the importance of the doctrine of unjust enrichment and the necessity for its existence in our law.

That the remedy to recover money paid under mistake as to the existence or amount of an indebtedness must be quasi-contractual is evident, as neither party intended to create an obligation in favor of the person making the payment, and the latter, if not both parties, thought that the payment would extinguish an existing obligation. To recover money paid under mistake, it must appear not only that the money was paid because of mistake in a case where there was no enforceable claim, or none enforceable to the extent of the payment, but in addition thereto it must also appear that the circumstances are such that it would be against conscience to allow the defendant to retain the money so paid. Thus if one should pay a debt barred by the statute of limitations, in ignorance of the bar, because of a mistake as to the date when the debt became payable, there could be no recovery of the money so paid, notwithstanding the plaintiff's ability to prove that he would not have paid the debt but for the mistake. In paying the debt he only did what in conscience he should have done, notwithstanding the existence of a statute protecting him from liability, and the party to whom the money was paid is certainly not unjustly enriched in retaining what in conscience should have been paid to him. If the payment in any case is caused by ignorance or mistake of law, then, notwithstanding the retention of the money by the defendant is against conscience in that nothing was owing to him, there can not, according to the weight of authority, be a recovery of the money so paid. See IGNORANTIO JURIS.

If in the commission of a tort the tort-feasor enriches himself by taking from the injured party's property and adding to his own, he may be sued in tort, in which event the measure of the plaintiff's recovery would be the damage done the plaintiff, or he may be sued in quasi-contract, where the measure of recovery would be the extent of the unjust enrichment. When one having the right to sue either in tort or in quasi-contract uses the latter remedy he is said to "waive the tort." These words are misleading. "Waiver of tort," so called, is nothing but an election of remedies. What was a tort before does not cease to be a wrong by the bringing of the action in quasi-contract, for unless the plaintiff proves the commission of a tort he will not be able to recover. The plaintiff is said to waive the tort for the reason that it is a rule of law that a plaintiff loses his right to sue in tort by suing in quasi-contract. It is equally true that he loses the right to sue in quasi-contract by suing in tort. We do not hear, however, of the doctrine of waiver of quasi-contract, for the reason that the older remedy is the action of tort. Whether a plaintiff shall or shall not waive the tort and sue in quasi-contract is often a question of great practical importance. If, for example, A should take B's horse, of the value of $500, and sell him for $300, it would be to B's advantage to sue in tort, since in that form of action he will recover to the extent of the damage suffered by him, which would be $500, whereas if he sued in quasi-con-

tract, in a count for money had and received, he would recover only $300, as that was the sum received by A. In jurisdictions where in such circumstances the tort-feasor can be sued in quasi-contract in a count for goods sold and delivered, it would be immaterial whether B sued in tort or in a count for goods sold and delivered. If, however, the property is wrongfully taken and the value thereof increased by the labor of the tort-feasor, then in jurisdictions where the measure of recovery is the value of the property at the time of the wrongful taking it is advantageous to sue in quasi-contract, since the extent of the tort-feasor's enrichment exceeds the injury done the owner, and in quasi-contract the plaintiff will be entitled to recover to the extent of the defendant's enrichment. For the reason that unjust enrichment is the basis of recovery where the tort is waived, no action can be brought in quasi-contract where the tort does not enrich the tort feasor. (*Fanson* vs. *Linsley*, 20 Kan. 235; *National Trust Co.* vs. *Gleason*, 77 N. Y. 400.) Thus, if A should slander B or commit an assault upon him, B's only remedy would be in tort.

To recover the proceeds arising from the sale of property wrongfully taken, the plaintiff must have had a right to the property at the time of the sale. If A, for example, should wrongfully take B's horse and retain possession thereof until the lapse of time within which an action for the wrongful taking is required by statute to be brought, and should then sell him, he could retain the proceeds, since the effect of B's failure to bring an action for the wrongful taking within the statutory period of time was to vest the title to the horse in A, and A therefore sold his own horse. The loss of the right to sue in tort does not necessarily, however, mean the loss of the right to sue in quasi-contract. If, for example, the right of action in tort existed at the time when the proceeds of the sale were received, then, notwithstanding the right to sue in tort is subsequently lost by a failure to bring an action within the statutory period of time, an action may still be brought to recover the proceeds until the statutory period of time as to quasi-contractual rights has run. So the common-law rule that the tort died with the person did not prevent an action against the estate of the deceased tort-feasor, notwithstanding the loss of the remedy in tort, if it were a case where the tort-feasor could have been sued in quasi-contract had he been alive.

It frequently happens that a person who has not sufficiently performed a contract to entitle him to sue thereon has nevertheless materially enriched the other party to the contract by a partial performance thereof. In such cases, if there is to be a recovery by the person who has partly performed, it must be on principle of unjust enrichment, and the right will therefore be quasi-contractual, as the case assumes that the defendant is not liable for a breach of contract. A plaintiff may in these circumstances seek a recovery where he makes no attempt to justify or excuse his failure to perform, or he may rely upon the fact that he endeavored in good faith to perform the contract, or upon the fact that he can not be sued for a breach of contract, because of the fact that the contract was an oral contract, with no memorandum thereof in writing complying with the Statute of Frauds, or for the reason that the contract was illegal or impossible of performance. It is generally held that one who willfully refuses to perform a contract to the extent necessary to entitle him to recover thereon can not recover in quasi-contract, notwithstanding the enrichment of the defendant arising from the part performance. (*Collins* vs. *Stimson*, 11 Q. B. D. 142; *Stark* vs. *Parker*, 2 Pick. 267; *Lantry* vs. *Parks*, 8 Cow. 63; *Moritz* vs. *Larsen*, 70 Wis. 569; but see *contra Britton* vs. *Turner*, 6 N. H. 481.) To this rule there seems to be one exception—namely, where the plaintiff has supplied property under a contract and the defendant can return the property, but refuses to do so. In some jurisdictions, where the rule is recognized that in the case of a deliberate refusal to perform a contract there can be no recovery for benefits conferred by a partial performance thereof, a recovery is allowed in quasi-contract if it appears that the plaintiff endeavored in good faith to perform the contract.

The fact that the plaintiff by reason of the Statute of Frauds can not be sued for a breach of contract will not entitle him to recover in quasi-contract, as the Statute of Frauds was intended not to confer a right of action, but to give a defense to an action on a contract which, though oral, was not illegal, and the performance of which was therefore permissible in point of law. *Collier* vs. *Coates*, 17 Barb. 471; *Greton* vs. *Smith*, 33 N. Y. 245; *Clark* vs. *Terry*, 25 Conn. 395; *Abbott* vs. *Inskip*, 29 Oh. St. 59; see *contra King* vs. *Welcome*, 5 Gray 41.

If the contract which the plaintiff has partly performed is illegal, there can be no recovery on the contract because of the illegality thereof. If, therefore, the plaintiff recovers it must be in quasi-contract. If the plaintiff, having partly performed an illegal contract refuses to perform further, he is regarded as acting in disaffirmance thereof, and if the illegality is merely *malum prohibitum*, not *malum in se*, i. e. is not inherently wrong, but wrong simply because of a positive prohibition, there can be a recovery if the defendant has in fact or in legal contemplation been enriched by the performance. If the act is *malum in se*, there can be no recovery, notwithstanding the defendant's enrichment. *Taylor* vs. *Bowers*, 1 Q. B. D. 291; *White* vs. *Franklin Bank*, 22 Pick. 181; *Tracy* vs. *Talmage*, 14 N. Y. 162.

In the U. S., differing from the law of England (*Cutter* vs. *Powell*, 6 T. R. 320), if after part performance further performance becomes impossible, and it can be fairly said that the contingency which has happened was not within the contemplation of the parties, as, for example, where full performance is prevented by sickness or death, there can be a recovery to the extent of the benefit conferred. *Wolfe* vs. *Howes*, 20 N. Y. 197; *Green* vs. *Gilbert*, 21 Wis. 395.

One who has performed a contract either in whole or in part, and who has been prevented from fully performing by the other party to the contract, may find himself unable to recover for a breach of contract, and yet the circumstances may be such that not to allow a recovery for what was done thereunder would work great injustice. Suppose, for example, that A should agree to work for B for the period of two years, for a lump sum to be paid by B at the end of two years, and at the end of that time B should refuse to pay for the services, relying upon the Statute of Frauds, requiring a written memorandum of such contracts, or suppose that after A had served him for six months B should discharge him without cause, relying upon the statute aforesaid. Clearly it would be the grossest injustice to hold in such a case that A had no enforceable rights against B, and yet, if he must rely upon the contract, he clearly can not recover for the services rendered, since the statute gives B an absolute defense. Upon the principle of unjust enrichment, however, the law imposes an obligation upon him to compensate A for the services rendered. So, when, after a complete or partial performance by the plaintiff, performance on the other side has become impossible in circumstances affording a defense to an action for a breach of the contract, the law will in case of full performance and also in the case of partial performance, where the amount is ascertainable, compel restitution or compensation to be made. It may be that a defendant who has no scruples in allowing a plaintiff to perform an illegal contract is averse to performing his side of the contract. In such a case there can be no recovery on the contract because of its illegality, and if, in the eyes of the law, the parties are *in pari delicto*, there can be no recovery in quasi-contract, notwithstanding the enrichment of the defendant. This result is justified only on grounds of public policy. If, however, the parties are not *in pari delicto*, but the position of the defendant is regarded as the more reprehensible, then a recovery in quasi-contract can be had.

A recovery in quasi-contract against a defendant refusing to perform a contract is not only allowed in cases where there can be no recovery on the contract, and yet where the plaintiff should have relief of some kind, but is also allowed in quasi-contract, notwithstanding the plaintiff's right to sue for a breach of the contract, in cases where the defendant received a benefit from the plaintiff's performance. This right to sue in quasi-contract is often of great value to a plaintiff. For example, suppose that A should pay in advance to B the sum of $500 in exchange for a promise on B's part to deliver to A certain goods on a certain day, and that on the day when the goods were to be delivered the goods were worth only $450. Should B fail to perform the contract in circumstances rendering him liable for breach thereof, the measure of A's recovery would be the expense involved in his purchasing the goods at that time, which would be $450. In an action in quasi-contract, however, the law would compel B to make restitution to A of the $500 which he received from A. *Nash* vs. *Towne*, 5 Wall. 689.

Whether the plaintiff or the defendant be in default, and whether the defendant be or be not liable on the contract, there can be no liability in quasi-contract unless the defendant has in fact or in legal contemplation been enriched by

the plaintiff's performance; hence it is that a guarantor who has made an oral contract to answer for the debt, default, or miscarriage of another, and who, because the contract does not comply with the Statute of Frauds, can not be sued on the contract—can not be sued in quasi-contract. The principal debtor, not the guarantor, was enriched by the plaintiff's performance. It is for this reason that a plaintiff who has bestowed labor upon chattel belonging not to the defendant but to the plaintiff, under a contract not enforceable because of the Statute of Frauds, can not recover in quasi-contract. *Dowling* vs. *McKenny*, 124 Mass. 478.

It not infrequently happens that one who is unable to establish a contract is able to show that he has conferred a benefit at the request or with the consent of the party benefited. If it can be shown that the benefit was conferred with an expectation on the part of the defendant to pay therefor, and that the plaintiff expected to receive compensation therefor, the fact that for some technical reason a contract which the parties attempted to create did not come into existence does not necessarily mean that the plaintiff is without remedy. Suppose, for example, that services have been rendered under a mutual mistake as to the terms of an offer and acceptance without fault on either side, or that goods have been furnished to a principal through his agent who had authority to purchase but exceeded his authority in executing a contract under seal. In such cases the plaintiff will not be without remedy, but will be allowed to recover in quasi-contract for the benefit conferred. (*Turner* vs. *Webster*, 24 Kan. 38; *Van Deusen* vs. *Blum*, 18 Pick. 229.) That the plaintiff intended to make a gift to the defendant of the services or property is, however, always fatal to a recovery, even though the act was done at the request or with the consent of the defendant. (*Osborn* vs. *Guy's Hospital*, 3 Strange 728; *Doyle* vs. *Trinity Church*, 133 N. Y. 372.) The motive that prompted the gift resulting in disappointed expectations is immaterial. It is for this reason that persons who have rendered services gratuitously in the hope of receiving a legacy on the death of the beneficiary are unable to establish a claim against the estate. (*Houck's Executors* vs. *Houck*, 99 Pa. St. 552.) If the gift was made under a mistake known to the defendant, or if the gift was induced by the fraud of the defendant, it would seem that the plaintiff should be allowed to recover in quasi-contract. *Peter* vs. *Steel*, 13 Yeates 250; *Kinney* vs. *Cook*, 4 Ill. 232; *Hickam* vs. *Hickam*, 46 Mo. App. 496. See also *Franklin* vs. *Waters*, 8 Gill 322.

There can not, as a rule, be a recovery for benefits conferred without the request or consent of the party benefited, even though the plaintiff did not intend to make a gift of his services. A person so acting is usually regarded as an officious volunteer, and no rights will be given him, as, for example, when one under no necessity of doing so pays the debt of another. In such a case the payment gives him no rights against the debtor. If, however, without any fault on the part of the person paying the debt of another, such payment is necessary to protect the person or property of person paying from seizure for the debt, the money so paid can be recovered from the debtor. In some cases, also, even where the plaintiff acts without the necessity therefor on his part, as where necessaries are supplied to a wife whom the husband wrongfully refuses to support, a right of recovery exists.

While money voluntarily paid can not be recovered even if paid under protest, money paid to protect one's person or property from unlawful seizure, or to prevent serious injury to one's business, can be recovered from the person to whom it was paid. That the money was paid to avoid a threatened suit will not, however, entitle the plaintiff to recover the money as paid under compulsion. In legal contemplation the money if not owing can not be collected, and if the party upon whom the claim is made desires to contest it, he is required to do it as a defendant in an action brought by the claimant. For a full treatment of the subject, see Keener on *Quasi-Contracts*. WILLIAM A. KEENER.

Quass Beer: See BEER.

Quas'sia [Mod. Lat., named from *Quassi*, a Negro slave in Surinam who used it as a remedy for fever]: in medicine, the wood of certain trees of the family *Simarubaceæ*. All the species of this family are noted for the intense bitterness of their wood, and until about the end of the eighteenth century quassia-wood was obtained from a small tree or shrub native in Panama, Venezuela, Guiana, and Northern Brazil, the *Quassia amara*. The wood of *Picræna excelsa* being found to have the same properties, and the latter being a tree of much greater size, the quassia of commerce is now almost wholly obtained from this source. *P. excelsa* is a tree from 50 to 60 feet high, with small yellowish and greenish flowers; the fruit is a drupe, black and shining, and about as big as a pea. It is a native of Jamaica and the Caribbean islands, where it goes by the name of *bitter ash*. The wood is whitish, but turns yellow on exposure. It has no smell, but a most intense, though pure, bitter taste. The bitterness depends upon a neutral crystallizable principle called *quassine* which is somewhat poisonous. Commercial quassia-wood consists of pieces of the trunk and branches of the tree of various sizes. For use by the druggist it is supplied in the form of raspings or turnings. Quassia, like other pure vegetable bitters, tends in small quantity to excite appetite and promote digestion. In large dose it nauseates. It is sometimes used in medicine as a stomachic bitter, but other less harsh and disagreeable bitters are generally preferred. Cups turned out of the solid wood are sometimes employed to prepare a weak quassia infusion by simply allowing cold water to stand for a few minutes in them. The water speedily becomes impregnated with the bitter principle, and may then be drunk. Quassia in infusion is the best remedy against the seatworm or *Oxyuris vermicularis*. Revised by H. A. HARE.

Quaternary Era: a division of geologic time co-ordinate with Primary, Secondary, and Tertiary. The term Primary has almost ceased to be used, and though Secondary and Tertiary are still employed, there is a growing tendency to substitute as general classific terms Paleozoic, Mesozoic, and Cenozoic, the term Cenozoic being made to include the divisions once called Tertiary and Quaternary. The same tendency replaces Quaternary Era by PLEISTOCENE PERIOD (*q. v.*). G. K. G.

Quater'nions [from Lat. *quater'nio*, the number four, a body or group of four, quaternion, deriv. of *quater'ni*, four at a time, by fours, deriv. of *quat'tuor*, four]: a mathematical method invented by Sir William Rowan Hamilton about 1840. Its fundamental idea is that of a vector. This latter is defined as a line passing from one (initial) point in space to another (terminal) point. It has two elements, *length* and *direction*. Two vectors are considered equal only when these two elements are the same in each. A vector moved about in space will remain the same vector so long as it remains parallel to itself and unchanged in length; but if either length or direction are changed, it becomes a different vector. The sum of two vectors is the vector joining the initial point of the first to the terminal point of the second when the two are placed end to end without changing the direction of either, as already explained. Any number of vectors may be added on this principle. See IMAGINARY QUANTITIES.

A quaternion is first defined as an operator, of which the function is to change one vector into another by altering its direction and its length. The operation which changes the length of the vector is in this case called the *tensor* of the quaternion, and that which changes the direction is called the *versor*. One quantity, a number, determines the tensor, and three are required to determine the versor, making four in all. Hence the term *quaternion*.

The great principle, however, of Hamilton's method consists in assigning to the vector itself the function of a quaternion, which it fulfills by turning a line at right angles to itself through ninety degrees around the vector itself as an axis. Comparing with the analogous operation of multiplying by the imaginary unit, as explained in the article IMAGINARY QUANTITIES, it will be seen that a quaternion has a close analogy to an imaginary quantity extended to space. From the definition of vectors and their sums it follows that every vector can be made up of the sum of three vectors at right angles to each other. These three vectors correspond to the co-ordinates used in solid analytic geometry. The unit lengths in the three directions are designated as i, j, and k. Then if x, y, and z are numbers, any vector can be represented in the form

$$ix + jy + kz.$$

A quaternion is formed by adding a pure number called a scalar to the vector as thus represented, and may therefore be written in the form

$$w + ix + jy + kz.$$

The reader must refer for a complete development of the method to special treatises on the subject, of which the

NEW BRUNSWICK AND QUEBEC, OF THE DOMINION OF CANADA

NOVA SCOTIA AND PRINCE EDWARD I.

Scale of Miles 10 20 40 60

Scale of Miles 10 30 50 70

Lon. W 69 from Greenwich

Lon. E 8 from Washington

GULF OF ST LAWRENCE

PRINCE EDWARD I.

CAPE BRETON ISLAND

RIVER ST LAWRENCE

BAY OF FUNDY

ATLANTIC OCEAN

NEW BRUNSWICK

QUEBEC

MAINE

NEW YORK

VERMONT

NEW HAMPSHIRE

ONTARIO

NOVA SCOTIA

most complete and generally accessible to the student is that of Tait, *Elementary Treatise on Quaternions* (3d ed., Edinburgh, 1890). There are also American works on the subject, one of which is by Prof. Arthur S. Hardy, of Dartmouth College.

The question of the real scientific value or usefulness of the method of quaternions is one on which opinions differ widely. In the U. S. it is a popular subject of study in advanced mathematics, and in Great Britain it is regarded by Tait and others as the most simple and useful method of developing many problems in physics. Very little attention has, however, been paid to it in France, and scarcely any in Germany, where the general opinion is that it leads to no result which can not be reached as readily by other methods. But there can be no question of its value as a training in the logical methods of modern mathematics. S. NEWCOMB.

Quatre Bras, kăatr'braa' : See WATERLOO.

Quatrefages de Bréau, kăatr'făazh'de-brā'ō', JEAN LOUIS ARMAND, de, D. Sc., M. D. : anthropologist ; b. at Berthezème, department of Gard, France, Feb. 10, 1810 ; studied at Strassburg, Toulouse, and Paris ; was appointed Professor of Natural History at Toulouse in 1838, at the Lycée Napoléon in 1850, and in 1855 at the Historical Museum of Anatomy and Ethnology. In the early years of his career he devoted himself to natural science, especially the study of marine invertebrata, but on his election to the chair of Ethnology he devoted himself exclusively to anthropology, becoming its foremost exponent. Of his writings, several have been translated into English : *Souvenirs d'un Naturaliste* (1854 ; London, 1857) ; *Métamorphose de l'Homme et des Animaux* (1862 ; London, by H. Lawson, 1864) ; *Histoire de l'Homme* (1869 ; New York, by Miss E. Youmans, 1875) ; *Charles Darwin* (1870) ; *La Race prussienne* (1871) ; *L'Espèce Humaine* (1877) ; *Hommes fossiles et Hommes sauvages* (1884) ; *Les Pygmées* (1887). D. Jan. 13, 1892.

Revised by S. T. ARMSTRONG.

Quatremère, -mār', ÉTIENNE MARC : Orientalist ; b. in Paris, France, July 12, 1782 ; became Professor of Greek at Rouen in 1809, of Hebrew, Aramaic, and Syriac at the Collège de France in 1819, and of Persian in the École des Langues Orientales Vivantes in 1827. His principal works were *Recherches historiques et critiques sur la Langue et la Littérature de l'Égypte* (1808) ; *Mémoires géographiques et historiques sur l'Égypte* (1810) ; *Observations sur quelques points de la Géographie de l'Égypte* (1812) ; *Mémoire sur les Nabatéens* (1835). He also translated and edited Rashid ed-Din's *Histoire des Mongols de la Perse* (1836), and Makrizi's *Histoire des Soultans Mamlouks* (1837–40). He was also a contributor to the *Journal Asiatique* and to the *Journal des Savants*. D. in Paris, Sept. 18, 1857. C. R. G.

Quatremère de Quincy, -de-kăñ'see', ANTOINE CHRYSOSTOME : archæologist ; b. in Paris, France, Oct. 28, 1755 ; studied archæology and art ; took part very actively, but always as a stanch royalist, in the various movements of the Revolution ; was appointed superintendent of public monuments in 1815 ; Professor of Archæology in the Royal Library in 1818 ; censor in 1824. D. in Paris, Dec. 28, 1849. His most remarkable works are *Le Jupiter olympien* (1814) ; *De l'Imitation dans les Beaux-Arts* (1823) ; *Raphaël* (1824) ; *Canova* (1834) ; *Michel-Ange* (1835) ; and a *Dictionnaire historique d'Architecture* (2d edition, 2 vols., 1833). Cf. *Biographie Universelle*, pp. 608–612.

Revised by A. GUDEMAN.

Quauhtemoc, or **Quauhtemotzin** : See GUATEMOTZIN.

Quay, MATTHEW STANLEY : U. S. Senator ; b. at Dillsburgh, Pa., Sept. 30, 1833 ; graduated at Jefferson College 1850 ; admitted to the bar 1854 ; prothonotary of Beaver County 1856 ; re-elected 1859 ; colonel of the 134th Pennsylvania Volunteers ; military secretary to the Governor of Pennsylvania 1861–65 ; member of Legislature 1865–67 ; secretary of the commonwealth 1872–78 ; recorder of Philadelphia and chairman of the Republican State committee 1878–79 ; again secretary of the commonwealth 1879–82 ; delegate to the Republican national convention 1872–76, 1880–92 ; State treasurer 1885 : elected to U. S. Senate as Republican, and took his seat Mar. 4, 1887 ; chairman of the Republican national committee 1888. C. H. THURBER.

Quebec, kwĕe-bek' : a province of British America, formerly known as Lower Canada, lying N. and S. of the St. Lawrence, extending E. and W. from the Peninsula of Gaspé to the head of Lake St. Francis, an expansion of the great waterway N. W. of the county of Huntingdon, and N. and S. from 52° 30′ N. lat. to the forty-fifth parallel, or the boundary-line of the U. S. The length within these limits is about 700 miles, and the breadth about 300 miles. The land surface is 227,500 sq. miles in extent, the water area 1,400 sq. miles, making a total area of 228,900 sq. miles.

Physical Features.—The natural features surpass in boldness those of the adjacent provinces, chiefly along and near the backbone or chief mountain-range of the country, the Laurentides, as they extend eastward from the vicinity of the city of Quebec to the Labrador coast. This range of highlands, in many places over 1,000 feet high, marks the plain watered by the St. Lawrence and its tributaries, and extending to the Ottawa, loses itself in the milder altitudes of the great watershed of the sister province of Ontario. The scenery along this chain of heights is of the most attractive character. There are many districts that rival the rugged grandeur of the Grampians, such as the highlands of Val Cartier, Laval, Murray Bay, and the Saguenay region. In the Peninsula of Gaspé is the Notre Dame range, an extension of the Alleghanies from the New England States through New Brunswick. The tract between these great ridges and the shores of the St. Lawrence is for the most part undulating and fertile, equaling in fertility the great southern plain of the Eastern Townships.

The distinguishing feature is the waterway of the ST. LAWRENCE RIVER (*q. v.*) and its numerous tributaries, the most important being the Ottawa, the St. Maurice, and the Saguenay on the N., and the Richelieu, the St. Francis, and the Chaudière on the S. The St. Lawrence is navigable as far as Montreal, 520 miles from the sea. The first interruption to navigation is at the Lachine Rapids, 9 miles from that city. The Carillon Rapids, 12 miles in length, prevent passenger steamboats sailing from Ottawa to the Lachine Canal, unless advantage is taken of the canal at Grenville. Beyond the Chaudière Falls at Ottawa the river is navigable. The St. Maurice is interrupted by the Shawenegan Falls, 24 miles from Three Rivers : their height is 150 feet. The Montmorency river falls abruptly into the St. Lawrence over a ledge 250 feet high. Between the St. Lawrence and the Bay Chaleurs, as well as on the N. of that river near the gulf, are innumerable streams famous in the legends of the sportsman and angler : while all over the province, irrigated in every part by the main tributaries of the St. Lawrence and their streamlet tributaries, the province presents every variety of scenery. The most important lakes are St. John, a circular basin drained by the Saguenay and having an area of 360 sq. miles : Temiscaming, drained by the Ottawa, having an area of 126 sq. miles ; Champlain, partly belonging to Canada, partly to the U. S., and by a system of canals connecting the trade of the St. Lawrence with that of the Hudson ; St. Peter, an expansion of the St. Lawrence above Three Rivers ; Memphremagog, the greater part of which lies in the province ; Metapedia ; Massawippi, near Stanstead ; and Megantic, the source of the River Chaudière. The principal islands are Anticosti ; Bonaventure, a fishing station near Gaspé ; the Magdalen islands, a group in the gulf, N. of Prince Edward island ; and, in the river, Bic island, Hare island, Île aux Coudres, Grosse île, the quarantine station, Crane island, Island of Orleans, and the river-girt lands near the confluence of the Ottawa and the St. Lawrence at Montreal, and on the Ottawa at Calumet and Allumette.

Climate.—The climate is on the whole agreeable and bracing. The extremes of heat and cold are more intense than in districts of a corresponding latitude in Europe. There may be said to be but two seasons—winter and summer, the winter extending from about the middle of October to the middle of April. The thermometer in summer seldom registers beyond 90° F., and in winter it sometimes falls 20° below zero. The farmer has his sowings finished early in May, and begins his harvesting in August. September is perhaps the pleasantest month of the year, with its warm days and cool evenings. In November the snow begins to fall, and, in the districts N. of the St. Lawrence, covers the ground until March or April. In the Eastern Townships the snow does not fall so early nor does it lie so late. All over the province the climate is exceedingly healthful, the air being clear and dry both in summer and winter.

Geology, Mineral Resources, etc.—The Quaternary formation is represented by the usual superficial drifts. The Lower Carboniferous series is seen in the thin strips on the southeastern coast of the Gaspé peninsula that form the northern limit of the coal-measures of the maritime prov-

inces; the Devonian system is represented by the Gaspé sandstones and limestones, in which are to be found indications of petroleum; the Silurian and Cambro-Silurian formations occupy the valley of the St. Lawrence between Quebec and Montreal, and constitute the northwestern limit of the Eastern Townships' mineral district; the Cambrian system constitutes the mineral deposits of the Eastern Townships and their crystalline schists; the Huronian formation occurs in the neighborhood of Lake Temis, coming where galena occurs; and the Laurentian formation occupies the northern portion of the St. Lawrence river and gulf.

The mineral wealth is incalculable, but is in an undeveloped condition. There are valuable gold mines at Beauce, copper mines in Megantic and Brome Counties, nickel mines in Pontiac, and the best of iron ore to be found in St. Maurice. Slate-stone, mica, and asbestos also abound.

In the Laurentides, with their rich crop of beautiful crystalline specimens, are to be found indications of iron in the phosphate and magnetic condition, plumbago, mica, and splendid building granites and limestones. Slate-stone for roofing purposes has been quarried in large quantities from the clay schists of Kingsbury, while the copper mines near Lennoxville are very valuable. The Trenton limestones of the Silurian deposits have supplied building material for Quebec and Montreal, while the gray and white granites of Compton and Stanstead Counties have also been utilized for purposes of building and ornamentation.

Fauna.—The fur-bearing animals that exist, though in diminished numbers, are beavers, minks, bears, muskrats, foxes, caribou, squirrels, and rabbits. Of the game-birds there are still to be found duck, geese, partridge, and snipe. Eagles, hawks, and loons are often taken by the woodsman.

Industries.—Fifty per cent. of the population farm the lands on and near the rivers. The principal agricultural products are hay, oats, potatoes, barley, wheat, turnips, peas, buckwheat, maize, and tobacco, and the chief domestic animals, sheep, swine, horses, and cattle. The most fertile districts are to be found in the Eastern Townships, where creameries and cheese-factories yield great profit.

The forest wealth is very considerable, and can be extensively utilized, as there is hardly a stream which does not provide water-power. The ship-building interest has all but disappeared, but the export of lumber is still an active branch of trade. The practice of squaring the timber for exportation has very much declined. Most of the timber exported is pine and spruce. The forest-trees include also maple, birch, elm, beech, cedar, oak, ash, and cherry.

While in the fishery industry Quebec occupies only the fourth place among the provinces of the Dominion, there is perhaps no district in the world that is so famous for its inland fisheries. At the mouth of the St. Lawrence and on the Chaleurs Bay are to be found large quantities of cod, haddock, salmon, mackerel, and lobster; and in the lakes of the province the trout-fisheries all but equal the fame of the salmon-fisheries of its coast waters. The government of the province holds in its own hands the leasing of the inland waters, and a considerable revenue is realized from the letting of these waters to fish and game clubs. Over $2,000,000 is realized annually from the fisheries.

Railways and Canals.—The principal railway companies are the Grand Trunk, the Canadian Pacific, and the Intercolonial. The Grand Trunk and the Intercolonial have their eastern terminus at Levis, the Canadian Pacific in the city of Quebec. The minor lines are the Quebec Central from Quebec to Sherbrooke, the Lake St. John from Quebec to Chicoutimi, the line between Montreal and Sorel, the Central Vermont, from Montreal to the U. S., the Maine Central, the Boston and Maine, the Canada Atlantic, and the Pontiac and Pacific Junction Railway. The principal canals, forming a system the largest and most important in the world, are the Beauharnais (11¼ miles, with 6 locks), the Soulanges (14 miles, with 5 locks), the Lachine (8½ miles, with 5 locks), the Carillon and Grenville, and the Chambly. Highways between all places of importance and by-roads between the outlying portions of remote settlements are kept in repair by the provincial government.

Political Divisions and Government.—The province is divided into sixty-three counties, which send to the Legislative Assembly at Quebec seventy-three members. The head of the provincial government is the Lieutenant-Governor, appointed by the Governor-General of the Dominion. His councilors, generally six in number, form the executive, subject to the Legislative Council (of twenty-four members) and the seventy-three members of the Assembly. Thus there are represented the three estates of Great Britain—the Lieutenant-Governor (as the sovereign), the Legislative Council (as the House of Lords), and the Legislative Assembly (as the House of Commons). To the Dominion House of Commons Quebec sends sixty-five members, and is expected to have twenty-four Senators appointed by the Governor-General to the Dominion Senate.

In 1900 the provincial auditor reported the gross receipts from all sources to be $4,539,736, and the expenditure to be $4,626,472. On June 30, 1899, the total funded debt outstanding was $35,128,847; the net floating debt was $1,522,462.

The judiciary, except the local magistracy, is in the appointment of the Dominion Government, and consists of the court of queen's bench, the superior court, and the court of review. In addition to these there are the admiralty court, the court of quarter sessions, and the courts for petty causes.

Population.—In 1871 the population was 1,191,516; in 1881, 1,359,027; in 1891, 1,488,535. The English-speaking persons number about 300,000. In 1891 there were 1,291,709 Roman Catholics, 75,472 members of the Church of England, 52,659 Presbyterians, 39,416 Methodists, 6,854 Baptists, 4,296 Congregationalists, 3,364 Adventists, and 2,703 Jews.

The principal towns are Montreal (pop., 1891, 216,650), Quebec (63,090), Hull (11,265), Three Rivers (8,334), St. Hyacinthe (7,016), Sorel (6,669), Valleyfield (5,516), St. Johns (4,722), and Fraserville or Rivière du Loup (4,175).

Education.—The education of the people is in the hands of the Department of Public Instruction, at the head of which is a superintendent. The Council of Public Instruction consists of two committees, the Roman Catholic and the Protestant, each having control of the schools according to the religion of the majority of ratepayers in any municipality. The schools supported by the minority in any municipality are called dissentient schools. The common schools are for the most part under the supervision of the department, with its forty inspectors and other officers. The Protestant committee has the immediate supervision of what are called the Protestant superior schools, and has an inspector of its own to visit and examine the model schools, academies, high schools, and colleges under Protestant control. These schools have a course of study of their own which brings them in line with McGill University in Montreal, and Bishop's College University at Lennoxville. Affiliated to these institutions are Stanstead Wesleyan College, St. Francis College at Richmond, and Morrin College at Quebec. The Roman Catholic University is at Quebec, a development of the two seminaries founded by the first Roman Catholic bishop, and is known as Laval University.

The public revenue, derived from the subsidy of the central Government, the sale of crown lands, lease of inland fisheries, and direct taxation, amounts to nearly $5,000,000. The amount spent on education by the Government is less than $400,000, and the amount for charitable institutions over $300,000.

History.—The early history of Quebec is that of Canada. Jacques Cartier in 1534 sailed up the gulf, passing Anticosti, and exploring Chaleurs Bay and Gaspé Peninsula. He returned in 1535 and sailed up the St. Lawrence as far as Montreal (then Hochelaga). Champlain founded Quebec in 1608, and after exploring the upper waters of the St. Lawrence and its tributaries established forts and fur-stations in various parts. The early colonization of Quebec was more or less a religious enterprise, an adjunct to the Recollet and Jesuit missions. The government was French up to 1759, when the battle of the Plains of Abraham was fought by Gen. Wolfe and the government became English. In 1791 Quebec was known as Lower Canada, and as such was united to Upper Canada in 1841. In 1867, by the Act of Confederation, it became a province of the Dominion of Canada.

J. M. Harper.

Quebec: the capital of the province of Quebec and the oldest city in Canada; situated mostly on a plateau and its ridges, at the confluence of the St. Charles and the St. Lawrence (see map of Quebec, ref. 4–D). The plateau extends from Cap Rouge, the site of Roberval's encampment, for a distance of 8 or 9 miles toward the island of Orleans, just below Quebec and about 180 miles from Montreal and 300 miles from what is generally called the Gulf of St. Lawrence.

Area and General Plan.—Quebec is one of the most interesting cities in America, and has often been called a bit of the Old World set down on the shores of the New. The city, which covers an area of 16,000 acres, may be divided

into three sections for purposes of description—the Upper Town, crowned by the citadel and facing the harbor at the Dufferin Terrace and the Grand Battery; the St. John Suburbs, on the northern slope of the plateau beyond the walls, meeting the level tract of St. Roch and St. Sauveur; and Champlain Street, running along the shore of the St. Lawrence under the steep sides of the plateau on the S. Dufferin Terrace stretches along the rock for a quarter of a mile at a height of 180 feet. It forms part of the line of fortifications around the city proper, and in summer is the favorite promenade of the citizens. The plateau is intersected by two main thoroughfares, St. John Street, within and without, vanishing in the St. Foye Road, and St. Louis Street, with Grande Allée, having for its prolongation the St. Louis Road. These run parallel with Champlain Street, and meet at the one end at Cap Rouge and at the other by means of the short connecting links of Fabrique Street, Buade Street, and the Place d'Armes at or near the Château Frontenac, a hotel built near the site of the old Château St. Louis, once the residence of the French governors.

Public Buildings.—On approaching the city from the harbor the principal structures are the Parliament buildings on the height of land just outside St. Louis Gate, Laval University to the right, the citadel to the left, and the Basilica, the English cathedral, the court-house, and the Château Frontenac with Dufferin Terrace between. Of these, the Laval University is the largest Roman Catholic educational institution in Canada. It receives its name from Bishop Laval, who founded the adjacent seminary in 1663, and has a valuable collection of pictures and scientific apparatus and specimens. Within the magnificent group of buildings behind the Grand Battery are the two seminaries, and that historic Basilica where four French governors lie buried. The Parliament buildings form a majestic quadrangle. The citadel is the most prominent feature of the city proper. It covers an area of 40 acres on the summit of Cape Diamond, and is in charge of a small troop of Canadian regulars. Passing along St. Louis Street toward the St. Louis Gate, the principal buildings are the Ursuline Convent, founded in 1641, the St. Louis Hotel, the old Military Hospital, used for some time as the Palais de Justice, Chalmers (Presbyterian) church, the old Government House, and the Club House. Outside the St. Louis Gate are the Convent of the Franciscans, completed in 1900, containing a very beautifully decorated chapel; the Convent of the Good Shepherd with its prominent spire, the Female Orphan Asylum, St. Bridget's Asylum, the Ladies' Protestant Home, and the District Jail. In St. John Street are the two fine churches of St. Matthew and St. Jean Baptiste. Near this thoroughfare are Morrin College, which contains the library of the Literary and Historical Society, St. Andrew's church, the Methodist church, the Jesuits' church, the National School Building, the Hôtel Dieu, the Gray Nunnery, the Hotel Victoria, St. Patrick's church, Trinity church, the Y. M. C. A. Building, the Finlay Asylum, and the new Jeffrey Hale Hospital. On the St. Roch side of the city there are six churches, and on the Champlain Street side there are four. The most interesting of these is the Church of Notre Dame des Victoires, built in 1688. It is the second oldest church in America, and was built to commemorate the victory of the French over Sir Hovenden Walker's English fleet. After the victory over Sir Wm. Phips in 1690 the church received its present name. The chief buildings in the Lower Town are the Champlain Market-house and the custom-house.

Suburban Places of Interest.—Among the places of interest in and about the city are the Plains of Abraham, with its monument to Gen. Wolfe, commemorating the battle of 1759; Wolfe's Cove, where the British landed, afterward gaining the heights; Près-de-Ville, where Gen. Montgomery fell in 1775; Montmorency Falls, where Montcalm kept Wolfe at bay for months before the decisive battle was fought; Beauport and its asylum; the island of Orleans, called Île de Bacchus by Cartier; Levis, with its three commanding forts; the graving-dock, capable of accommodating the largest vessel afloat; the Louise Embankment and its basin of safety for ships; the River St. Charles and its picturesque scenes; Lorette, with its falls and ancient Indian church; the Chaudière Falls at the outlet of the Chaudière, a tributary of the St. Lawrence; Château Bigot, beyond the pretty village of Charlesbourg, once the residence of the Intendant Bigot; the mouth of the Lairet, where Jacques Cartier spent his first winter in Canada; and Cap Rouge.

Industries, Commerce, etc.—The chief industries are the manufacture of leather and the shipping of lumber and grain. The principal factories are for boots and shoes, tobacco, and peltries. In 1900 the value of exports was $4,879,503, and of imports $6,317,937; 627 sea-going vessels entered and cleared the port; total tonnage, 1,126,901. The docks and wharfage properties extend from the mouth of the St. Charles round the river frontage for nearly three miles. The first bank was established in 1818. Five banks have a combined capital of $6,600,000, and there are besides three savings and loan societies and three branch banks. The principal railway lines meeting in the place are the Intercolonial, the Quebec Central, and the Grand Trunk on the south side of the river, and the Canadian Pacific, the Lake St. John, the Great Northern of Canada, and the Montmorency and Charlevoix line on the north side. The city has an abundant supply of water from Lake St. Charles, 9 miles distant. It is also lighted with electricity, the power being obtained from Montmorency Falls, 7 miles distant, and from the Jacques Cartier river, 14 miles distant. There is also an excellent electric street-railway system.

Civic Government, Taxation, etc.—The city government has at its head the mayor, chosen by the council, which consists of thirty aldermen elected by the various city wards. The new civic buildings, a handsome block with two wings, are situated on the site of the old College of the Jesuits, in the center of the city, opposite the Basilica. Taxation is 17½ per cent. of the rental value of property, which for the whole city is estimated at $1,370,500, while the estimated value of the property itself is $27,741,000. The debt is $7,493,895, but this is offset by city property valued at $4,713,025. There are 5 daily newspapers—2 French and 3 English—and 7 weekly journals, only 2 of which are English.

History.—Quebec was founded by Champlain in 1608, but its site had been visited by Cartier in 1535. In 1663 it became the capital of the royal government established in New France. The French held possession of it till 1759. In that year the battle of the Plains of Abraham led to the Treaty of Paris in 1763, when the whole country became British, with Quebec as its first capital. Pop. (1881) 62,446; (1891) 63,090; present estimate, 76,000.

Revised by J. E. Middleton.

Quebracho, kĕe-braa'chō: an evergreen tree (*Aspidosperma quebracho*) of Brazil and the Argentine Republic, from the bark of which may be obtained six different alkaloids. The aspido-spermine of commerce practically represents all six of these substances. The bark is used in cases of disordered respiration, more particularly asthma.

Quedlinburg, kwed'lin-boorch: town of Prussia, province of Saxony, at the foot of the Harz Mountains, on the Bode (see map of German Empire, ref. 4–E). It was founded by Henry the Fowler in 920, and is surrounded with walls surmounted by towers, and has manufactures of damask, linen, and woolen, besides breweries, distilleries, and sugar-refineries. It is famous for its nurseries, and exports seeds to other parts of Europe and to America. Pop. (1890) 20,761.

Queen Anne's Bounty: See Bounty.

Queen Charlotte Islands: a small group in the North Pacific Ocean, about 80 miles from the coast of British Columbia. Only Graham and Moresby are of considerable size. The islands extend about 180 miles parallel with the coast of the mainland and their greatest breadth is 60 miles. Adapted by the genial climate and fertile soil to support a considerable population, the islands have but few colonists. The coast waters abound with fish. The Haida Indians living along the coasts now number only a few hundred. For best description see Dawson's *Report of Progress* (1878–79), Geological Survey of Canada.

Queen Charlotte Sound: See Vancouver Island.

Queens, Borough of: See the Appendix.

Queen's Counsel: See King's Counsel.

Queen's County: a county of Ireland in the province of Leinster. Area, 664 sq. miles. The surface is mostly flat, rising in the N. W. into the Slieve Bloom Mountains, whose summit, Ardern, is 1,734 feet high. It is drained by the Barrow and the Nore. The soil is fertile; agriculture and dairy husbandry are the principal occupations, and there is a little cotton and woolen weaving. The principal towns are Maryborough and Mt. Mellick. Pop. (1891) 64,883.

Queensland: the youngest of the Australian colonies of Great Britain, though it has surpassed all except New South Wales and Victoria in population and commercial importance. Occupying the northeast part of the continent between New South Wales and Torres Strait, it is surpassed in

size only by the colony of South Australia. Area, 668,497 sq. miles. The most important feature of its physical formation is the back-bone of hills known as the Great Dividing Range, which extends along the east coast from 50 to 200 miles inland. It forms, in large part, the water-parting between the eastern and western rivers, and though not so high as the southern Australian mountains, much of the moisture carried inland is condensed on its eastern slopes and carried back to the sea in numerous small rivers. The result is that the narrow, eastern part of the colony is better watered and more fit for agriculture than the great plains lying west of these ranges of hills. The plains are fresh and green in the spring, but most of the year they are parched for lack of water, though grazing in this region is one of the chief industries. The better settled districts are along the southern half of Eastern Queensland, where the annual rainfall is about 60 inches, while along the northeastern tropical coast the precipitation is about 120 inches a year, and on the western plains only 10 to 30 inches. Half of Queensland and four-fifths of its 2,500 miles of coast-line lie within the Torrid zone, but the climate of the large regions adapted for white colonists, although very hot, is, on account of its dryness, more salubrious than in most other countries in the same latitude. There is scarcely any fever, except in some new settlements.

Most of the flora peculiar to Australia is found in Queensland, with the addition of about 500 Indian and Malayan species. The fauna is for the most part identical with that of New South Wales. Of Australia's 700 species of birds, about 600 are found in Queensland. The agricultural possibilities are enormous, though much of the farming region suffers from alternation of droughts and floods. Maize is the principal product, though wheat and oats are also grown. Most of the grains and fruits of the U. S. thrive on the highlands, while all the best tropical fruits are grown to perfection in the low-lying coast districts. Sugar is becoming one of the great industries. The growing of sugar-cane centers chiefly in the neighborhood of 21° S. lat., though it is raised as far S. as Brisbane. Most of the work on the sugar-plantations has been done by natives of the South Sea islands, whom the Australians call Kanakas. Various abuses connected with their importation have led to legislation practically cutting off this source of labor supply and temporarily retarding the development of sugar-planting. The colony is unusually rich in valuable woods, both hard and soft, there being about 200 species that are useful. The semi-arid plains are adapted for raising cattle and sheep on a large scale, because some of their grasses have a remarkable power of enduring droughts. The Mitchell grass is most noted in this respect, and other very nutritive plants are the kangaroo and blue grasses. Of the 360 kinds of grasses found in Australia, about three-fourths thrive in Queensland. The settlements are steadily extending into the western downs since various lines of railway have made them easily accessible. All the rivers are shallow and not navigable for large vessels, but there are a number of good harbors and dredging operations are constantly improving them.

The colony has great mineral wealth, particularly in gold, silver, copper, tin, antimony, and mercury. The gold is found chiefly in quartz-veins, and only about one-fifteenth of the miners are working placer claims. Many mineral regions among the hills can not be developed until railways make them more easy of access. Some unexampled mines have been discovered, among them mountains of pure iron ore at Cloncurry, one of which is 200 feet high. Mt. Morgan, discovered in 1884, is the richest gold mine in Australia. Gold is found there under conditions not known elsewhere, being distributed throughout the mass of the mountain, which is 300 feet high, and was evidently produced in the tertiary period by a hot spring which deposited siliceous sinter, with some limonite and clayey substances, through all of which the gold was sprinkled. There is also a large production of gold in the Charters Towers district. The coal formations cover a vast territory, and Queensland promises to become the leading exporter of coal in the southern hemisphere.

The population in 1891 was 422,776, including 20,000 Chinese and about 21,000 aborigines. There are ten towns having over 5,000 population, and the growth of Brisbane, the capital, has been remarkably rapid. (See BRISBANE.) The population of the towns exceeds by very little that of the agricultural and grazing regions. There are about 140 men to every 100 women. The natives are rapidly dying out. Those living in the north are cannibals, and few of them seem able to live long under civilization. C. C. ADAMS.

Queens'town: town; in the county of Cork, Ireland; on the south side of Great island in Cork harbor; 12 miles S. E. of the city of Cork (see map of Ireland, ref. 14–F). Though poorly built on the whole, it presents a fine appearance from the sea. The principal feature is a large Roman Catholic cathedral. Queenstown is an important port of call in connection with the carriage of the mails between the U. S. and the United Kingdom. The place was known as *Cove* until 1849, when it received its present name in honor of the Queen's visit in that year. Pop. (1891) 9,123.

Quelpaert, kwel'pärt: island: about 60 miles S. of Korea, to which it belongs; is about 40 miles long and 17 miles broad (see map of China, ref. 5–L). A mountain range traverses its entire length, culminating in the center in the Auckland (Halla San) peak, 6,500 feet high. The natives follow both agriculture and fishing with much success. The chief towns are Chu'Song (pop. 20,000), Chong-Hai, and Tai-Chong (pop. 5,000 each). Pop. of island about 50,000. C. C. A.

Quemada: See MEXICAN ANTIQUITIES.

Quercia, kwär'chi-ää, JACOPO, della: sculptor; b. at Quercia, in the Sienese district, Italy, in the latter part of the fourteenth century. At the age of nineteen he produced an equestrian statue of Giovanni d'Azzo Ubaldini, composed of stucco and wood, materials which had never before been so employed. After having executed some marble statues of prophets for the cathedral façade, and some wood-carving of great merit, Jacopo went to Lucca, where, in the Church of San Martino, he made the monument to Ilaria del Carreto, the wife of Paolo Guinigi. In Bologna, under the patronage of Giovanni Bentivoglio, he executed the principal door of San Petronio. When he returned to Siena the Signoria commissioned him to make a fountain to adorn the piazza. This, his principal work, led to his being called Jacopo *del Fonte*; the Signoria bestowed knighthood on him and the office of chief of the works of the cathedral. Three years later he died at Pisa at the age of sixty-four. W. J. STILLMAN.

Quer'citron Bark [*quercitron* is irreg. < Lat. *quercus*, an oak + *citrus*, a tree of the lemon kind]: a valuable dyestuff obtained from the BLACK OAK (*q. v.*). The bark contains a glucoside, quercitrin ($C_{36}4_{38}O_{20} + 3H_2O$), which is decomposed by dilute acids, yielding a yellow dye, *quercetin*, and a variety of sugar known as isodulcite. Flavine is a concentrated product prepared by treating the bark with sulphuric acid. See DYESTUFFS. I. R.

Queres: See PUEBLO INDIANS.

Querétaro, kā-rā'-tăă-rō: an interior state of Mexico, between San Luis Potosí, Hidalgo, Mexico, Michoacan, and Guanajuato; area, 3,938 sq. miles. It lies entirely in the region of the high plateau, but the surface is mountainous, especially in the northern part. The valleys are very fertile, and the higher slopes are covered with pine and oak forests; the climate is temperate and healthful. Deposits of gold, silver, lead, etc., have been worked with profit, especially during the colonial period; but most of them are now abandoned. Agriculture and stock-raising are the most important industries; the chief crops are maize, beans, and maguey on the higher lands, and sugar-cane in the warm valleys. Manufactures, especially of cotton and woolen goods, are important. Pop. (1893) estimated, 211,475, the Indian element being largely represented. H. H. S.

Querétaro: city; capital of the state of the same name; on a fine plain, surrounded by wooded hills; 5,904 feet above the sea; 152 miles by the Mexican Central Railway N. W. of Mexico city (see map of Mexico, ref. 7–G). It presents a very pleasing appearance, owing to the numerous gardens and lines of trees with which it is ornamented, and its handsome and substantial buildings. The Church of Santa Clara is noted for its exquisite wood-carvings. A fine aqueduct, dating from the eighteenth century, supplies the city with water. Querétaro is one of the most important manufacturing centers of the republic, and contains the largest mills, principally devoted to the making of cottonades. The Hercules mill employs 2,000 workmen, and is remarkable for being fortified and for maintaining a small armed force, which has more than once defended it successfully during revolutionary outbreaks. The town was founded by Chichimec Indians in the fifteenth century, and was conquered by the Spaniards 1531–51. In 1867 Maximilian made his last stand here; the city was taken after a bloody siege, and the ex-emperor was shot on a hill near it. Pop. (1892) about 36,000. HERBERT H. SMITH.

Quern [O. Eng. *cweorn* : M. H. Germ. *kurn* : O. N. *kvern* : Goth. *qaírnus*, mill]: the old-fashioned hand-mill for grinding grain, in use in Asia at the present day, as well as in the Hebrides, in Ireland, and in various remote places. The quern is made of two stones, after the manner of millstones, or it is a rude mortar of wood or stone. Remains of querns belonging to prehistoric peoples have been dug up in many places in Europe.

Quesada, kā-saa′-dăă, Gonzalo Ximenez, de: conqueror of New Granada; b. at Granada, Spain, 1498. He was a lawyer of good family, and Pedro Fernandez de Lugo, who became governor of Santa Marta in 1535, made him his chief lieutenant. The settlement of Santa Marta had been recently founded, and its jurisdiction embraced the present northern coast of Colombia, with an undefined extension southward, including the unexplored river Magdalena. Quesada was given command of an expedition to the interior in Lugo's interests; he left Santa Marta Apr. 5, 1536, with 620 infantry, 85 cavalry, and many Indians. The route southward lay over mountains and then through vast swamps, where the Spaniards suffered terribly from famine, fevers, and hostile Indians. At Tamalameque, on the Magdalena, the survivors met vessels which Lugo had sent them; they then ascended the river to Tora, near the junction of the Sogamosa, where they arrived about Jan., 1537, and passed the rainy season. In exploring the mountains to the E. they heard of the rich kingdom of the Chibchas of Bogotá; and though the force was reduced to 166 men (including 62 horsemen), it was determined to attack this powerful nation. At Barbacoas Quesada (imitating Cortés) resigned his command, and had himself elected governor of the new conquests by the soldiers; in this way he threw off allegiance to Lugo. In the battles which ensued the Indians fled, terrified by the horses. The Spaniards occupied Bogotá, where they were besieged for a month, but gradually the neighboring tribes made peace with them. The *zipa*, or king of the Chibchas, who held out, was killed in battle; a usurping zipa who succeeded him swore allegiance to the King of Spain, but was subsequently tortured and killed. By raids and barter the Spaniards secured a large amount of gold and emeralds. The Spanish city of Santa Fé de Bogotá was founded Aug. 6, 1538. Soon after Benalcazar and Federmann (*q. v.*) joined Quesada, having fought their way respectively from Peru and Venezuela. The three chiefs went to Spain together to present their claims to Charles V. Meanwhile Lugo had died, but his son claimed the conquest. Quesada offended the emperor by unseemly ostentation, and was dismissed. For many years he led a dissolute life in various countries of Europe, until he had squandered the treasure brought from Bogotá. He then renounced all claim to the governorship, and, in consideration of his services, was made marshal of New Granada and given a large *encomienda* of Indians (1549). He took some part in subsequent conquests, and is said to have died, at a great age, of leprosy. An account of the conquest which he wrote has been lost, but it was used by Piedrahita.—His brother, Hernan Perez de Quesada, was left as governor of Bogotá in 1538, and long held the district against the agents of Lugo. In 1543 he made an expedition in search of El Dorado, was arrested and banished on his return, and perished in a shipwreck, 1545. His remains were buried in the Cathedral of Bogota. Herbert H. Smith.

Quesnay, kā′nā′, François: one of the most noted economists of the eighteenth century; b. at Mérey, department of Seine-et-Oise, France, June 4, 1694; studied medicine at Paris, and was appointed first physician to Louis XV. D. at Versailles, Dec. 16, 1774. He is now chiefly known as the founder of the physiocratic school of political economy, and is regarded as the inventor of the term political economy. He developed his views partly in articles in the *Encyclopédie*, partly in his *Tableau économique* (1758), and other writings, which were published in a collected edition in 1768 under the title of *La Physiocratie, ou Constitution naturelle du Gouvernement le plus avantageux au Peuple.* See Political Economy.

Quesnel, kā′nel′, Pasquier: theologian; b. at Paris, July 14, 1634; studied theology at the Sorbonne; entered in 1657 the Congregation of the Oratory; became director of the Paris house of the order in 1662, and prepared his famous *Réflexions morales sur le Nouveau Testament*, for the use of the young men under his charge. He edited the works of Leo I. the Great (Paris, 1675, rep. in Migne's *Pat. Lat.*), and took occasion to defend the Gallican liberties. Compelled to flee in consequence in 1685, he repaired to Brussels, where he joined Arnauld, and finished the *Réflexions*, which was translated into English (London, 1719–25, 4 vols., and the part on the Gospels, n. e., New York, 1867). The book was at first considered harmless by the Roman Catholic authorities, but soon it was discovered that it really contained all the most obnoxious doctrines of the Jansenists. A hot controversy arose, and the author was denounced to the Spanish police in Brussels, and his book was condemned by the pope in the bull *Unigenitus*, 1713. He fled to Amsterdam, where he afterward lived in retirement. D. in Amsterdam, Dec. 2, 1719. He was a very prolific writer, both on moral and historical subjects. His letters were edited by Le Courayer, Paris, 1721–23, 3 vols.

Revised by S. M. Jackson.

Quételet, ket-lā′, Lambert Adolphe Jacques: astronomer and statistician; b. at Ghent, Feb. 22, 1796; was appointed a professor of mathematics in 1814 in his native city and in Brussels in 1819; superintended the erection of the observatory of that city in 1826, and was its director to his death Feb. 17, 1874. His writings on physical science—*Positions de Physique* (1834), *Météorologie de la Belgique* (1864), *Sur la Physique du Globe* (1861), etc.—are valuable, but it is his statistical works—*Sur l'Homme, et le Développement de ses Facultés* (1835), *Sur la Théorie des Probabilités appliquées aux Sciences morales et politiques* (1846), *Du Système social et des Lois qui le régissent* (1848)—which have procured for him a wide reputation.

Quevedo, kā-vā′dō, José Heriberto García, de: poet; b. at Coro, Venezuela, in 1819; d. in Paris, June 6, 1871, in consequence of a bullet received in passing a barricade of the Commune. From the age of six he was educated in Puerto Rico, and later in France and Spain. He traveled extensively in Asia and America, but later became a Spanish citizen, and served first in the Royal Guards and then in the diplomatic corps. His poetical reputation was decidedly ephemeral. Among his *Odas á Italia* (1849), which show imitation of Filicaia and Manzoni, are bits of genuine poetic eloquence; but his long philosophical poems—*Delirium*, *La Segunda Vida*, *El Proscripto*—written in a great variety of meters, are turgid, vague, and confused to the last degree. He wrote also numerous dramatic pieces, and essayed the prose tale and the critical essay, but without permanent success. His *Obras poéticas y literarias* are collected in two volumes (Paris, 1863). A. R. Marsh.

Quezaltenango, kā-saăl-tā-naan′gō: a town of Guatemala, 96 miles W. N. W. of Guatemala city and 35 miles N. E. from its port of Champerico, on the Pacific, on the northern slope of the Cerro Quemado volcano, 7,700 feet above the sea (see map of Central America, ref. 4–D). It is the second city in the republic in size and importance, is the center of a rich agricultural district, and exports coffee and a little sugar. There are several good schools and lyceums and handsome churches. The climate is healthful, though somewhat cold and damp in winter. Quezaltenango was an Indian town before the conquest, and the Indian element still predominates. Pop. about 24,000. It is the capital of a department of the same name, which has an area of 957 sq. miles and a population of 104,800.

Quiché Indians: See Indians of Central America.

Quichua Indians: the Kechuan or Inca nation. See Indians of South America.

Quick, Robert Herbert: See the Appendix.

Quicksand: a sand which yields so readily that any heavy body placed upon it gradually sinks. Quicksands occur on beaches, in bars at the mouths of rivers, in the beds of streams, and are interbedded with formations on the land. Their unstable character renders them unfit for foundations and dangerous to men and animals which attempt to walk across them. Ordinary dry sand is compacted by pressure, and though moving somewhat when pressure is first applied, quickly becomes firm. A sand that is slightly moist has the same properties; but if water is present in such quantity as not merely to fill the interstitial spaces but to hold the grains apart, friction is largely overcome and the mass yields to pressure. This condition often obtains when a current of water moves horizontally through the sand, and always when the direction is upward. As the pressure of particles upon one another is influenced also by their size, a fine sand becomes quick more readily than a coarse one, and a strong movement of water is necessary to render a gravel insecure. The principle of the quicksand is utilized in the

engineering process known as "water-jet pile-driving." A hose or other pipe is attached to a pile so as to discharge water near its lower end. The pile is then placed in position, resting upon the sand to be penetrated, and a stream of water forced through the pipe. The water loosens the sand, and, rising through it, keeps it in a quick condition so that the pile is carried downward by its own weight. The pipe is then withdrawn, and if the sand is not disturbed by a natural water movement, it soon becomes compacted and holds the pile firmly. See FOUNDATION. G. K. GILBERT.

Quicksilver: See MERCURY.

Quietism: a peculiar movement within the Roman Catholic Church, which originated from the celebrated devotional work of the Spanish priest Molinos, *Guida Spirituale* (1675). Quietism makes perfection on earth consist in uninterrupted contemplation, during which the soul remains passive or quiet, under the influence of the Spirit of God, and does not bestir itself enough even to make acts of faith, hope, and charity, to desire heaven, to hate hell, or positively to resist temptation. In opposition to the worldly tendencies of the regular orders, the Jesuits and Dominicans, and to the external character of the Roman Catholic worship, quietism presents a somewhat mystical appearance. It is a sentiment, not a doctrine. It founded no sect, though it met with much sympathy outside of the Roman Catholic Church, especially among the Pietists. In spite of its peaceable character, it awakened, nevertheless, the enmity of other parties, and was even exposed to persecution. Some of its disciples —as, for instance, Madame Bouvier de la Mothe Guyon— described their devotional feelings and exercises in a peculiar manner, which could not fail to call forth severe censure, and even caused the police to interfere. Moreover, the emphasis which the Quietists laid on the inner state of the soul made the ceremonies and rules of the Roman Catholic worship seem somewhat superfluous, and provoked the rigid churchmen. Bossuet attacked Fénelon, their most conspicuous spokesman, who immediately submitted to the decision of the pope. The movement died out in the middle of the eighteenth century. See MOLINOS, MIGUEL.

Revised by J. J. KEANE.

Quilimane, kĕē-lĕē-maa′nā: port of the Portuguese province of Mozambique, East Africa; in a swampy, unhealthful district, at the mouth of the Quaqua river (see map of Africa, ref. 8–G). This river was used by commerce to attain the Zambesi river above the delta, before the discovery (1889) of the Chinde branch of the delta, where ocean vessels may meet river craft. The town was founded in the fifteenth century, but has never attained large importance owing to its insalubrity, difficulty of access, and Portugal's onerous restrictions on commerce. Its trade was formerly in ivory and slaves, thousands of whom were sent to Brazil. Ivory and the British interests in Nyassaland give it a trade of about $1,000,000 a year. Revised by C. C. ADAMS.

Quillota, kēēl-yō′tăă: a town of the province of Valparaiso, Chili; on the river Aconcagua; a station on the railway from Valparaiso to Santiago (see map of South America, ref. 8–C). It dates from before the conquest, and was formerly celebrated for gold-washings. Copper is mined in the vicinity. Pop. about 12,000. H. H. S.

Quills: the shafts of the large wing-feathers of birds. They were formerly the almost exclusive material from which pens were made, and there is still considerable commerce in them. Quills are obtained chiefly from geese, but also from swans, turkeys, and other birds. Crow-quills are valuable in some kinds of drawing. The so-called quills (spines) of the European porcupine have considerable commercial value. Quills are also used for making toothpicks, and for various other purposes. See FEATHERS.

Quillworts: See FERNWORTS (class *Lycopodinæ*, order *Isoetaceæ*).

Quiloa, kee′lō-ăă, or **Kilwa**: a port of German East Africa, about 170 miles S. of Zanzibar; founded by the Arabs in the tenth century; occupied by the Portuguese in the sixteenth century; surrendered in the seventeenth century to Arabs of Muscat, who settled in Zanzibar; acquired in 1888 by Germany from the Sultan of Zanzibar; chief town of the administrative district of Kilwa (see map of Africa, ref. 7–G). It has a fair harbor, and is the center of considerable trade, and was long famous as a shipping-point in the slave-trade. It is a regular port of call for German East African steamers. Pop. about 7,000. An island of the same name lies a little S. C. C. ADAMS.

Quinault, kēē′nō′, PHILIPPE: dramatist; b. in Paris, France, June 3, 1635. He studied law, but at eighteen appeared as a dramatic author. From 1653 to 1666 he produced sixteen comedies, tragi-comedies, and tragedies, which had considerable influence, though scathingly criticised by Boileau. His comedies—the best of which is *La Mère coquette* (1665)—are comedies of plot and situation; and his tragedies (for example, *La Mort de Cyrus*, 1656; *Amalasonte*, 1658; *Astrate*, 1663) are marked by excess of tender sentiment. His greatest originality was shown in the fourteen operas which he wrote for the composer Lulli, and they also had the greatest success. He was chosen to the Academy in 1670. D. Nov. 26, 1688. Editions of his works: *Théâtre* (5 vols., Paris, 1739); *Œuvres choisies* (2 vols., Paris, 1842); *Théâtre choisi*, ed. by V. Fournel (Paris, 1880). A. G. CANFIELD.

Quince [apparently a plur. form taken as singular < Mod. Eng. *quyne, coin*, from O. Fr. *coin* > Fr. *coing* < Lat. *Cydonium* (sc. *ma'lum*, apple), Cydonian apple, quince, from Gr. Κυδωνία, Cydonia, a city of Crete]: a small tree (*Pyrus cydonia* or *Cydonia vulgaris*) of the Rose family; native to Western Asia, and cultivated from the earliest times. The fruit (also called quince) is usually somewhat pear-shaped, yellow when ripe, and clothed with a floccose wool. The five cells are normally many-seeded, thus differing from other fruits of the genus *Pyrus*, as the apple and pear. It has no true peduncle or stem, but the flowers expand directly from the terminal bud of small shoots of the season. As these shoots must grow before the flowers appear, the blooming-season of the quince is two or three weeks later than that of most other fruit-trees. The large fruits, therefore, always terminate the branches, and they are directly subtended by the leaves. It is this habit of bearing flowers and fruit upon the ends of the twigs which makes a quince-orchard in bloom or in crop one of the most showy of all fruit-plantations. Quinces require a rather moist loamy soil. It is customary to plant them from 12 to 16 feet apart each way, and to allow the branches to start a foot or so above the ground. The leading variety in the U. S. is the Apple or Orange, and this generally reproduces itself very closely from seed. Other popular varieties are Rea, Champion, Meech, and Missouri Mammoth. The Angers quince is grown almost wholly as a stock upon which to graft or bud the pear to make it dwarf. (See PEAR.) The quince is chiefly propagated by means of hardwood cuttings, but it is sometimes grafted upon the apple-root, the latter serving only as a temporary nurse until the quince forms roots from its own tissue. The chief quince-growing region of the U. S. is Western New York.

The Chinese quince is *Pyrus cathayensis*. The fruit is much larger than that of the common quince, and wholly unlike it. The tree is not hardy in the northern parts of the U. S., and the species is not generally esteemed. The flowering or Japanese quince (*P. japonica*) is a popular low thorny tree or bush, planted for hedges and ornament. Its fruits are occasionally used for jellies. L. H. BAILEY.

Quincy: city (settled in 1822, incorporated as a city in 1839); capital of Adams co., Ill.; on the Mississippi river and the Burlington Route, the Omaha, Kansas City and Eastern, and the Wabash railways; 113 miles W. of Springfield, 263 S. W. of Chicago (for location, see map of Illinois, ref. 6–B). It is built on a limestone bluff, 120 feet above the river, and laid out regularly, with N. and S. streets 3 miles long and E. and W. streets 2¾ miles long. The city is lighted with electricity, is supplied with filtered water from the channel of the river by means of a reservoir 230 feet above tide-water, and is well drained. There are several lines of electric street-railway, a fine railway and wagon bridge across the river, and six public parks. The notable buildings include the court-house, cost $300,000; U. S. Government building, cost $250,000; and the group, on the cottage plan, comprising the State Soldiers' and Sailors' Home, surrounded by 210 acres of park, cost $400,000; city hall, cost over $100,000. There are 41 churches, 27 public and private school buildings, public-school property valued at $300,000, Chaddock School for boys (Methodist Episcopal, chartered 1876), St. Francis Solanus College (Roman Catholic, opened 1860), 3 libraries (free public and two college) containing over 40,000 volumes, a business college, erected in 1890 at a cost of $100,000, with an average attendance of 1,000 and the largest institution of its kind in the world, 2 national banks with combined capital of $500,000, a state bank with a capital of $300,000, a private bank with a capital of $100,000, and 4 monthly, 4 daily, and 14 weekly periodicals. Quincy is a manufacturing city, with excellent shipping facilities.

There are 7 stove-foundries, with an annual output of over 25,000 stoves, the largest governor works in the world, 10 machine-shops, 10 carriage and wagon factories, 2 agricultural-implement works, 3 incubator-factories, 4 shirt and overall factories, cigar and tobacco factories, flour and grist mills, breweries, brickyards, limekilns, saddle and harness factories, and artificial-ice plants. The assessed valuations in 1890 aggregated $11,651,418; and the net debt on Jan. 1, 1900, was $1,071,000. Pop. (1880) 27,268; (1890) 31,494; (1900) 36,252. EDITOR OF "MORNING WHIG."

Quincy: city (settled in 1625, set off from Braintree as a town in 1792, incorporated as a city in 1888); Norfolk co., Mass.; on the Quincy river and bay, and the N. Y., N. H. and Hart. Railroad; 8 miles S. of Boston (for location, see map of Massachusetts, ref. 5–I). The city is noted for its extensive granite-quarries and large shoe-manufactories; also as a terminus of the first railway built in the U. S. (for transporting blocks of granite from the quarries to the site of the Bunker Hill Monument). It contains 8 public-school buildings, public high-school building (completed in 1894, cost $60,000), 2 national banks, with combined capital of $300,000, a savings-bank with deposits of over $1,750,000, Merry Mount and Faxon parks (besides playgrounds of more than 6 acres each in five wards of the city, secured at a cost of $40,000), the Adams Academy (founded in 1823, opened for pupils in 1872), the Thomas Crane Public Library (founded in 1871) containing over 17,000 volumes, and a daily, a monthly, and 2 weekly periodicals. The assessed valuations in 1893 aggregated $16,338,070, and the total debt in Mar., 1894, was $1,103,730, including a water-debt of $714,000. Quincy was the birthplace of John Hancock, John Adams, and John Quincy Adams. Pop. (1880) 10,570; (1890) 16,723; (1900) 23,899. C. H. PORTER.

Quincy, EDMUND: author; son of President Josiah Quincy; b. in Boston, Mass., Feb. 1, 1808; graduated at Harvard 1827; was prominent as secretary of the American and the Massachusetts anti-slavery societies; contributed to magazines; was author of *Wensley, a Story without a Moral* (1854), and of a *Life of Josiah Quincy* (1867), and editor of the *Speeches of Josiah Quincy* (1875). D. at Dedham, Mass., May 17, 1877. *The Haunted Adjutant, and other Stories* was issued in 1885. Revised by H. A. BEERS.

Quincy, JOSIAH, Jr.: lawyer; b. in Boston, Mass., Feb. 23, 1744; son of Josiah Quincy (1709–84), a merchant; graduated at Harvard University in 1763, and became an eminent lawyer. He had already by his writings and speeches obtained prominence as an ardent advocate of the cause of liberty when called upon, in conjunction with John Adams, to defend the soldiers implicated in the Boston Massacre. Although successful in securing the acquittal of their clients, popular feeling ran so high that, notwithstanding their established reputation for patriotism, they incurred much odium by their connection with the defense. In 1774 he went to England, where he was active in promoting the interests of his country. D. on the return voyage, off Gloucester, Mass., Apr. 26, 1775. In 1774 he published his *Observations on the Act of Parliament, commonly called the Port Bill.* See *Memoir of the Life of Josiah Quincy, Jr., by his Son* (Boston, 1825; 3d ed. 1875).

Quincy, JOSIAH, LL. D.: statesman; son of Josiah Quincy, lawyer; b. in Boston, Mass., Feb. 4, 1772; graduated at Harvard University 1790; studied law with Judge Tudor, and was admitted to the bar in 1793; member of the State Senate in 1804, and member of Congress 1805–13, during which time he opposed the embargo law and the war with Great Britain; again State Senator 1813–21; member of State Legislature 1821–23, and Speaker of that body during his last term; appointed judge of the municipal court in 1822, but resigned the following year, having been elected mayor of Boston on the decease of the Hon. John Phillips, the first incumbent; continued in office until 1829, during which time many public improvements were carried out; was president of Harvard University from 1829 until Aug., 1845. Among his published works are *Centennial Address on the 200th Anniversary of Boston* (1830); *History of Harvard University* (2 vols., Boston, 1840); *History of the Boston Athenæum*, of which he was president 1820–30 (Boston, 1851), and *Municipal History of Boston* (Boston, 1852); *Memoir of John Quincy Adams* (Boston, 1858). *Speeches in Congress and Orations* have also been published, besides numerous *Memoirs*, including one of his father (1825). D. at Quincy, Mass., July 1, 1864. See the biography by his son, Edmund (Boston, 1867).

Quincy, QUATREMÈRE, de: See QUATREMÈRE DE QUINCY.

Quinet, kē'nā', EDGAR: author; b. at Bourg, Ain, France, Feb. 17, 1803. He studied at Paris, Geneva, Strassburg, and Heidelberg. He was profoundly influenced by German thought, and upon his return published a translation of Herder's *Ideen zur Philosophie der Geschichte der Menschheit* (3 vols., Paris, 1827). In 1828–30 he was a member of a scientific expedition to Morea; contributed from 1831 to 1839 to the *Revue des Deux Mondes* essays principally on foreign life and thought; was made Professor of Foreign Literature at Lyons in 1839, and of the Languages and Literatures of Southern Europe at the Collège de France in 1842. His political utterances, ardently liberal and anti-clerical, led to his removal in 1846. He then traveled in Spain, took part in the revolution of 1848, was a member of the Constituent and Legislative assemblies, was banished in 1852 after the *coup d'état*, lived in Holland and Switzerland, returned at the fall of the empire, and was deputy in the National Assembly in 1870. D. at Versailles, Mar. 27, 1875. He wrote vast philosophical epics dealing with the history of humanity (*Ahasvérus*, 1833; *Napoléon*, 1836; *Prométhée*, 1838), remarkable for loftiness of conception and striking ideas, but lacking measure and sobriety; and a large number of works of eloquent prose dealing with history, politics, religion, and literature, among them *Le Christianisme et la Révolution Française* (1846); *La Révolution* (1865); *France et Allemagne* (1867). They have been collected in *Œuvres complètes* (vols. i.–x., 1857–58; vol. xi., 1870; vols. xii.–xxviii., 1877–79); to them must be added *Le Livre de l'Exilé* (1875) and *Lettres d'Exil* (4 vols., 1884–88). A. G. CANFIELD.

Quinette de Rochemont, kē'net'de-rōsh'mōn', ÉMILE THÉODORE, Baron: civil engineer; b. at Soissons, France, Aug. 19, 1848; educated at the Polytechnic School and at the École de Ponts et Chaussées, where he graduated 1859; attached to the council general of bridges and roads 1862; 1863–79 resident engineer of the port of Havre; engineer-in-chief of the canal from the Escaut to the Meuse 1879; engineer-in-chief of the port of Havre 1883; inspector-general of bridges and roads at the ministry of public works 1892; and professor at the École de Ponts et Chaussées since the same year. He has published *Mémoire sur le Clyde, Glasgow, Port Glasgow, et Greenock* (1869); *Note sur les phares électriques de la Hève* (1870); *Régime des courants et des marées à l'embouchure de la Seine* (1874); *Notice sur le port du Havre* (4to, 1875); numerous memoirs and notices of the port of Havre 1877 to 1889; *Note sur l'Escaut maritime et le port d'Anvers* (1878); *Note sur le type d'écluse pour le Canal de l'Escaut à la Meuse* (1883); *Les ports maritimes de la Hollande* (1890); *Les ports Allemands de la Baltique* (1891); *Les ports Allemands de la mer du Nord* (1892); *Les ports de la Mersey et de la Clyde* (1892). W. R. HUTTON.

Quinine, ki-neen' or kwī'nīn [= Fr., from Span. *quina*, Peruvian bark, from Peruv. *kina*, bark]: the most important medicinal ingredient of cinchona or Peruvian bark. It was discovered in yellow or calisaya bark in 1820 by Pelletier and Caventou. It exists in all the official barks, but is most abundant in the calisaya. To obtain it, it is first extracted from the bark as a sulphate by means of a complex process. By treating this salt with the solution of an alkali, the quinine is precipitated, and is then washed, dried, dissolved in alcohol, and reobtained by slow evaporation. It may be amorphous, but with care it can be obtained in silky crystals. Quinine is an alkaloid with strong basic properties, and forms with acids crystallizable salts. Its formula is $C_{20}H_{24}N_2O_2$. It is without smell, but has an intensely bitter taste; is very insoluble in water, but dissolves freely in alcohol and moderately in ether. Solutions of the alkaloid or its salts, treated first with chlorine water and then ammonia, strike a brilliant green color. This test is very delicate, and distinguishes quinine from all other vegetable alkalies except quinidia. Quinine is used in medicine principally in the form of sulphate or hydrochloride, the latter salt having the advantage of being more soluble. Quinine salts are locally irritant, and internally in small dose are stomachic; in large, powerfully disturbing to the nervous system, while also tending to cause nausea and vomit. In medicinal doses the most prominent symptoms of cinchonism are headache and deafness, with buzzing or roaring in the ears, muscular debility, and some reduction of the force and frequency of the pulse. In poisonous dose the individual may become completely blind, deaf, and paralyzed, but death is rare. Quinine salts are powerfully anti-

septic, a small percentage preventing or arresting putrefactive and fermentative processes. They also, in small percentage, arrest protoplasmic movement, as in white blood-corpuscles, bacteria, etc., and even destroy permanently the vitality of the organisms. These salts are used in medicine, especially to cure malarial affections of all kinds, over which they have a well-known and unequaled power, by preventing activity in the peculiar micro-organisms (*Hæmatozoon malariæ*) of malarial disease. The five other alkaloids of cinchona bark—namely, quinidine and quinicine and cinchonine, cinchonidine and cinchonicine—are all more feeble than quinine in power and are rarely used, except cinchonidine. Quinicine and cinchonicine are both artificial alkaloids. Revised by H. A. Hare.

Quinisext Council [Lat. *quinque*, five, *sextus*, sixth]: the Oriental Church council which was convened in 692 A. D. to supplement the acts of the fifth and sixth œcumenical councils. It is called also the Second Trullan Council, because it was held in the domed room of the imperial palace at Constantinople, called the *Trullus*. The Greeks consider it the seventh œcumenical council, but the Latins do not recognize it. It was convened by Justinian II., and gave 102 stringent canons on clerical discipline, but allowed the marriages of priests to stand, provided they were first marriages and with virgins. See Trullan Councils.

Quino'a: a woody herb (*Chenopodium quinoa*), which, with other nearly related species, is cultivated in the highlands of Spanish America for its nutritious seeds. Its leaves are used as a potherb.

Quinsy [for *squinancy*, from O. Fr. *esquinancie*, *quinancie*: Span. *esquinancia* < Lat. *cynanche* = Gr. κυνάγχη, a kind of sore throat]: acute suppurative tonsilitis, or inflammation of the tonsil, terminating in abscess. One attack usually leaves subacute or chronic disease of the tonsil, which predisposes the person to repeated attacks in subsequent seasons. Quinsy is most often unilateral, less frequently attacking the two tonsils successively, and rarely coincident upon both sides. It attacks adults, less often children; the two extremes of life, infancy and old age, being quite exempt from it. It occurs in persons of full habit, especially when the diet has been excessive and luxurious. The rheumatic and gouty diatheses especially predispose. The immediate or exciting cause is some exposure of the body to wet or cold. The attack is manifested by soreness of the throat, increased by swallowing and talking, rigidity of the jaw, hypersecretion of saliva, coated tongue, labored breathing, and sense of obstruction, tension, and tumefaction in the throat. With the first development of pus intense throbbing pain exists. The disturbance of the general system is variable, but in general it is remarkable how much constitutional disturbance results from limited local disease in throat-troubles of this kind. In mild cases only impaired appetite and sense of lassitude exist; in graver attacks there may be a slight or marked chill at the onset, and a succession of light chills; the temperature elevated to 102° or 104° F.; the pulse full and bounding; delirium at night, and by day the face expressive of great fatigue, suffering, and alarm. Internal examination discloses the tonsil symmetrically enlarged, extending to the median line of the throat and obstructing it. Palpation by the finger may detect the softness and fluctuation of pus. In from five to eight days the suppurated tonsil bursts, all the symptoms vanish, and recovery is speedy. In its formative or first stage, quinsy may sometimes be aborted by scarification, by ice in the mouth, cold gargles or spray, and astringent gargles or applications, as of alum or tannin, and by administration of saline cathartics and arterial sedatives or quinine. When developed, the inhalation of steam, warm anodyne gargles, soothing poultices or fomentations, anodynes to secure rest, tonics and diet to sustain the strength, and early evacuation of pus with the knife, are the essentials of treatment. Sudden death may occur when the abscess opens spontaneously during sleep and the pus enters the air-passages, or from hæmorrhage when the internal carotid artery is involved by the suppuration. Revised by W. Pepper.

Quintain [Fr. *quintaine*: Ital. *quintana*, *chintana* < Lat. *quinta'na*, a street in the Roman camp between the fifth (*quintus*) and sixth maniples, where probably was set a post for use as a target]: an object, often in the form of a man, designed to be tilted at with a lance. It was sometimes placed at the end of a crosspiece so balanced upon a pivot that if the rider were not very quick a bag of sand at the other end of the crosspiece would strike him in the back.

Quintal [via Fr. and Span. from Arab. *qinṭār*, a weight of 100 lb., probably from Lat. *centena'rius*, consisting of a hundred, from *centum*, hundred]: a hundred weight, chiefly used in weighing fish.

Quintana, kĕĕn-taa'năă, Manuel José: author; b. in Madrid, Spain, Apr. 11, 1772. He studied at the University of Salamanca, and became a lawyer at Madrid. His first literary works, a tragedy and a volume of poetry, were intended to rouse the national spirit against the French, who were then invading the Peninsula; they were very popular. During part of the "war of liberation" Quintana was secretary of the Cortes and the regency; after the restoration his liberal principles led to his mild imprisonment in the castle of Pamplona. In 1833 he was made preceptor to the infant queen, Isabella, and in 1835 he became a senator. His principal work, and one of the modern Spanish prose classics, is *Vidas de Españoles célebres* (1807–34; many later editions). It includes biographies of the Cid, Gonzalo Fernandez de Córdoba, Balboa, Pizarro, Las Casas, etc., and is characterized by clearness and simplicity of style, with much original research. D. in Madrid, Mar. 11, 1857. H. H. Smith.

Quintard, Charles Todd, M. D., D. D., LL. D.: bishop; b. at Stamford, Conn., Dec. 22, 1824; graduated in medicine at the University of New York 1847; became a physician to the New York City Dispensary 1847; Professor of Physiology and Pathological Anatomy in the Memphis Medical College 1851; contributed to medical periodicals; took orders in the Protestant Episcopal Church 1855; was successively rector of churches at Memphis and Nashville; was a chaplain in the Confederate army, and was chosen Bishop of Tennessee 1865. He was the second founder of the University of the South at Sewanee, Tenn., after its destruction during the civil war. He obtained large endowments for this institution in England, and until 1893 was vice-chancellor and trustee. D. Feb. 15, 1898. Revised by W. S. Perry.

Quintil'ian (Lat. *Marcus Fabius Quintilianus*): author; b. at Calagurris, Spain, about 35 A. D.; educated at Rome, and gained there the highest reputation as a teacher of eloquence; received a regular salary from the treasury fund established by Vespasian, and was loaded with the highest civil honors and titles by Domitian. D. probably about 96. About 95 he published his *Institutio Oratoria*, a work in twelve books on the art of oratory, which, besides its great historical interest (bk. x.), may still be read for practical purposes. There are English translations by Guthrie (1756), Patsall (1774), and Watson (1856). The best critical editions are by Halm (2 vols., Leipzig, 1868) and Meister (2 vols., Prague, 1886–87). The lexicon to Quintilian by Bonnel (Leipzig, 1834), forming the sixth volume of Spalding's edition, is valuable. Separate editions of book i. are by Fierville (Paris, 1890), of book x. by Bonnel-Meister (Berlin, 1882), Krüger (Leipzig, 1888), and Petersen (Oxford, 1891). The two collections of *Declamationes*, 19 longer and 145 shorter, ascribed to Quintilian, are probably spurious. A complete edition is by Gronovius (Leyden, 1665) and Burmann (Leyden, 1720). Of the 145 shorter by C. Ritter (Leipzig, 1884). See Schanz, *Gesch. der Röm. Lit.* (Munich, 1892, 2d part, p. 442). Revised by M. Warren.

Quin'tus Cur'tius Ru'fus: the author of an historical work in ten books on Alexander the Great, *Historiæ Alexandri Magni Macedonis*, which was much read and much admired during the Middle Ages. Of the author nothing definite is known. He may have been a rhetor mentioned in an *Index* of Suetonius. Of the work, which was composed under the Emperor Claudius, the first two books have been lost, and some of the others considerably damaged. The narrative is very pleasing, but by no means accurate, and is full of fables. The best editions are by E. Hedicke (Berlin, 1867), Th. Vogel (Leipzig, 1881; and with notes, 1885), S. Dosson (with French notes, Paris, 1887). See also Dosson, *Étude sur Quinte Curce, sa vie et son œuvre* (Paris, 1887). Revised by M. Warren.

Quin'tus Smyrnæ'us, or **Calaber**: Greek epic poet, who composed *Posthomerica* (τὰ μεθ' Ὅμηρον), in fourteen books. The name *Smyrnæus* comes from his own statement (12, 310) that he had lived at Smyrna, *Calaber* from the fact that his poems were discovered in Calabria by Cardinal Bessarion in 1450 A. D. His versification points to an earlier period than that of Nonnus (*q. v.*). The poem covers too much ground and lacks unity. It produces the effect of a mosaic for which Homer, Hesiod, Sophocles, Euripides, Apollonius, Lycophron, and probably even Vergil and Ovid have been laid

under contribution. The style is simple, the descriptions do not lack epic detail, similes abound, and the work is further commended by purity of tone, but there is no true life in it, and no one comes back to Quintus except to investigate his sources. There is an edition by Köchly (Leipzig, 1850), another by the same in the Teubner Library, and a critical one by Zimmermann (Leipzig, 1891). B. L. GILDERSLEEVE.

Quir'inal [from Lat. *Collis Quirina'lis*, the Quirinal Hill; *col'lis*, hill + *Quirina'lis*, pertaining to *Quirinus*, a name of the deified Romulus, deriv. of *Cu'res*. See QUIRITES]: one of the seven hills of Rome, lying N. and a little E. of the Forum. Like the Palatine it was originally the seat of a separate community (as Mommsen has conclusively shown, *Roman History*, vol. i., p. 82) with religious and political institutions of its own. Aside from the ancient temple of *Quirinus*, restored by Julius Cæsar and Augustus, the most important buildings on the Quirinal, of which remains still survive, were the baths of Constantine and the baths of Diocletian. See Ch. Hülsen, *Zur Topographie des Quirinals*, *Rheinisches Museum*, vol. xlix. (1894), pp. 379–424. On the baths, see Middleton, *Remains of Ancient Rome*, vol. ii., pp. 177–186. G. L. HENDRICKSON.

Quiri'tes [= Lat., plur. of *Qui'ris*, probably meaning a citizen of CURES (*q. v.*)]: the citizens of ancient Rome, synonymous with *populus Romanus*, or even added to it, as *populus Romanus Quiritium*. The singular *quiris* is very rare, and the plural form is only used in certain set formulas —e. g. *Quirites* (as a form of address), *jus Quiritium* (full Roman citizenship), and the example given above. G. L. H.

Qui-tam Actions: See INFORMER.

Quit-claim: a word often employed in deeds in which the grantor or seller undertakes no responsibility in regard to the validity of his own assumed right to the property in question, but merely conveys to the grantee or buyer his own interest, whether valid or the reverse.

Quitman, JOHN ANTHONY, LL. D.: lawyer and soldier; b. at Rhinebeck, N. Y., Sept. 1, 1799; received a liberal education; became a lawyer, and was professor at the Mount Airy College, Pa., 1819; practiced law at Chillicothe, O., 1820–23; removed to Natchez, Miss., where he became a successful planter and rose to distinction in his profession and in the politics of the State; was chancellor of the superior court 1828–31 and 1832–34; member of the State Legislature 1828–32; president of the Senate in 1835 and Governor *pro tem.*; judge of the high court of errors and appeals 1839; distinguished in the Texan struggle for independence, he was, on the outbreak of the war with Mexico, appointed brigadier-general of volunteers; promoted to be major-general Apr., 1847; was distinguished at Monterey, Chapultepec, and assault and capture of the city of Mexico; Congress presented him with a sword for his services at Monterey, and Gen. Scott appointed him governor of the city of Mexico. Returning home at the close of the war, he was elected Governor of Mississippi in 1850, and from 1855 to 1858 was a member of Congress and chairman of the committee on military affairs. D. at Natchez, July 17, 1858. See his *Life and Correspondence* (2 vols., 1860), by F. H. Claiborne.

Quito, kee'tō: a city; capital of Ecuador; on the Andine plateau, 9,250 feet above the sea; a few miles S. of the equator, and 165 miles N. N. E. of Guayaquil (see map of South America, ref. 3–B). The plain or valley of Quito is an elevated basin nearly surrounded by some of the highest peaks of the Andes. The city itself is built on the lower spurs of the Pichincha volcano, and Cayambé, Antisana, Cotocachi, Cotopaxi, Sinchalagua, Corazon, and Iliniza are in plain sight, their snow-clad peaks forming a panorama of almost unequaled grandeur. The ground occupied by the city is very uneven and is traversed by deep ravines spanned by arches: the streets are narrow, indifferently paved, and so steep that carriages can not be used. Owing to the danger from earthquakes, most of the houses are built with only one story, but many of them are substantial, and the older ones recall the early colonial period. The public buildings are generally of stone; the cathedral, government and archbishop's palace, and city-hall are grouped about the Plaza Mayor, a handsome square and public garden. There are many churches and convents, a public (formerly the Jesuits') library, hospitals, observatory, and several educational institutions, including the ancient university, which is essentially a theological seminary. Many of the ecclesiastical buildings are adorned with paintings by native artists, and the city has a wide reputation as an art center. In population and commerce it is surpassed by Guayaquil; it has been impoverished by frequent revolutions. No railway connects it with the outer world, and there is only one good carriage-road out of the city—that to Guaranda. The bulk of the population consists of small tradesmen and artisans and Indian laborers and servants. The climate is spring-like, very equable, and salubrious. The natural drainage keeps the city healthful, though sanitary rules are neglected. Quito is probably the oldest existing city in America, having been the capital of the ancient Quitu chiefs. It was taken by the Inca Tupac Yupanqui about 1470, was thereafter a favorite residence of the Incas, and when their empire was divided in 1525, became the capital of the northern portion. The Spanish general Benalcazar took it and founded the modern city in 1534. During the colonial period it was the capital of the presidency of Quito (now Ecuador). The most destructive earthquakes were in 1797 and 1859. Pop. about 35,000. HERBERT H. SMITH.

Quittor: See FARRIERY.

Quoits, kwoits or koits [M. Eng. *coite*, from O. Fr. *coitier*, push, harass < Lat. *coactare*, force, freq. of *cogere*, compel]: a game of strength and skill, in which the player strives to pitch a flattened ring of steel (called a quoit) in such a way as to land it as near as may be to a peg or hob of iron stuck upright in the ground, or, if possible, to make it ring the hob. This game differs from the discus-play of the ancients, in which the player threw a disk of metal or stone as far as he could, the longest thrower winning the prize.

Quoratean Indians [*Quoratean* is an adaptation of Quoratem, or Kworatem, the native name of Salmon river, California, as well as of a small band formerly residing at its mouth]: a linguistic stock of Indians, whose geographic limits are somewhat indeterminate. The main area occupied by the tribes includes both banks of the lower Klamath, from a range of hills a little above Happy Camp to the junction of the Trinity, and Salmon river from its mouth to its sources. On the N., Quoratean tribes extended to the Athapascan territory near the Oregon line.

The tribal divisions are the Ehnek, Karok, and Pehtsik. The Ehnek are well formed and compact, and in stature are but slightly inferior to the whites. The women are better-looking, fairer, and of livelier disposition than any on the coast, and not a few have married among the settlers. The social organization is exceedingly democratic, the authority of their village chiefs being only nominal. In time of war they had a single chief, and instead of taking scalps, decapitated their captives. The Ehnek have many dances, among which is one performed in the fall, for the spirits of the earth and forest, and another immediately before the salmon-catch in spring. The term Karok means *up the river*, and is applied to the Indians who reside on the middle Klamath, in contradistinction to those living near the mouth. In 1889 the Indians of this stock numbered about 600. See INDIANS OF NORTH AMERICA, and Stephen Powers, *Tribes of California* (*Contributions to North American Ethnology*, iii., Washington, 1877). F. W. HODGE.

Quorum: See PARLIAMENTARY LAW (*Adoption of Motions*).

Quotidian: See FEVER and CHILL.

Quo Warranto, Writ of, or (as often abbreviated) **Quo Warranto** [Law Lat., by what authority; Lat. *quo*, by what + *warranto*, abl. of Mediæv. Lat. *warrantum*, warrant, authority]: a very ancient common-law writ, in the nature of a writ of right, for the crown against a person or corporation claiming or usurping any office, franchise, or liberty, to inquire by what authority the claim was supported, or to determine the right. The writ also lay in case of non-user or long neglect, and in case of misuse or abuse. The respondent was commanded to appear and show by what right he exercised the office, franchise, or liberty, not having a grant of it, or having forfeited it for non-user or abuse. The proceeding of *quo warranto* was long, and the judgment in it conclusive even against the crown. In England it was superseded at an early day by the proceeding called an information in the nature of a *quo warranto* (see INFORMATION), and it is little used in the U. S. F. STURGES ALLEN.

R

: the eighteenth letter of the English alphabet.

Form.—It is the Latin R or ℟ derived from the Greek R, ℟, a form of the letter Ρ (rho), particularly common in the alphabets of Eubœa, Bœotia, Phocis, Locris, Thessaly, and the Peloponnesus. The added dependent stroke was preserved in the Latin alphabet as a convenient means of distinguishing the letter from the form of *pi* (Ρ instead of Π) generally adopted there. The Phœnician form of the letter was ϟ.

Name.—The Semitic name *rēsh*, head (side view), was changed in Greek to *rhō* (ῥῶ). In Latin the letter received the phonetic name *er*, which appears in O. French as *erre*, Provenç. *erre*, *erro*. Adopted into M. Eng., this yielded in Mod. Eng. the present name *ar*; cf. *ferme* > *farm*, *persone* > *parson*, *persil* > *parsley*, *gerner* > *garner*, etc.

Sound.—In the standard English of Great Britain and in that of the southern and northeastern part of the U. S., *r* stands for a consonant only when it immediately precedes a vowel as in *ride*, *dry*, *try*. This consonant sound is a spirant, either voiced or voiceless, produced between the tip of the tongue and the forward palate or the ridge between palate and gums. Before the back-vowels the tongue-tip is turned back toward the palate, as in *raw*, *roar*, *rout*; otherwise it turns toward the ridge of the gums, as in *rid*, *red*. It is often voiceless after voiceless consonants; contrast *try* and *dry*. After vowels it denotes, in the language of the localities mentioned above, the sound of the obscure vowel ə, or is entirely silent. Thus it is pronounced as ə in *care*, *floor*, *dire*, *our*; it is silent or results in lengthening the preceding vowel in *far*, *sir*, *fern*.

Source.—In Teutonic words it generally represents either (1) Teutonic and Indo-European *r*; as *red* < O. Eng. *rēad*: Goth. *ráuþs*: Germ. *roth*, cf. Gr. ἐρυθρός: Lat. *ruber*: Sanskr. *rudhirá-*, or (2) Teutonic *z* < Indo-European *s*; as *ear* < O. Eng. *ēare*: Goth. *áusō*: Germ. *ohr*, cf. Lith. *ausis*; *sear* < O. Eng. *sēar*, cf. Lith. *saũsas*, dry, Gr. αὕειν, to dry up.

Symbolism.—R = rood, rod, king (*rex*), queen (*regina*), take (*recipe*); Rh. = rhodium. See Abbreviations.

Benj. Ide Wheeler.

Ra (Egypt. *Rā*): the Egyptian "sun-god," "father of gods and men," in whom in particular the solar worship of the Egyptians was centered. Heliopolis contained his principal sanctuary and was the center of his cult, which was very ancient. He was regarded as the offspring of the celestial ocean, and was believed to have appeared first at Heracleopolis (*q. v.*), where he gained a victory over the "children of the rebels" and assumed divine rule over the world. So long as he was young his kingdom was strong, but with advancing age his subjects became rebellious. With the aid of Hathor he revenged himself upon mankind and almost utterly destroyed them. Such are the main features of the myth of Rā. (See Brugsch, *Die neue Weltordnung nach Vernichtung des sündigen Menschengeschlechtes*, Berlin, 1881.) Rā is represented as hawk-headed, with the sun-disk and the uræus on his head, the sun-disk being his emblem. Rā himself was the sun at midday; the rising sun was Ra-Harmachis, "Horus on the horizon"; and the setting sun was Ra-Tum (Àtum, the closer), as an aged man. During the night he was regarded as in conflict with the serpent Àpepi, but from the contest he emerged each morning in victory. The *Adoration of Ra* was one of the chief and best-known poems of the Book of the Dead. The worship of Rā as Àten, the sun-disk (see Khunaten), was the nearest approach to monotheism which Egypt ever saw. Joined with Àmen, as Àmen-Rā, he became the principal national god after the expulsion of the Hyksos, and joined with Mont, as Mont-Rā or Menthu-Rā, he was the god of war. Rā was also conceived of as joined with various other gods of the Egyptian pantheon. Charles R. Gillett.

Raab: town of Hungary; at the influx of the Raab into the Little Danube, a branch of the Danube; 67 miles W. N. W. of Budapest (see map of Austria-Hungary, ref. 5–F). It was formerly fortified, and has a fine old cathedral. Its manufactures of tobacco and cutlery and its transit trade are extensive. Pop. (1890) 23,956.

Raabe, raa'be, Wilhelm (pseudonym *Jakob Corvinus*): novelist; b. at Eschershausen, Brunswick, Sept. 8, 1831; studied philosophy at Berlin and devoted himself entirely to literary pursuits. He is distinguished as a humorist among the German novelists of the nineteenth century. His principal works are *Die Chronik der Sperlingsgasse* (1857); *Leute aus dem Walde* (1863); *Der Hungerpastor* (1864); *Wunnigel* (1879); *Horacker* (1876); *Das Horn von Wanza* (1881); and *Der Lar* (1889). J. G.

Raba'nus Magnen'tius Mau'rus (spelled also *Hrabanus* and *Rhabanus*): archbishop; descended from an ancient Roman family, and pronounced by Kurtz "the most learned man of his age"; b. at Mentz about 776; studied in the monastery at Fulda, and afterward in Tours under Alcuin; teacher at Fulda from about 805 till 814 and again from 817, and made abbot there in 822; Archbishop of Mentz 847. D. at Winkel, Feb. 4, 856. The name of Maurus was given to him by his teacher, Alcuin, in remembrance of St. Maur, the disciple of St. Benedict. He opposed the doctrine of transubstantiation, first distinctly set forth by Paschasius Radbert in 831 (expanded in 844). His works fill six volumes (107–112) of Migne's *Patrologia*. See Bach's *Rabanus Maurus, der Schöpfer des deutschen Schulwesens* (1835); Kunstmann's *Rabanus Magnentius Maurus* (1841); and Spengler's *Leben des Rabanus Maurus* (1856).

Revised by M. Warren.

Rabat': strongly fortified town of Morocco, Northern Africa; at the mouth of the Wadi-el-Buregreg on the Atlantic; formerly a port of considerable importance, but less accessible now on account of a sand-bank in front of the river mouth (see map of Africa, ref. 1–B). Most European trade has therefore sought safer ports, though one or two steamers a month call to leave tea, sugar, cloths, candles, and small wares, and take away olive oil, beans, wool, skins, and bones. The fine and brilliantly colored carpets, woolen cloths, mats, leather goods, and potteries for which Rabat is famous are not extensively exported, but are widely distributed in Morocco. Pop. 25,000, one-sixth Jews, besides about 100 Europeans. Zelâ, across the river (pop. 10,000), has its own local government, its people following the same industries as those of Rabat. C. C. Adams.

Rab'ba: ancient capital of the native state of Nupé; on the middle Niger river, West Africa. It was destroyed by the Fulahs early in the nineteenth century when they were spreading the tenets of Mohammedanism. Though no longer the capital, it is a large town in a well-cultivated region, and has a considerable trade with Sokoto and other places in the Sudan. It was once one of the most important slave-markets in West Africa. Revised by C. C. Adams.

Rabbah: same as Amman (*q. v.*).

Rabbi [= Lat. = Gr. ῥαββί, from Heb. *rabī*, my master, deriv. of *rab*, master, lord, teacher; cf. Arab. *rabb*]: a title of honor anciently employed by the Jews to designate those learned in the law, in which sense it is frequently found in the Gospels. It was also used by disciples of other teachers, for it was applied to John the Baptist (John iii. 26) and to Jesus himself (e. g. Matt. xxvi. 25, 49; Mark x. 31; John i. 38). Luke employs the term *didaskale*—i. e. teacher—but this is only the Greek translation of rabbi. The term *rab* is applied by Oriental Jews in a manner similar to the use of the English "esquire."

Rabbinical Literature: a name wrongly given to the whole of the literature produced by the Jews, but one which may fitly describe that portion of it which is the result of the literary activity of the rabbi in his position as religious and judicial leader of the community. Its subject-matter is civil and ecclesiastical law, both the legislative and executive power in the Jewish community being in post-Talmudic times, the period treated of, in the hands of the rabbis.

The continuity of oral tradition had not been disturbed by the completion of the Mishnah and the Talmud (*q. v.*).

The latter became the basis for all further discussions in the schools, and was modified and developed as occasion required. The literature which resulted from these discussions took on the form of commentaries, glosses, compendia, and practical decisions. Of the two redactions of the Talmud, it was the Babylonian which soon acquired absolute authority, almost to the exclusion of the Palestinian. It was in the schools of Babylon (Sora and Pumpaditha) that the first attempts were made to bring order into the chaos of the Talmud. The most noted of the Gāōnīm ("Highnesses," 800–1037) as Talmudic scholars were Sherīra (980), who wrote an encyclical to the Jews of Kairowān in which he detailed the history of the formation of the Talmud; his son, Hai (969–1038), to whom a commentary on the Mishnah is ascribed; and Samuel ben Chofni (960–1034). Even before their death Jewish scholarship had sought a new home in Spain and North Africa. The Jews in Spain lived in greater freedom and busied themselves more with poetry and philosophy. Talmudic science had been transported there from the East by Moses ben Chanoch (960), and was kept alive by his son Chanoch and by Joseph ibn Abitur; but rabbinical science found its first real home across the Pyrenees—in Provence, in France, and then in Germany. The influence of Soloman ben Isaac (Rashi 1040–1105) of Troyes was supreme in France, and as a result of his commentaries there arose a school of Tosafists ("adders"), which, in contradistinction to the Spanish compilers and epitomizers, developed the careful criticism of the text and its application to the needs of actual life. Zunz has put together nearly 200 names of Tosafists, some of whom carried their methods into England.

In Spain the controversy evoked by Maimonides (*q. v.*) in favor of philosophy against the exclusive study of the Talmud produced two men who deserve notice: Moses ben Nachman (Ramban, Nachmanides, 1263) of Gerona, who wrote a commentary, and who may be called the Spanish Tosafist, and Solomon ben Adret (1300) in Barcelona, the author of novellæ to many Talmudic treatises. In Italy this period produced three scholars whose fame reached beyond their own country: Nathan ben Yechīēl (d. 1106) of Rome, the author of an excellent Talmudic dictionary; Isaiah ben Mali (1250) of Trani, who because of his rational and critical spirit is ranked even above the Tosafists of France and Germany; and Joseph Kolon (Maharik, d. 1480). In Germany the importance of the study of the Talmud was emphasized by the meeting of the rabbinical councils of Mayence in 1223 and 1245. Mēīr ben Baruch (d. 1293) of Rothenburg, called the German Tosafist, may justly be considered the head and front of the new school.

It was in the middle of the sixteenth century that the Jews began to wander into Poland, where the Talmud reached its culminating point as the supreme religious and legal authority. Being there largely excluded from all other employments, the Jews found their only consolation in the schoolhouse (Yeshībhāh), where they studied and restudied their ancient lore. This study developed into a mere exercise of ingenuity, into pure casuistry similar to the casuistry of the Christian and Mohammedan scholastics. This casuistry is called Pilpul (√pepper), and the new matter thus evolved Chiddūshīm (novellæ). A fair description of the method employed will be found in the *Autobiography* of Solomon Maimon (Boston, 1888, chap. vi.). Its origin is ascribed to Jacob Pollak (d. 1541) and to Solomon Shechna (1557) of Lublin. In Poland and Russia it still exists; but with a wider and more secular education it is gradually making way for a critical and intelligent study of the Talmud.

The numerous compendiæ which were written for the purpose of making the decisions scattered up and down the Talmud available for the practical office of the rabbi and the rabbinical decisions deserve a special mention. Very shortly after the completion of the Talmud a digest was attempted by Hai Gāōn (969–1038), who tried to put the whole material into memorial verses. Simon of Kahira arranged all the decisions upon the basis of 613 commandments supposed to be contained in the Pentateuch. Similar compilations were made by other writers. More important were the *Halāchōth* of Isaac ben Jacob (Alfasi), and more scientific the *Mishnēh Thorah* of Maimonides. This last codification by Maimon was, however, too scientific for actual use, and presupposed a too intimate acquaintance with the material. To remedy this other compendiæ were made by Moses ben Jacob of Coucy in his *Sēfer hammitzwōth*; Solomon ben Adret in his *Tōrath habbayith*, and others; and finally by Joseph Caro (1556) of Safed, in his *Shulchān Ārūch*.

The rabbinical decisions are in the form of questions and answers (*Sheēlōth Ūtheshūbhōth*). Such questions upon religious and juristic matters were sent to prominent Talmudic scholars all over Europe, Asia, and North Africa, but the authority of the teacher as such was not final. Apart from their intrinsic value, these decisions contain a large amount of material for the history of the social life of the Jews during the whole of the post-Talmudic period. They exist by the hundred thousands.

Among numerous works giving information on this subject, see Renan and Neubauer, *Rabbins Français* in *Histoire littéraire de la France*, vol. xxvii.; A. Geiger, *Nachgelassene Schriften* (Berlin, 1875, vol. ii.); M. Güdemann, *Geschichte des Erziehungswesen und der Cultur der abendländischen Juden* (Vienna, 1873–84, 3 vols.); Joel Müller, *Briefe und Responsen der vorgeonäischen Jüd. Lit.* (Berlin, 1886), *Die Responsen der Spanischen Lehrer des 10ten Jahrhunderts* (Berlin, 1889); and those given in bibliography of article Jewish Literature (*q. v.*). Richard Gottheil.

Rabbit [M. Eng. *rabet*; cf. dial. Fr. *rabotte*, Old Dutch *robbe*, and Gaelic *rabaid*, rabbit]: the English name for many species of the family Leporidæ (*q. v.*), but more especially applicable to *Lepus cuniculus*. This species is found generally distributed throughout Europe (except in its more northern portions), as well as the contiguous portions of Asia and Northern Africa, and is also naturalized in Australia, where it is a serious pest, and elsewhere. It lives in communities, burrows in the ground, and brings forth its young blind and naked. It is very prolific, beginning to breed at the age of about six months, and having several litters in the course of a year, and in each litter some four to eight young ones. In the U. S. the name rabbit is also generally given to all species, the best known of which is the common small rabbit of the Eastern and Middle States (*Lepus sylvaticus*); this species, as well as the other species of the family (*Lepus cuniculus* excepted), agrees with the hare in making forms, instead of burrowing, and in bringing forth its young provided with hair and able to see.

Revised by F. A. Lucas.

Rabelais, răă'be-lā', François: author; b. at Chinon, Indre-et-Loire, France, toward the end of the fifteenth century (1495?). Being the youngest son he was destined for the Church. He studied first at the abbey of Seuillé, then at the monastery of La Baumette, near Angers. About 1509 he entered the Franciscan monastery at Fontenay-le-Comte. There he passed his novitiate and was made priest in 1519. His intellectual curiosity was enormous, and he devoted himself to reading and study, attaining to an almost cyclopædic knowledge of the science of that time, becoming well read in Latin, Greek, law, mathematics, and astronomy. His passion for learning was directly opposed to the spirit of his order, and his devotion to books and relations with scholars made his brother monks distrust him. His cell was searched, his books seized, and he himself sought safety in flight. The intervention of influential friends, especially of Geoffroy d'Estinac, Bishop of Maillezais, and Guillaume Budé, saved him from further consequences. Clement VII. authorized him, in 1524, to leave the Franciscan order for the Dominican and enter the abbey of Maillezais; but he soon abandoned the monastic life, assuming with the consent of his superiors the garb of lay preacher, and began a kind of free, roving existence to which his great curiosity for knowing the world predisposed him, adding continually to his vast information. The story of this vagabondage is obscure. He took a course of medicine at Montpellier and was teaching there in 1530; from 1532 to 1534 he was at Lyons practicing medicine, editing the first of a series of almanacs, engaged in various works of scholarship, and beginning his great *Pantagruel*. In 1534 he went to Rome with Jean du Bellay, Bishop of Paris, who was there made cardinal, and returned with him to Paris in 1535. In 1539 he entered the abbey of Saint-Maur as canon, but with the privilege of freely practicing medicine. From 1540 to 1542 he was again in Italy with Guillaume du Bellay, as his physician, and wrote in Latin the history of his wars, now lost. In 1547 he was at Metz, in 1549 again in Rome with Cardinal du Bellay. In 1550 he was in Paris, and was made curate of Meudon, but surrendered this living, with that of Saint-Christophe-du-Jambet, previously given him, in 1552. D. probably in 1553. His main fame is due to his *Gargantua* and *Pantagruel*. The first *Gargantua* was but a new edition, with a few original additions by Rabelais, of an older popular romance. Its success provoked an original continuation,

Pantagruel. This too was very successful, and to bring the story of *Gargantua* to its level he rewrote it in 1535, and in this form it is now the first book of the complete work. In 1546 appeared with the royal privilege a third book of *Pantagruel*, generally considered the best; and in 1552 a fourth book appeared, also with the royal privilege, which did not prevent its being condemned by the Sorbonne. In 1562–64 a fifth book appeared, of which certainly not all, probably not much, is by Rabelais. The work recounts the marvelous lives and deeds of the giants Gargantua and Pantagruel; but it is the actual life of the time which it really pictures, with all its ferment of ideas, its struggle between mediævalism and the Renaissance, its mixture of fragments of the decomposing Middle Ages, and of elements of a new order. The spirit of these pictures is that of exuberant and jovial satire. They breathe a disrespect for the traditional authorities and conventional forms, and are especially keen against the ideas and practices of the Church. They are saturated with the sense of intense delight in life, the physical and sensuous existence of the human animal in all its manifold exhibitions, and it is rendered with such frankness and absence of reticence that throughout the work coarseness and obscenity are frequent and prodigious. Good recent editions are by Desmarets and Rathery (2 vols., Paris, 1857–58); Marty-Laveaux (4 vols., Paris, 1868–81); Jannet (2 vols., Paris, 1858–72). Cf. E. Gebhart, *Rabelais, la Renaissance et la Réforme* (Paris, 1877); P. Stapfer, *Rabelais* (Paris, 1889). The English translation by Sir Thomas Urquhart (1653), continued by Motteux (1693–94), and often reprinted, is a famous piece of translation. A. G. Canfield.

Rabener, raa′be-ner, Gottlieb Wilhelm: poet; b. at Wachau, near Leipzig, Germany, Sept. 17, 1714; studied law at Leipzig, and entered the civil service of Saxony; d. at Dresden, Mar. 22, 1771. He gained his reputation chiefly as a satirist, and, like his friend Gellert, he represents the perfection as well as the mediocrity of German literature previous to the classical era. Though his satires seem very tame they were widely read and admired by the middle class of his contemporaries. See P. Richter, *Rabener und Liskow* (1884). J. G.

Rabenhorst, Gottlob Ludwig: botanist; b. at Treuenbrietzen, Brandenburg, Prussia, Mar. 22, 1806; educated in Universities of Berlin and Jena, resided in Luckau and Dresden from 1831 to 1875, devoting himself after 1840 entirely to botanical studies. His most important publications are *Flora Lusatica* (1839–40); *Deutschlands Kryptogamen Flora* (1844–53); *Kryptogamen Flora von Sachsen* (1863–70); *Flora Europæa Algarum* (1864–68). He was editor of *Hedwigia* (1852–71); published exsiccati as follows: *Algen Sachsens* (1,000 species, 1848–61); *Hepaticæ Europææ* (with Gottsche, 660 species, 1856–78); *Bryotheca Europæa* (1,450 species, 1858–75); *Lichenes Europæi Exsiccati* (900 species, 1855–79); *Cladoniæ Europææ* (380 species, 1860–63); *Algæ Europææ Exsiccatæ* (1,600 species, 1861–79); *Fungi Europæi Exsiccati* (2,600 species, 1861–79). D. at Meissen, Apr. 24, 1881. Charles E. Bessey.

Rabies: an extremely fatal infectious disease of many animals. In man it is generally called Hydrophobia (*q. v.*).

Rabshākeh [from the Assyrian *Rab-shākē*, chief of the officers]: a high officer in the Assyrian army, next in rank to the *tartan*, or field-marshal. At times he seems also to have been employed as interpreter and ambassador. It is he who carries on the negotiations with the officers of King Hezekiah of Judah (702 B. C.) before the walls of Jerusalem, during the campaign of Sennacherib. A similar officer is sent by Tiglath-Pileser II. on a mission to Tyre (734 B. C.). See Schrader, *Keilinschriften und das Alte Testament* (2d ed. Giessen, 1883, p. 319); Fried. Delitzsch, *The Hebrew Language* (London, 1883, p. 13); Thiele, *Babylonisch-Assyrische Geschichte* (Gotha, 1856, p. 497).
Richard Gottheil.

Rabulas (or, more correctly, **Rabbula**): Bishop of Edessa and the predecessor of Ibas. He is said to have governed his diocese with great authority, and succeeded in suppressing the various heretical sects which arose before the Nestorian controversy. D. at Edessa, Aug. 8, 435. Of his writings, some hymns and letters, the rules he drew up for the monks, and a sermon he delivered in Constantinople are still extant. They were edited by Overbeck (*Ephraemi Syri et Rabulæ Edessini Opera*, Oxford, 1865), and translated into German by Beckell in the *Kempten Bibliothek* of Church Fathers (1874).

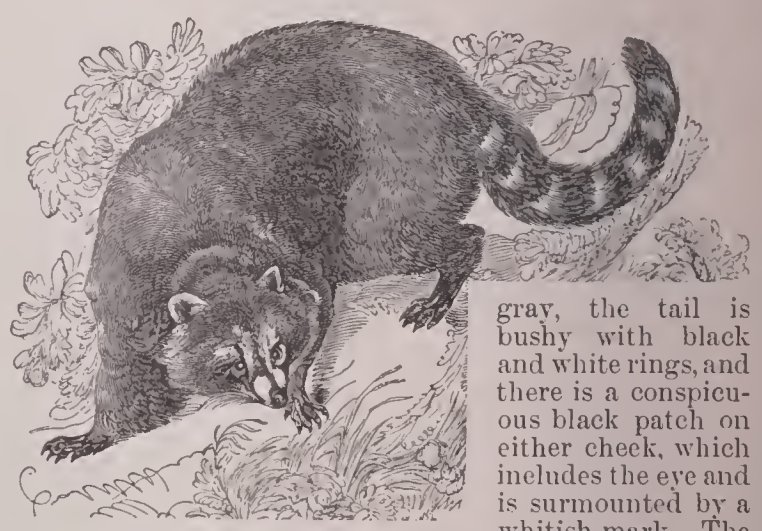
Racahout, răăk′a-hoŏt, or **Racahout des Arabes**: a starchy food prepared in Barbary from the acorns of *Quercus ilex* and *Q. ballota*, oaks of that region. It is flavored with herbs, and is sometimes prescribed for invalids. The racahout of confectioners is a compound of starch with chocolate, vanilla, etc., sold as a sweetmeat, or for making a beverage.

Racalmu′to: town of Sicily, province of Girgenti; on the left bank of an affluent of the Platani; about 15 miles N. E. of the town of Girgenti (see map of Italy, ref. 10–F). The neighboring country is very rich in grain, vines, olives, and fruits, and abounds in sulphur, saltpeter, and gypsum. Pop. 13,133.

Racan, răă′kaăn′, Honorat de Bueil, Marquis de: author: b. at La Roche Racan, Touraine, France, in 1589. In 1605 he became page at the court of Henry IV., and a few years later served a short time in the army, taking part in the siege of La Rochelle. He then withdrew to his estate and devoted himself to letters. D. in 1670. He stood under the influence of Malherbe, but was too indolent and negligent to reach his polish of language and style. His chief work is a pastoral drama, *Les Bergeries* (1618). He wrote also odes, sonnets, epigrams, and a paraphrase of the Psalms. He was one of the first members of the Academy. His *Œuvres complètes* were edited by de Latour (2 vols., Paris, 1857). A. G. Canfield.

Racconigi, răăk-kō-nee′jĕe: town of Northern Italy, province of Cuneo; on the right bank of the Maira; about 19 miles by rail S. of Turin (see map of Italy, ref. 3–B). It is a walled town, and the three old castles of Migliabruna, of Carpanetto, and of Bonavalle are in its remote neighborhood, but it is now chiefly known for the royal castle and park in its immediate vicinity. This castle was originally a fortress, was converted into something like a villa by E. Filiberto in 1681, and has been improved by successive princes until it is one of the most sumptuous of the Italian royal palaces. Pop. 7,875.

Raccoon, **Racoon**, or more often **Coon** [from Amer. Ind. *arrathkune*, whence Fr. *raton*, raccoon (in form adapted to *raton*, augment. of *rat*, rat]: the common name for a small carnivorous mammal, *Procyon lotor*, the best-known member of the family *Procyonidæ*, a group nearly related to the bears. The raccoon is about 2 feet long, without the tail; the body is stout, tail rather short and bushy; feet plantigrade, furnished with rather slender toes. The fore feet are well fitted for grasping, although none of the digits are opposable, and the animal climbs well. The general color is


The crab-eating raccoon.

gray, the tail is bushy with black and white rings, and there is a conspicuous black patch on either cheek, which includes the eye and is surmounted by a whitish mark. The raccoon dwells in hollow trees, and is nocturnal and omnivorous; though aquatic animals (fish, mollusks, and crawfish) form a large portion of its food. It is readily tamed, and is an amusing but mischievous pet, although like all carnivores subject to sudden outbreaks of temper. It has the peculiar habit of washing its food, whence the specific name of *lotor* (washer) and the German name, *Waschbär* (wash-bear). It is found throughout the greater part of the U. S., and a closely related species, *Procyon cancrivora*, the crab-eating raccoon or agonara, larger with shorter fur and more powerful dentition, is found in the northern parts of South America.
F. A. Lucas.

Raccoon Nation: See Iroquoian Indians.

Race, Cape: See Cape Race.

Race'mic Acid [*racemic* is from Lat. *race'mus*, bunch of grapes or fruit], also called **Paratartaric Acid** and **Uvic Acid** ($C_4H_6O_6$): an acid found with tartaric acid in grape-juice, and identical with it in composition, though differing from it in its action on polarized light and in some other characters. It was discovered by Kestner in wines of certain vintages. It may also be formed artificially. Racemic acid itself has no action on polarized light, but by certain treatment may be separated into two isomeric constituents, one of which is ordinary dextro-rotatory tartaric acid, and the other is lævo-rotatory, the two being called *dextro-tartaric* and *lævo-tartaric* acid. Pasteur found certain relations between the modifications of the crystals of the two acids and the action on polarized light, which have attracted much attention on account of a theory that has been proposed to account for them. See STEREO-CHEMISTRY.

Revised by IRA REMSEN.

Rachel [from Heb. *Rāchel*, liter., ewe]: a native of Northern Mesopotamia, younger daughter of Laban, favorite wife of Jacob, and mother of Joseph and Benjamin. Her tomb, about 4 miles from Jerusalem on the road to Bethlehem, though of modern construction, undoubtedly marks the site of her burial, described in Gen. xxxv. 19, 20.

Rachel, răă'shel', properly ÉLISA RACHEL FÉLIX: actress; b. at Mumpf, Switzerland, Feb. 28, 1820, daughter of a wandering Hebrew peddler. In Lyons, Paris, and other cities she, with her sister Sophia, afterward called Sarah, sang at the *cafés* and on the boulevards. Choron, teacher of singing at the Royal Institution, attracted by their voices, took them from the streets and gave them frec instruction. In 1833 they were admitted to the Conservatoire, where Élisa developed more dramatic talent than musical. In 1837 she made an unsuccessful *début* at the Gymnase, but in 1838 astonished and captivated Paris by her performance, at the Théâtre Français, of Camille in *Les Horaces*. Her fame and fortune were made. The classic tragedies of Racine, Corneille, and Voltaire were revived; her intensity, originality, naturalness, the singular expressiveness of her face, the skill of her declamation, made a new era in dramatic art. She played, also, with great power Jeanne d'Arc, Marie Stuart, Adrienne Lecouvreur (the play by that name was written for her by Legouvé and Scribe), and other characters. In 1855, in company with her brother, Raphael Félix, and her sisters, Sarah, Lia, and Dinah, she went to the U. S., but after she had played in a few cities failing health compelled her to desist. She returned to France, and died at Cannet, near Cannes, Jan. 3, 1858. See Janin, *Rachel et la Tragédie* (1858), and the *Life* by Mrs. Kennard (1885). Rachel was slender, graceful, not beautiful, and had a pale complexion, expressive features. brilliant eyes, and fascinating presence.—RAPHAEL FÉLIX became in 1868 director of the Théâtre Porte Saint-Martin; SARAH (d. 1877) was connected with the Gymnase, the Français, and the Odéon; LIA, devoted to high tragedy, distinguished herself at the Porte Saint-Martin; REBECCA died in 1854, having been five years at the Théâtre Français.

Rachmaninoff, SERGI W.: See the Appendix.

Racine: city (settled in 1836, incorporated in 1848); capital of Racine co., Wis.; on Lake Michigan, at the mouth of Root river, and the Chicago, Milwaukee and St. Paul and the Northwestern railways; 25 miles S. by E. of Milwaukee, 62 miles N. of Chicago (for location, see map of Wisconsin, ref. 7–F). It has one of the best harbors on Lake Michigan, is connected with the principal lake ports by steamboat and propeller lines, and has considerable shipping of its own. The city is laid out regularly on a plateau 40 feet above the level of the lake and 690 feet above that of the sea, is lighted with gas and electricity, and has a new system of water-works, which provides an abundant supply of water from the lake. There are 3 national banks with combined capital of $625,000, a State bank with capital of $100,000, and 2 daily, 5 weekly, a semi-monthly, and 2 monthly periodicals. The educational institutions include Racine College (Protestant Episcopal, chartered in 1852), St. Catharine's Academy (Roman Catholic, opened in 1866), the McMurphy Home School (Protestant Episcopal, opened in 1877), and Racine Academy (non-sectarian), and the benevolent institutions, St. Luke's Hospital and the Taylor Orphan Asylum. There are four libraries, High School, Racine College, Y. M. C. A., and McMurphy's Home School) which contain over 14,000 volumes. The census returns of 1890 showed that 190 manufacturing establishments reported. These had a combined capital of $11,533,207, employed 4,872 persons, paid $2,418,498 for wages and $4,340,308 for materials, and had products valued at $8,462,359. The principal industries were the manufacture of agricultural implements, which had 11 establishments, a capital of $5,573,207, and products valued at $1,979,613; of carriages and wagons, which had 5 establishments, a capital of $2,347,932, and products valued at $1,902,536; and of leather, trunks and valises, and malt liquors. Pop. (1880) 16,031; (1890) 21,014; (1900) 29,102.

Racine, răă'scen', JEAN BAPTISTE: dramatic poet; b. at La Ferté-Milon, Aisne, France, Dec. 22, 1639. He studied first at the College of Beauvais, then at Port-Royal, where he underwent the influence of its severe moral and religious ideas, and under such masters as Nicole, Lancelot, and Hamon became an eager and proficient student of the classic literatures, especially that of Greece; finally at the Collège d'Harcourt, at Paris, where he was fascinated by the gayety and elegance of social life. He remained at Paris after his studies were finished, mixing with men of letters and giving himself freely to the pleasures and dissipations of the capital. His first literary venture, *Les Nymphes de la Seine*, an ode on the marriage of Louis XIV. (1660), brought him some praise and a royal gift of 100 louis. His habits gave concern to his family, and he was sent to an uncle, vicar at Uzès, in Languedoc, to study theology and qualify himself to receive a benefice. The efforts of his uncle to secure a benefice for him met with repeated failure, and he lost patience and in 1662 was again in Paris, where he offended his friends of Port-Royal still further by the manner of his life, and yielded fully to his inclinations for the theater, which they were then condemning. In his first tragedies, *La Thébaïde* (1664) and *Alexandre* (1665), his original genius is less conspicuous than the influence of Rotrou, Corneille, and Quinault. In his next play, *Andromaque* (1667), he achieved a new and original type of tragedy, which finds the constant motive of conduct in the passion of love taken at a moment of crisis, and seeks the dramatic interest entirely in the conduct of its characters under the play of this motive. This type is the perfection of French classic tragedy, and reappears in the six plays that followed: *Britannicus* (1669); *Bérénice* (1670); *Bajazet* (1672); *Mithridate* (1673); *Iphigénie* (1674); and *Phèdre* (1677). In all he follows the working of violent passion, especially in his heroines, with great psychological penetration. To these plays, to which an excellent comedy, *Les Plaideurs* (1668), must be added, he gave a rare perfection of form by an exquisite polish of language and an unequaled harmony of versification. The intrigues of jealous rivals, culminating in the apparent failure of *Phèdre*, powerfully seconded by a recoil in his moral attitude toward the ideas of Port-Royal, led Racine to abandon the theater. This recoil amounted to a conversion, and he even thought of becoming a Carthusian monk. In the same year he was married, and, with Boileau, was appointed royal historiographer. At the prayer of Madame de Maintenon he wrote for her schoolgirls of St.-Cyr two biblical tragedies with chorus, *Esther* (1688) and the masterpiece *Athalie* (1691), which keep the qualities of his earlier works, except that passions of another order are substituted for that of love. After this he wrote only letters, epigrams, some religious verse, and a short *Histoire de Port-Royal*. D. Apr. 21, 1699. He had entered the Academy in 1673. The best edition of his works is that of P. Mesnard in the *Collection des Grands Écrivains de la France* (8 vols. and 2 albums, Paris, 1865–73). See P. Robert, *La Poétique de Racine* (Paris, 1890); P. Stapfer, *Racine et Victor Hugo* (Paris, 1887); F. Brunetière, *Les Époques du théâtre français* (Paris, 1892).

A. G. CANFIELD.

Racine, LOUIS: author; son of Jean Baptiste Racine; b. in Paris, Nov. 2, 1692. His education was directed by Boileau and Rollin, and he grew up with the religious sentiments of Port-Royal. He wrote memoirs on his father's life, and religious and didactic poems which possess grace and elegance, but lack spirit and interest. The most important are *La Grâce* (1720), in four cantos, and *La Religion* (1742), in six cantos. D. in Paris, Jan. 29, 1763.

A. G. C.

Racing: See HORSE-RACING.

Rack: a kind of liquor. See ARRACK.

Rack: a certain gait of a horse. See GAITS.

Rack [M. Eng. *racke*; cf. Dutch *rek*, *rek-bank*; Germ. *reck*, *reck-bank*, rack; *recken*, stretch + *bank*, bench]: an engine of judicial torture formerly much employed in Europe to compel accused persons to plead guilty and to ob-

tain satisfactory testimony from recusant witnesses. It was introduced into England in 1447 by the Duke of Exeter as constable of the Tower of London. In 1628 it was pronounced illegal by the courts. The victim was stretched upon a platform of wood; cords were attached to his limbs, and then strained by pulleys until the sufferer yielded or had his joints dislocated.

Rackarock: See EXPLOSIVES (*The Chlorates*).

Rackets, or **Racquets** [from O. Fr. *rachette* > Fr. *raquette*, from Span. *raqueta*, racket, battledore, palm of the hand (tennis being originally played with the palm of the hand), perhaps from Arab. *rāhat*, palm of the hand]: a game originally similar to tennis, now played with ball and racket-bat in a closed court, about 60 feet long and 30 wide. The front wall has two lines marked on it, the first (play-line) 2 feet from the floor and the second (service-line) 8 feet. The half of the floor-space farthest from the front wall is marked off into two courts by a line midway between the side walls. One player stands in each court. The first serves the ball so that it may rebound from the front wall above the service-line and strike in the opposite court, the second returns it above the play-line, and so on. The server is allowed one "fault"; i. e. if on his first attempt the ball strikes between the two lines, or rebounds to a part of the floor not his opponent's court, and the second player declines to return it, he may serve again. If the second player fails to return the ball properly the first scores one; if the server fails, his "hand is out" and his opponent serves. The one who first scores fifteen wins.

Radbertus, PASCHASIUS: one of the most prominent ecclesiastical writers of the Carolingian age; b. toward the close of the eighth century; entered the monastery of Corbie, in Picardy, in 814. The favorite pupil of Abbot Adalbard, a relative of Charlemagne, Radbertus became teacher in the cloistral school, and in 844 he was elected abbot, but, being unable to maintain discipline in the monastery, he resigned in 851. A complete and critical edition of his extant works was published by Sirmond (Paris, 1618) and reprinted in Migne, *Patrol. Latin.* By far the most interesting is his *De Corpore et Sanguine Domini*, in which he exposed the doctrine of the Roman Catholic Church on the Eucharist. This book became famous because of the controversies it gave rise to in the following century, when Hrabanus Maurus, Ratramnus, Scotus Erigena, and others opposed certain of its tenets, but their opposition was based on a misunderstanding of the text. See Wetzer and Welte, *Kirchenlexikon*, and Ebert, *Geschichte der Literatur des Mittelalters*, vol. ii., p. 230. The best text of this little work is in Martène and Durand, *Amplissima Collectio* (vol. ix., Paris, 1723).

Revised by J. J. KEANE.

Radcliffe, ANN (*Ward*): novelist; b. in London, England, July 9, 1764; married in 1786 William Radcliffe, subsequently editor of *The English Chronicle*; published several romances notable for their wild and fantastic plots, of which *The Mysteries of Udolpho* (1794) is the only one remembered. Others once popular were *The Sicilian Romance* (1790), *The Romance of the Forest* (1791), and *The Italian* (1797). D. in London, Feb. 7, 1823. Her writings had considerable influence upon the literature of the time, and even Byron was among her imitators. A *Memoir* by Talfourd appeared in 1826, introducing the posthumous romance *Gaston de Blondville*, and a collection of her poems was issued in 1834. Revised by H. A. BEERS.

Radcliffe, CHARLES BLAND, M. D., F. R. C. P.: physician; b. at Brigg, Lincolnshire, England, June 2, 1822; M. B., London University, in 1845 and M. D. in 1851; became physician to the Westminster Hospital in 1857 and to the National Hospital for the Paralyzed and Epileptic in 1863; was lecturer on botany in the medical school of Westminster Hospital 1850–54, and lectured on materia medica 1854–60; was Gulstonian lecturer in 1860 and Croonian lecturer in 1873 of the Royal College of Physicians. He was joint editor of *Rankin's Abstract of the Medical Sciences* from 1852–64. Among his published works are *Proteus, or the Law of Nature* (London, 1850); *The Philosophy of Vital Motion* (London, 1851); *Epilepsy and other Affections of the Nervous System* (London, 1854); *Dynamics of Nerve and Muscle* (London, 1871); and articles in *Reynolds's System of Medicine*. D. June 18, 1889. S. T. ARMSTRONG.

Radcliffe College: See HARVARD UNIVERSITY.

Radetzky, răă-det'skĕĕ, JOHANN JOSEPH WENZEL ANTON FRANZ KARL, Count: soldier; b. at Trzebnitz, Bohemia, Nov. 2, 1766; entered the Austrian army in 1784; fought with distinction at Aspern and Wagram in 1809, and at Kulm and Leipzig in 1815; was made commander-in-chief of the Austrian troops in Italy in 1831, and field-marshal in 1836; put down the revolution in Milan and Venice in 1848, though then over eighty years old; won the victories at Custozza and Novara over the Piedmontese, and governed the Austrian possessions in Italy to Feb. 28, 1857, when he resigned. D. at Milan, Jan. 5, 1858. See Radetzky's *Denkwürdigkeiten in Mittheilungen des kaiserlichen Kriegsarchivs* (1887), and Kunz, *Die Feldzüge des Feldmarschalls Radetzky in Oberitalien* (1890).

Radiata [from Lat. *radia'tus*, having spokes or rays, perf. partic. of *radia're*, furnish with spokes or rays, deriv. of *ra'dius*, spoke]: one of the four great groups or branches into which Cuvier divided the animal kingdom, and which included those forms in which the parts radiated from a central axis like the spokes from the hub of a wheel. It included, as limited by him, the Cœlenterates, Ctenophores, Gephyrea, Polyzoa, Protozoa, and Parasitic Worms of later zoölogists. It was soon found that some of these forms had other affinities, and the clear definition by Leuckart of the *Cœlenterata* and *Echinodermata* gave the death-blow to the ill-assorted group, which disappeared from European works about the middle of the nineteenth century, but lingered in the U. S. for twenty years more. J. S. KINGSLEY.

Radiation: See the Appendix.

Radical Axis: a line related to two circles and determined by the condition that the tangents from any point upon it to the circles are equal in length. If the circles intersect it is their common chord. S. N.

Radicals [from Lat. *radica'lis*, deriv. of *ra'dix*, root, origin, foundation], in chemistry sometimes called **Radicles**: a term applied to a group of elements that can pass unchanged through a series of compounds by chemical reactions. Thus in the salts formed by ammonia with acids the presence of the hypothetical radical *ammonium*, NH_4, is assumed. So, too, in all cyanogen compounds the group CN is assumed. Among the compounds of carbon such groups are very common, so much so that Liebig proposed the name chemistry of the compound radicals for organic chemistry. Thus ALCOHOL (*q. v.*) is a compound of the group or radical ethyl, C_2H_5, with the group or radical hydroxyl, OH. Or alcohol is the hydrate of this radical; ether is the oxide, $(C_2H_5)_2O$; chlorethane the chloride, C_2H_5Cl, etc. Some of these organic radicals are called *residues* or *rests*. Thus ethyl, C_2H_5, is the *residue* or *rest* of ethane, C_2H_6. It is that which is left after one atom of hydrogen has been removed. The theory of radicals played an extremely important part in the development of the science of chemistry. I. R.

Radiograph: See *X*-RAYS.

Radiola'ria [Mod. Lat., from Lat. *radius*, a ray]: a subclass of Rhizopodous Protozoa which occur in the sea, at times extremely abundant. They have the body divided into two portions, inner and outer, by a perforated membrane. In the inner portion is the nucleus, while the outer contains no nuclei, but gives rise to numerous radiating filaments of protoplasm (*pseudopodia*). There is in addition, frequently, a skeleton, either horny or siliceous, and often of extreme beauty. The central protoplasm alone is concerned in reproduction, and in it are found flagellate spores which in turn develop into *Actinophrys*-like embryos. (See HELIOZOA.) Haeckel, in his great monograph of the Radiolaria collected by the Challenger expedition, recognizes 739 genera and 4,318 species of these pelagic organisms. Many forms are interesting from the fact that they contain "yellow cells" which are known to be unicellular algæ living symbiotically with the Radiolarians. See SYMBIOSIS. J. S. KINGSLEY.

Radiom'eter [from Lat. *ra'dius*, ray, *radia're*, radiate + Gr. μέτρον, measure]: in physics, any instrument for the detection and measurement of radiant heat. One of the earliest forms was the differential thermometer of Leslie, which consisted of two glass bulbs, the necks of which were joined. The air contained within these bulbs is separated by means of a column of liquid. In order to prevent liquid from collecting in the bulbs the tube which joins the two is generally bent twice at right angles, and the instrument is mounted so that the bulbs are uppermost. (See Fig. 1.) One of these bulbs being subjected to the radiant heat while the other was protected, the expansion of the atmosphere in the heated bulb served to drive the liquid column along the tube,

bringing it to rest in some position other than that which the liquid would occupy when the temperatures of the two bulbs were the same. By means of this simple device Leslie discovered many of the important facts concerning radiant energy.

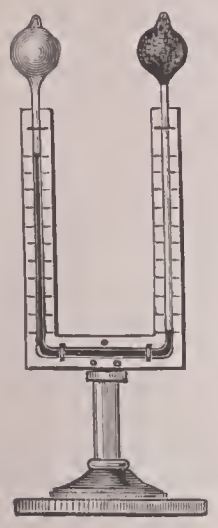


Fig. 1.

The Thermopile (*q. v.*), which in the hands of Melloni yielded such remarkable results, is also to be classified as a radiometer. It is, indeed, with the possible exception of the Bolometer (*q. v.*), the most important instrument for the study of radiation. Whether the thermopile, which enables us to measure radiant energy by means of the electromotive force which is generated by the difference of temperature between its junctions, or the bolometer, an instrument which indicates temperature through the variation in the electrical resistance of a wire or strip of metal which is exposed to the rays, the intensity of which it is desired to measure, is the more sensitive is as yet an open question. The bolometer has, however, one very great advantage over the thermopile in that its mass may be reduced to an exceedingly small quantity. Possessing small mass, it is susceptible to very rapid fluctuations of temperature, and is capable of following sudden changes much more accurately than can be done by means of the ordinary form of thermopile.

Many other forms of radiometer have been described, for some of which a degree of delicacy surpassing that attainable with either of the instruments just mentioned is claimed. The best known of these are the thermo-galvanometer of d'Arsonval, the tasimeter of Edison, and the selenium cell. The thermo-galvanometer, which, under the name of the radio-micrometer, has been developed and utilized by Boys, consists of a very small light thermo-couple of bismuth and antimony closed upon itself so as to form a complete circuit. (See Fig. 2.) The same is suspended in a strong magnetic field by means of a quartz-fiber. When one of the bismuth-antimony junctions is exposed to radiation differences of potential arise, and since the circuit is of low resistance a considerable current flows. In consequence of this current the suspended thermo-element tends to turn in the field, and the movement is noted by means of a very small light mirror and a telescope and scale.

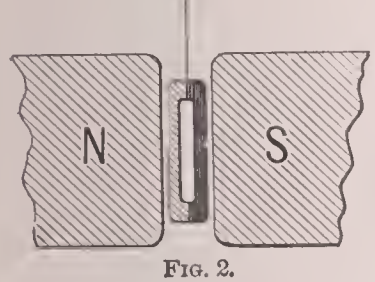


Fig. 2.

The tasimeter depends for its action upon the change of contact resistance of carbon with change of pressure. A vulcanite strip is so placed that one end of it rests upon a microphone button. Vulcanite possesses a large coefficient of expansion. When subjected to radiation its elongation is sufficient to materially compress the carbon button, reducing the resistance of the same and thereby increasing the flow of the current through a galvanometer in circuit with the latter. Neither of these forms has been found to be so serviceable as the bolometer or the thermopile, although an almost incredible sensitiveness has been claimed for both.

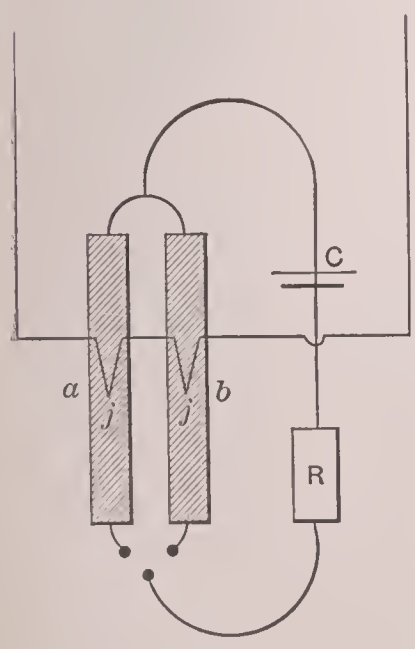


Fig. 3.

A method for the measurement of radiant heat was described by Knut Ångström in 1893 (see *Physical Review*, vol. i., p. 365), which, although not of exceeding sensitiveness, affords a very accurate means of comparing radiant intensities. Ångström's instrument takes advantage of the principles of both bolometer and thermopile. It consists of two similar strips of metal (*a* and *b*, Fig. 3), one of which is exposed to radiation, while the other is shielded. These strips are in contact with the opposite junctions of a thermo-element, *j*, which is placed in circuit with a sensitive galvanometer. By means of the heating action of an electric current generated in the battery, C, the temperature of the protected strip is brought into equilibrium with that of the exposed strip, a condition which is indicated by the reduction of the galvanometer deflection to zero.

A very sensitive radiometer is that which is based upon the remarkable changes in the conductivity of selenium when this substance is exposed to light. The selenium radiometer has been found a very unsatisfactory instrument, however, on account of the uncertainty of its action. Its sensitiveness to radiation depends upon instability of molecular structure. Like all other changes which consist in the breaking down of molecular arrangement, this is of great irregularity, and beyond accurate control.

The instrument with which the name radiometer is most generally connected is, in the strict sense of the word, not a radiometer at all. The apparatus in question is Crookes's radiometer (Fig. 4). It consists of a set of four mica-veins mounted at the ends of arms and revolving upon a needle-point. The arrangement is inclosed in a glass bulb from which the air has been exhausted by means of the mercury-pump. Crookes found that when the atmosphere reached a certain degree of attenuation these mica-veins began to revolve under the action of light. The phenomenon attracted great attention and many investigations concerning it were made. The result of these studies has been to show that the instrument is entirely unfitted for use as a measurer of radiant energy. The phenomena which the instrument presents are in themselves, however, of great interest.

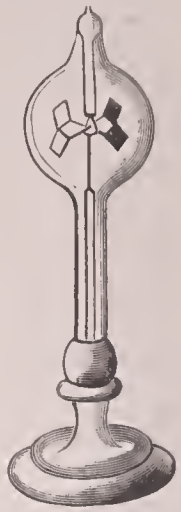


Fig. 4.

For a description of Crookes's radiometer, see Crookes, *Quarterly Journal of Science* (1876); Schuster, *Proc. Royal Society* (1876); Stoney, *Phil. Mag.* (1876). E. L. Nichols.

Radish [from O. Fr. *radis*, radish, Lat. *ra'dix*, root, whence O. H. Germ. *rātih* (> Mod. Germ. *rettich*) and O. Eng. *rādic*, radish]: the *Raphanus sativus*, a cruciferous plant, a native of Asia, cultivated for its root, and used as a table relish. The root is stimulant, diuretic, and antiscorbutic. The seeds of some varieties yield an oil almost identical with rape and colza oil.

Radium: See the Appendix.

Radius [Lat. *ra'dius*, spoke, ray]: the outer bone of the forearm, on the same side with the thumb. It is parallel with the ulna, which is larger than the radius, and enters much more closely into the formation of the elbow-joint, while the radius forms the joint with wrist-bones.

Radnorshire: a county of South Wales, adjoining two English counties—Shropshire on the N. and Hereford on the E. Area, 432 sq. miles. The surface is irregular and mountainous, reaching an altitude of 2,163 feet in Radnor Forest; more than half of the soil is bog and moorland. Of the latter, however, the larger part has been reclaimed, and is under cultivation. The valleys afford rich pasturage for large herds of cattle. Barley, oats, and potatoes are grown; cattle and sheep are reared. Principal towns, Presteign and New Radnor. Radnorshire returns one member to Parliament. Pop. (1891) 21,791.

Radowitz, raa'dō-wits, Joseph Maria, von: soldier and statesman; b. at Blankenburg, Brunswick, Germany, Feb. 6, 1797; received his military education at Paris and Cassel; fought in the campaigns of 1813 and 1815; taught mathematics at the military school of Cassel: removed in 1823 to Prussia, and held high military and diplomatic positions, and for a short time in 1850 was Minister of Foreign Affairs. He was a member of the Frankfort Parliament in 1848, and on its dissolution was the chief agent in bringing about the union of the three kingdoms, an attempt to found a united German state under the leadership of Prussia. D. in Berlin, Dec. 25, 1853. His *Gespräche aus der Gegenwart über Staat und Kirche* (Stuttgart, i., 1846; ii., 1851) and *Gesammelte Schriften* (5 vols., Berlin, 1852–53) derive their principal interest from the friendship and community of ideas between the author and Frederick William IV.

Rădulescu, Ioan Eliade: See Héliade, Jean.

Rae, John, M. D., LL. D.: Arctic explorer; b. in the Orkney islands (1813); studied medicine at Edinburgh; entered the service of the Hudson Bay Company as a surgeon 1833: for ten years lived at Moose Factory; made a boat journey (1846) along Hudson Bay to Repulse Bay; surveyed (1847) 700 miles of new coast-line, connecting surveys of Ross in Boothia with those of Parry at Fury and Hecla Strait. The only book he published was an account of this expedition, *Narrative of an Expedition to the Shores of the Arctic Sea* (1850). He took part in the expedition (1848) down the Mackenzie river in search of Sir John Franklin, and explored the whole coast of the Arctic Sea between the Mackenzie and the Coppermine rivers. He explored and mapped 700 miles of coast (1851), the south shores of Wollaston Land and Victoria Land. He proved the insular character of King William Land (1853), elicited from the Eskimos the first information obtained of Sir John Franklin's fate, and secured many relics of that party. For this discovery he received the admiralty grant of $50,000. He was a gold-medalist of the Royal Geographical Society, and attributed his success in Arctic travel to his ability to live in Eskimo fashion. D. in England, July, 1893. Revised by C. C. Adams.

Raff, Joseph Joachim: composer; b. at Lachen, Switzerland, May 27, 1822; owing to poverty was able to study music only at intervals; supported himself by teaching till he was twenty-four years of age, and then on the advice of Mendelssohn joined his class; but the death of Mendelssohn occurring soon after altered his plans. He had many struggles, and encountered much opposition, but force of character, persistency, and real musical talent enabled him to overcome them and to gain an eminent place in the ranks of composers. He was director of the conservatory at Frankfort-on-the-Main from 1877 till his death June 25, 1882. His works include eleven symphonies, including *Im Walde*, one of the best of modern works, an oratorio, *Das Weltgericht*, several operas and cantatas, very many sonatas for piano, for violin, and other instruments, much chamber music, songs, and many other pieces. His numbered works run up to Opus 216. He was a vigorous writer as well as composer, and contributed many articles to the German papers advocating the Wagner school. D. E. Hervey.

Raffles, Sir Thomas Stamford: administrator and ethnologist; b. at sea off Point Morant, Jamaica, July 5, 1781; son of a sea-captain in the West India trade; obtained at the age of fifteen an assistant-clerkship in the East India House. In 1805 he was appointed assistant secretary to the government of Pulo Penang (Prince of Wales island), and in 1807 he was made principal secretary. He soon became a leading authority upon the ethnology of the Indian Archipelago. He was secretary to the Governor-General of India, Lord Minto, during the expedition against Java 1811; was made lieutenant-governor of the newly acquired colony, and administered that important island and its dependencies with great judgment for five years. Returning to England on account of ill health, he was knighted in 1817, and published his *History of Java* (2 vols., 1817). Java having been restored to the Dutch, Raffles was in 1818 made lieutenant-governor of the settlement at Fort Marlborough, Bencoolen, on the coast of Sumatra. While in Sumatra he emancipated the slaves, formed the new British settlement of Singapore (1819), endowed there a college for the study of Malay and Chinese literature, and published *Malayan Miscellanies* (2 vols., Bencoolen, 1820–22). He returned to England in 1824, and founded the Zoölogical Society of London, of which he was the first president. D. in London, July 5, 1826. See the *Memoir* by his widow (1830).

Raffle'sia [Mod. Lat., named for its discoverer, Sir T. Stamford Raffles (1781–1826)]: a genus of plants of the family *Rafflesiaceæ*, natives of Sumatra and Java, and parasitic upon stems and roots of *Cissus*. They are greatly degraded, and are nearly stemless, rootless, and leafless, being little more than mere flowers, with a few scales for leaves; the seeds are rudimentary, and the embryo small and few-celled. The plant has a fungus-like, fleshy appearance, and a strong odor of carrion. *R. arnoldi* is considered the largest flower in the world. It is 3 feet in diameter, and has been known to weigh 15 lb. It is worshiped by the Javanese. *R. patma* has strong styptic power. *R. horsfieldii* is but 3 inches across. Revised by Charles E. Bessey.

Rafinesque, Constantine Samuel: naturalist; b. of French-German parents at Galata, Constantinople, in 1784. His mother's name being Schmaltz, he took for a time the name Rafinesque-Schmaltz. He was sent to the U. S. in 1802, landing at Philadelphia; he soon developed a fondness for natural history; made many excursions for collecting botanical specimens; went to Leghorn 1805, and thence to Sicily, where he resided ten years, and published (in Italian) several scientific works; sailed for New York 1815; lost by shipwreck on the coast of Long Island all his effects, including valuable books, manuscripts, and collections; was for some years Professor of Botany in Transylvania University, Lexington, Ky.; traveled and lectured in other States; settled finally at Philadelphia: wrote many monographs in various branches of natural history, especially *Ichthyologia Ohioensis* (Lexington, 1820); published *Annals of Kentucky* (1824), *The American Florist* (1832), *Atlantic Journal and Friend of Knowledge* (8 numbers, 1832–33), *The American Nations* (2 vols., 1836), *Medical Flora of the United States* (2 vols., 1828–30), *A Life of Travel and Researches* (1836), and other works. D. in Philadelphia, Sept. 18, 1842. The *Writings of S. C. Rafinesque on Recent and Fossil Conchology* was edited by W. G. Binney and G. W. Tryon, Jr. (Philadelphia, 1864). See *An Eccentric Naturalist* in *Science Sketches* by Jordan. Rafinesque was a man of large learning, quick insight, and great energy, but all his work is vitiated by an insatiate desire for novelties and a lack of recognition of the value of exact statement.
Revised by D. S. Jordan.

Rafn, Carl Christian: scholar; b. at Brahesborg, island of Fünen, Denmark, Jan. 16, 1795; studied at the University of Copenhagen; was appointed librarian of the university in 1821; and founded in 1825 the Society of Northern Antiquities. D. in Copenhagen, Oct. 20, 1864. Besides a number of critical editions, like *Krákumál* (1826), *Fornaldar Sögur* (3 vols., 1829), *Færeyinga Saga* (1832), and parts of *Fornmanna Sögur* (12 vols., 1828, *seq.*), and minor essays, he wrote *Antiquitates Americanæ* (1837), *Grönlands historiske Mindesmærker* (3 vols., 1838–45), and *Antiquités russes et orientales* (3 vols., 1850-54). In his *Antiquitates Americanæ* he gave the first popular account of the Norse discovery of America. Revised by D. K. Dodge.

Raglan, Fitzroy James Henry Somerset, Baron: son of the fifth Duke of Beaufort; soldier; b. in England, Sept. 30, 1788; educated at Westminster School; entered the army 1804; accompanied the Duke of Wellington in the Spanish Peninsula as a member of his staff, rising to the position of aide-de-camp and military secretary 1807; was wounded at Busaco 1810; distinguished himself at Badajoz 1812: was wounded in the battle of Waterloo; was knighted and made colonel; was secretary of embassy at Paris 1816–19; entered Parliament as a Conservative 1818 and 1826; was appointed master-general of the ordnance Sept., 1852; was made Baron Raglan Oct., 1852; commanded the British expedition to the Crimea, with the rank of general, Mar., 1854: defeated the Russians at the battle of the Alma Sept. 20; fought the battles of Balaklava, Oct. 25, and Inkermann, Nov. 5, and was made field-marshal Nov., 1854. The criticisms which were made on his command, on account of the sufferings of the troops, and the fearful repulse he suffered on June 18 weighed upon his mind, and he died in the camp before Sebastopol on June 28, 1855. His military papers formed a part of the material for Kinglake's *History of the Crimean War*.

Ragnarok [Icel. *ragna rökr* (translated into Germ. as *götterdämmerung*), the twilight of the gods]: in Scandinavian mythology, the final dissolution of the cosmic world, when gods and giants and men destroy each other in an internecine feud. Depravity and strife in the world proclaim the approach of the great event, which is preceded by a fall of snow from the four corners of the world, cold, piercing winds, tempestuous weather, the absence of summer, and convulsions of nature. Kindred slay each other for mere gain. The Fenris-wolf is freed from his chains, and the Midgard-serpent gains land. The heavens are rent in twain, and the sons of Muspel come riding through the opening in brilliant array to the battle-field called Vigrid. Thither repair also the Fenris-wolf, the Midgard-serpent, and all the forces of evil. The gods, who assemble without delay, arm themselves with speed, and sally forth to the battle-field, led by Odin. Odin is swallowed by the Fenris-wolf, and the wolf is killed by Vidar. Thor kills the serpent, but falls suffocated by its venom. Finally the earth, consumed by fire, sinks beneath the sea. After Ragnarok there is a new green earth, and there comes a new golden age in

which all will be good and happy. Then comes the Mighty One, he who is from everlasting to everlasting, and establishes peace and good will among gods and men. See SCANDINAVIAN MYTHOLOGY. RASMUS B. ANDERSON.

Raguet, ra-gā', CONDY, LL. D.: merchant and lawyer; b. in Philadelphia, Pa., Jan. 28, 1784; was educated at the University of Pennsylvania, and studied law; engaged in commercial pursuits; went to St. Domingo as supercargo of a vessel 1804; returned there 1805; published two small books giving an account of the state of that island and a history of the massacre of the planters; went into business on his own account 1806; accumulated a fortune; took an active part in several useful corporations and mercantile associations, and in taking measures for the defense of the city against an expected attack by a British fleet 1812; served in both branches of the Legislature; became in 1822 consul at Rio de Janeiro, Brazil; negotiated a commercial treaty with that country, to which, in 1825, he was appointed the first *chargé d'affaires*; returned in 1827, and wrote much in periodicals, especially in *The Portfolio*, in favor of free trade. D. in Philadelphia, Mar. 22, 1842. Author of *Principles of Free Trade* (1835); *On Currency and Banking* (1839); and other works; editor of *Free Trade Advocate* (2 vols., 1829); *Examiner* (2 vols., 1834–35); and *Financial Register* (2 vols., 1837–39).

Ragusa: town of Austria, in Dalmatia, on the Adriatic; picturesquely built in terraces along the side of Monte Sergio (see map of Austria-Hungary, ref. 10–F). It was the capital of a mediæval aristocratic republic, and during centuries the chief city on the eastern Adriatic. It rivaled Venice in activity and wealth and Florence in literary life, being commonly called the Slavic Venice. Its land-trade also was enormous; frequent caravans brought raw materials for export and manufacture, and took manufactured goods away. In 1364 it made a treaty of alliance with Murad I., the first concluded between a Christian state and the Ottomans; in 1421 it obtained from the Holy See special privileges or a sort of monopoly of trade with the Mussulmans; after 1453 it paid a small tribute to the Ottomans, but was always favored and protected by them; was twice almost destroyed by earthquake—in 1634 and 1667, when 5,000 persons perished. Napoleon suppressed the republic in 1808. In 1815 it was ceded to Austria; it had then 44,000 inhabitants. The doges' palace, library, and hospital are fine buildings. Grass grows in the principal streets, and the city is in full decay. Of its two harbors, Porto Cassonne is used only by fishing-boats, but Gravosa, 2 miles N., is the finest port on the Dalmatian coast, accommodating the largest men-of-war. Pop. (1891) 7,143. Seven miles S. are the ruins of Ragusa Vecchia, the ancient Epidaurus, destroyed by the Slavs in the seventh century. E. A. GROSVENOR.

Ragusa: town of Southeastern Sicily; in the province of Syracuse (see map of Italy, ref. 10–F). It is of very ancient origin; it sided with Syracuse against the Romans, and was by them made a colony. In 844 it was sacked by the Saracens. It has suffered greatly from earthquakes, being almost destroyed in 1693. In the city and immediate vicinity are remains of mediæval buildings, ancient tombs, and cisterns and caves in the rocks. Count Cabrero (d. 1423), who claimed the Sicilian crown, is buried here. The city consists of two distinct parts, each having its own municipal organization—Ragusa Superiore, pop. 24,183, and Ragusa Inferiore, pop. 6,260. E. A. GROSVENOR.

Rahbek, KNUD LYNE: poet and critic; b. in Copenhagen, Denmark, 1760. After studying theology and law he devoted himself to literature. In 1785 he published a volume of *Prosaiske Forsög* (Prose Attempts). In 1788 he delivered the first course of lectures on æsthetics ever given in Denmark, and in 1790 was appointed to the new chair of æsthetics at the University of Copenhagen. Besides *Minerva*, he edited alone *Den Danske Tilskuer* (The Danish Spectator, 1791–1808), the more general character of whose articles gave it an even greater influence than the earlier periodical. In Aug., 1798, he married Karen Margrete Heger, famous in Danish social and literary history as Kamma Rahbek. Besides editing a vast number of works of earlier and contemporary writers, among the former Holberg, he published *Dansk Læsebog* (Danish Reader, 1799), the first of its kind; *Ludwig Holberg som Lystspildigter* (Ludwig Holberg as Writer of Comedies, 1815–17); and many dramas and occasional poems, several of the latter of which still retain their popularity. Though only a second-rate writer and thinker, Rahbek exercised a greater influence upon his time than many of his more gifted contemporaries. For this he was in no slight degree indebted to his wife, whose wit and culture attracted to their home, Bakkehus, all that was best in the intellectual life of the capital. D. Apr. 1, 1830. D. K. DODGE.

Rahway: city; Union co., N. J.; on the Rahway river, and the Penn. Railroad; 19 miles S. W. of New York (for location, see map of New Jersey, ref. 3–D). Direct water-communication with New York is afforded by the river, which is here navigable for vessels of light draught. The city is tastefully laid out, and contains the residences of many people doing business in New York. There are 10 churches, a public high school, 4 grammar schools, a public library with over 10,000 volumes, a Y. M. C. A. building containing baths, gymnasium, bowling alley, and reading, social, and recreation rooms, a State bank with capital of $50,000, a savings-bank, and 2 weekly newspapers. The industries comprise a large printing and bookbinding house, printing-press manufactory, railway-signal works, woolen-mills, and carriage, hub, and spoke factories. Pop. (1880) 6,455; (1890) 7,105; (1900) 7,935.

Rai'æ [Mod. Lat., from Lat. *ra'ja*, ray, skate]: according to some authors an order, and to others a sub-order, of the class of elasmobranchiates, including the rays, torpedoes, and related types. The pectoral fins are much developed, produced from the anterior margins forward, and are connected with the rostral cartilages, thereby constituting an integral part of the form, and are not abruptly differentiated from the body, as in the sharks and all true fishes; the branchial openings are in two converging rows of five each on the inferior surface of the body; spiracles are well developed behind the eyes. In other respects the order essentially agrees with the *Squali*, and the two form a common super-order or sub-class—the *Plagiostomi*. The form varies considerably in the several members of the order; on the one hand, the sawfishes have an outline much like that of the sharks, and with a long caudal portion; and on the other hand, the eagle-rays and certain sting-rays have a disk extremely wide —much wider than long—and the caudal portion is reduced to a whip-like appendage. Revised by F. A. LUCAS.

Rai'idæ: a family of the order *Raiæ*, including the common skates or rays. In all these the disk is broad and sub-rhomboid, and the tail slender, but fleshy, and rather longer than the disk; the skin covered with radiated spines or asperities; the head well defined, and with a pointed snout; the internasal region furnished with a broad velum; the mouth transverse; the teeth small, generally varying according to the sex; the dorsals two in number, small and situated on the terminal half of the tail; the caudal reduced to a narrow seam. The female is oviparous, laying eggs provided with parchment-like cases furnished at each angle with a filamentous extension; these cases are known popularly as sailor's-purses, and are often found on the seashore. Between thirty and forty species are known. Some inhabit all seas, but they are more numerous in the northern than the southern hemisphere. Five species are found along the east coast of the U. S. (*Raia erinacea*, *R. ocellata*, *R. radiata*, *R. eglanteria*, and *R. lævis*), and several others on the west coast, *R. binoculata* being the most common.

Raikes, FRANCIS WILLIAM: See the Appendix.

Raikes, ROBERT: originator of Sunday-schools; b. at Gloucester, England, Sept. 14, 1735; succeeded his father as editor and publisher of the Gloucester *Journal*; founded a system of Sunday-schools for poor children in 1781, and witnessed its extension to most of the towns of England. D. Apr. 5, 1811. See the *Lives*, by Gregory (London, 1877) and Eastman (London, 1880), and SUNDAY-SCHOOLS.

Rail [from O. Fr. *raale* (> Fr. *râle*), deriv. of *raller*, have a rattling in the throat]: a popular name for any member of the *Rallidæ*, a family of marsh-haunting birds, having stout legs, long slender toes, weak wings, a compressed body, and, usually, a rather long bill. Rails are widely distributed throughout the world, and range in size from little larger than a sparrow to about 15 inches in length, or, if the COURLAN (*q. v.*) be counted a rail, 2 feet. They fly poorly, but run among the reeds with ease. They nest on the ground, and lay a number of cream or buff colored eggs with brown markings; the young run about as soon as hatched. Rails feed on all manner of small aquatic animals, such as snails and worms, and, to some extent, also on seeds. The common rail of Europe is *Rallus aquaticus*; the common species of the U. S. are the Virginia rail (*Ral-*

lus virginianus) and the sora, or ortolan (*Porzana carolina*). Both are found over the greater part of temperate North America, and are especially abundant during the fall migrations in the marshes and rice-fields of the Southern Atlantic States. F. A. Lucas.

Railways, or **Railroads**: roads with parallel lines of rails, upon which the (usually flanged) wheels of vehicles may run. The term *railways* is exclusively used in Great Britain, and is gaining ground in the U. S. Some writers confine the meaning of the term "railway" to the superstructure upon which the carriages run, the "railroad" being regarded as the formation of earthworks or other material upon which the "railway" itself rests. This distinction, however, is more fanciful than real, and the terms may properly be used synonymously.

General History.—The precise date of the first use of railways can not be ascertained. The plan of facilitating the draught of carriages by forming a hard continuous surface for the wheels to run upon is old and simple, and the successive adaptations of flagstones, pieces of timber, and finally strips of iron fastened to the top of the timbers, are the several improvements it has undergone. The use of iron was found to reduce the friction very sensibly, and to increase more than fourfold the amount which the horses could draw from the mines, where such tracks were mostly in use; a ledge or flange on the inner, or in some cases the outer, edge of the plate of iron forming the rail enabled the ordinary wagon to keep on the rails without difficulty. This kind of track was long in use, and was known as a tramway. The next improvement, growing out of the necessity for increased strength in the rails, was the introduction of the edge-rail, formed by setting up a bar of cast or rolled iron in the form of a T. This required special supports called "chairs," spiked to the timber-rails or to cross-supports of timber called "ties," or at intervals to stone blocks. In this rail the flange, which in the tramway was necessary to prevent the wheels from leaving the track, was removed, and in lieu of it a flange was cast on the inner edge of the wheel-tires. Railways constructed upon this principle were in operation in the principal collieries in Great Britain and Germany toward the close of the eighteenth century, used for the transportation of coal or ores from the pit to the port of shipment, sometimes by the force of gravity; and where the acclivity had sufficient steepness the loaded wagons in descending drew up the empty wagons by means of an endless rope passing around a pulley at the summit of the incline; in others, horse or steam power was used.

From the date of the application of the edge-rail—about the year 1790—in lieu of the timber-rail, with its strip of flat iron permitting but a limited speed, the additional strength thereby conferred on the railway proper naturally led those interested to seek a means of propulsion more effective than horse-power, and so the progress and extension of railways became intimately connected with the improvements in the locomotive engine.

The advantages of the low-pressure condensing steam-engine, as demonstrated by James Watt, led to the neglect of the high-pressure principle, although the high-pressure engine, from its comparative lightness, dispensing with the cumbrous apparatus necessary for condensation, is alone applicable to locomotive purposes on land.

Richard Trevithick in 1802 was the first person to take out a patent for a high-pressure engine adapted to motion on roads; his engine was first tried on common roads, but subsequently applied to colliery railways. Improvements made by him were the subject of a patent in 1804, and as early as this steam was used as a means of propulsion on some of these roads, but the speed was not greater than that of horses, owing to the imperfect construction of the boilers of the engines; and on grades as low as 18 feet per mile they required to be assisted by auxiliary power of some sort. The progress of improvement in the engine used for roads was much retarded for many years by an imaginary difficulty which it would seem a single experiment would have sufficed to remove. This was in the opinion that the friction, or the adhesion of the driving-wheels of an engine to the rails, did not offer sufficient resistance to slipping to allow of the power of the engine being applied to the axles so as to produce locomotion. As late as 1811 Blinkinsop obtained a patent for the application of a rack-rail, laid on one side of the railway, into which a cog-wheel on the axles of the driving-wheels worked. Other patents are on record as late as 1815, seeking to overcome this fictitious difficulty—some by means of chains extending the whole length of the road between the rails, and others by means of jointed levers worked by steam. It was at about this date that the discovery was made that the adhesion of the wheels of the engine to the rails furnished a sufficient fulcrum for the action of the propelling power, thus dispensing with all the cumbersome contrivances of racks and chains.

In 1814 George Stephenson built an engine for the Killingworth colliery. The boiler was a flue-boiler, and as it did not make steam enough for a speed of more than 3 miles per hour, it would have been condemned as useless had not Stephenson applied the steam-blast to it, which increased its speed to full 6 miles per hour. It is in the accounts of the day that this application was accidental; the noise of the escape steam was complained of as a nuisance, and to avoid it Stephenson turned the escape-pipe into the chimney, thus creating a draught.

Notwithstanding the efforts made by Stephenson to bring his engines into general use, the opinions of some able engineers of that day were that they did not possess the advantages which the inventor had anticipated. Their use was extending, however, in the neighborhood of the collieries for the transport of coal from the mines, although still supplemented on some of the inclines by horse-power, and on others by rope and stationary engines.

The Stockton and Darlington Railway, 37 miles in length, intended originally for the transport of coal alone, was opened in 1825. It had been the intention to operate it with horses, but Stephenson soon succeeded in introducing the use of locomotives. Engines and tenders weighing 12 tons drew loads of 92 tons upon that road, which has an average grade of 21 feet per mile, some places being level and others having a grade of 53 feet per mile; on the steeper grades 37 tons were taken up at a speed of 4 miles per hour, 6 miles per hour being the speed on other parts of the road; but a speed of from 7 to 8 miles per hour was attained under favorable circumstances. Increased commerce between Manchester and Liverpool, much hampered by the excessive tolls and uncertain movements on the canal between these points, led to chartering the Liverpool and Manchester Railway in 1828, its main object being the transport of merchandise between the two places, but by horse-power. The engineer, George Stephenson, however, advocated the use of steam exclusively. The directors of the road were induced to offer a reward for a locomotive engine which should be able to take three times its own weight on a level road at a speed of 10 miles per hour. In Oct., 1829, the Rocket, an engine built by Robert Stephenson, Jr., a nephew of George Stephenson, more than performed all the stipulated requirements; weighing but $7\frac{1}{2}$ tons, it drew 44 tons at the rate of 14 miles an hour. The effect of this announcement was electrical, and was felt in every civilized country in the impulse given to railway construction.

The first railway built in the U. S. was from the granite-quarries of Quincy, Mass., to tide-water, length 5 miles; begun in 1826 and completed in 1827, it was built to supply the granite for the Bunker Hill Monument, and made of wooden rails laid on granite sills, with a strap-rail of rolled iron. The second road was begun in Jan., 1827, and completed in May of the same year, extending from the coal-mines to the Lehigh river at Mauch Chunk, Pa.—a distance of 9 miles. The loaded cars passed down the inclined planes by gravity, and the empty cars were drawn up by mules. The rails were of timber covered with a strap of iron. In 1828 the Delaware and Hudson Canal Company constructed a railway from its coal-mines to Honesdale, the termination of the canal, to transport the anthracite coal to tide-water. The Baltimore and Ohio and the South Carolina railroads were begun, the latter in 1830. By the close of the year 1830 the following railways had advanced in construction as shown below:

NAME.	Projected, miles.	Completed, miles.
Quincy	5	5
Mauch Chunk	9	9
Delaware and Hudson Canal Company	16	16
Baltimore and Ohio	250	60
Mohawk and Hudson	16	12
South Carolina R. R. (Charleston and Augusta)	135	20
Camden and Amboy	50	constructing.
Ithaca and Owego	29	"
Lexington and Ohio	75	"

All these roads, with a single exception to be noted subsequently, were built for and operated by horse-power. The

first number of *The Railroad Journal* (from which the above list is taken) contains also a list of the railway companies then petitioning the Legislature of the State of New York for charters, the aggregate capital reaching the sum of $43,000,000; this prior to 1831. The roads mentioned in the table, it will be observed, were chartered before the experiment of the Rocket at Liverpool had indicated the most advisable power for operating railways.

In Jan., 1828, Horatio Allen, of the Delaware and Hudson Canal Company, went to England, charged with the duty of procuring the iron rails for that company's road, and also, at his discretion, to order three locomotive engines. He accordingly ordered one engine from the works of Foster, Rastrick & Co., of Stourbridge, and two engines from the works of R. Stephenson at Newcastle. These orders were given in the early summer of 1828, and the engines were received in New York in the following winter (1828–29). The burning of anthracite coal in the furnaces of engines was the point to be demonstrated by the Delaware and Hudson Canal Company, whose extensive mines were waiting a demand on the part of the public, the total consumption of anthracite coal having reached but about 80,000 tons yearly. In the spring of 1829 one of these three engines was ordered to be sent by river and canal to Honesdale, Pa., the initial point of the company's railway. The accident which sent the Stourbridge engine rather than either of the other two has not been accounted for. The other two engines were precise counterparts, and identical in boiler, engine, plan, and appurtenances with the Rocket, by the same maker, which subsequently startled the world by its performances at Liverpool. The Stourbridge Lion, as the engine was named, was put upon the track—built of hemlock timbers and strap-rails, with timber trestles 35 feet in height, and curves of 720 feet radius—and Mr. Allen ran the engine himself for some 6 miles at good speed amid the cheers of the incredulous spectators. No load was attached, as it was feared that it would prove too severe for the road, but it was the first trip ever made on a railway by a locomotive engine in America. It is true it was a foreign-built engine, but its plan had been selected by an American engineer many months before there existed any acknowledged standard by which such machines were to be judged; and there are few bolder achievements of the civil engineer on record than this trip for the first time with an engine between 8 and 9 tons weight at full speed upon such a road. The experiment was successful in exhibiting the value of anthracite coal as a fuel for steam purposes.

Horatio Allen had been appointed chief engineer of the South Carolina Railroad (not then constructed) at the date of his experimental trip with the Stourbridge Lion; and, entering upon his duties a short time subsequently, he reported his views as to the power which he considered it advisable to adopt for its operation in a paper dated Sept., 1829, strenuously urging, for reasons stated at length, the employment of steam as the locomotive power. This report, submitted to the board of directors and unanimously adopted and placed on record Jan. 14, 1830, was the first act by a corporate body, either in the U. S. or elsewhere, adopting the locomotive engine as the tractive power on a railway for general passenger- and freight-transport. Accordingly, in pursuance of that resolution, in Mar., 1830, E. L. Miller, on the part of the South Carolina Railroad Company, contracted with the West Point Foundry Company for a locomotive engine. This was the first locomotive engine built for railway service in the U. S., and was first put upon the road Nov. 2, 1830.

A second locomotive was also built at the West Point Foundry works for the same railway company, and from designs of the chief engineer. In 1830 trials of a small steam-engine built by Peter Cooper were made by the Baltimore and Ohio Railroad, which, however, continued to be operated by horse-power till 1832. The engine was placed on a platform-car.

The improvements made in the locomotive engine became so numerous that it is difficult to determine the precise value of their respective claims. Their effect upon the extension of railways was most marked, and projects and charters were multiplied, not unfrequently much in advance of the wants of the locality. The flat rail—or strap-rail, as it was called—was soon abandoned; the New Orleans and Lake Pontchartrain Railroad was the first to adopt the T-rail (1830–31), Gen. J. G. Swift being the engineer.

Between the years 1828 and 1833 the present system of railway communication in the U. S. may be said to have been begun by the commencement of the Baltimore and Ohio, the Baltimore and Susquehanna, the Camden and Amboy, the New Castle and Frenchtown, the Hudson and Mohawk, the Charleston and Augusta, the Boston and Providence, the Boston and Lowell, and other roads. If we except the Baltimore and Ohio, it will be seen that there was little foresight of a future great connecting system; and it may be said that in general the great lines of communication with the Mississippi valley and the States W. of it are made up of parts originally having little reference to each other. Indeed, the roads in the U. S. have been gradually called into existence to supply a need which they themselves have created, and which did not in the beginning exist. The Baltimore and Ohio and (at a later date) the Pennsylvania roads, connecting the Ohio with Baltimore and Philadelphia, the Mobile and Ohio, connecting that river with the Gulf, may be called the first through lines. The necessity of connecting the newly developed Pacific States with the older body gave rise to the most extended system of reconnoissance and survey through a vast expanse of mountain-chain and desert for the determination of practicable routes, and finally to the rapid construction of the most remarkable through line of railway in the world. The Union Pacific Railway (completed 1869) was built, many parts of it, at the unprecedented rate of a mile a day, but even this is regarded as slow, and the reports of the Canadian Pacific Railway (completed 1885) for the year 1883 show a progress for the entire working season, from Apr. 18 to Nov. 21, of 2·4 miles of completed track laid for every working day.

Following the history of railways to the present day, it will be in order to consider briefly some of the principles to be considered in their construction. The principles of the construction of the accessory works of a railway, such as embankments, bridges, tunnels, etc., differ in no essential save dimensions from those required for first-class turnpike-roads; but the location of the *curves*, or horizontal deviations from a right line; the *grades*, by which we understand the rise or fall in the direction of the length of the road; and the *gauge*, or width between the rails of the track, are the elements which determine the capacity or classification of a railway as a means of transport, and are matters requiring careful study.

Curves.—The amount of resistance to locomotion occasioned by curves in a road is partly due to the effect of centrifugal force, causing the flange of the outer wheel of the cars to press against the rail; partly to the dragging of the wheels, which, being necessarily fixed on the axle, are obliged to perform an equal number of revolutions whether on the inner and shorter, or outer and longer rail of the track; and partly to the axles being *fixed* parallel. In practice, curves of a mile radius offer but little impediment to rapid motion. The necessities of the locality very frequently call for curves of much less radius than this, and the expense of maintenance of both road and machinery is thereby much enhanced unless the curves be traversed at a reduced speed.

It is customary to reduce the rate of inclination on the portions of such parts of the road as are curved at the rate of ·05 feet per 100 for every degree of curvature, as also to raise the outer rail of the track a height proportioned to the speed of the trains. It has also been customary to make the tread of the wheels a conic surface, that in traversing a curve the wheels on the outer rail may run on a longer diameter and so cover a greater length of the track than those on the inner rail, and thus assist the movement around the curve; but this method has been found to produce much oscillation and concussion on the straight portions of the track, and has in a great measure been discontinued—at least to the extent originally thought necessary—although a coning of the wheels to the extent of $\frac{1}{16}$ inch is occasionally practiced. The action of the edge of the rail upon the wheel tends to wear the base of the cone into a groove, as it were, and what at first was thought a notable device for facilitating the movement of the vehicles around a curve is found in practice to be of no value, and in the U. S. the tread of the wheels is now made cylindrical. In European practice the coning of the wheels is still followed to a considerable extent, and the rails are inclined inward at an angle of from 1 in 20 to 1 in 24 in order to allow the rail-head to fit the wheel.

The velocity of the train being an element in the calculation for the super-elevation of the outer rail of the track, what would be suitable for one speed of train would be unsuitable for another; hence a compromise has to be made,

and the average speed of passenger-trains is usually taken from which to calculate this super-elevation:

Theoretically, if v = speed of train in feet per second,
r = radius of curve, in feet,
g = gauge of track, in inches,

then $g \times \frac{v^2}{32{\cdot}2r}$ = elevation in inches to be given to the outer rail of the track. In practice it is customary to disregard the speed and elevate the rail $\frac{1}{2}$ inch per degree of curvature for ordinary-gauge tracks. When the term "degree of curvature" is mentioned in speaking of curves, it is to be understood as the number of degrees subtended by a 100-foot chord. Thus a $\frac{1}{2}°$ curve is one of about 2 miles radius; a 1° curve is of about a mile radius; a 2° is of about a half-mile radius, or, more accurately—

Radius, feet.	Curvature, degrees.	Radius, feet.	Curvature, degrees.
22,918	½	2,292	2½
11,459	¾	1,910	3
7,639	¾	1,433	4
5,730	1	1,146	5
3,820	1½	955	6
2,865	2		

Hence the super-elevation to be given to the outer rail would be, in inches, for a 1° curve, ½; for a 2°, 1; for a 3°, 1½; for a 4°, 2; for a 5°, 2½ inches, and so on, which according to Trautwine is sufficient for speeds as high as 40 miles per hour. The modern refinement of the introduction of transition-curves, by which the point of tangency is virtually thrown back a considerable distance on the tangent, and the curve thus eased on its approach to the latter, gives the opportunity for availing earlier of the super-elevation of the outer rail. This results in a smoother motion when the cars take the curve, very perceptible in comparison with the older methods of change of direction.

Grades.—The additional resistance to motion occasioned by the various grades or inclinations in a road is susceptible of precise calculation, and is a constant quantity for the same inclination, let the state of the road or the machinery be what it may. It is as the sine of the angle of inclination; or, virtually, it is that fraction of the weight which is represented by dividing the height of a given inclination by its length. For instance, in a rise of 22 feet per mile it would be represented by $\frac{22}{5280} = {\cdot}004$, which is 8 lb. for a ton of 2,000 lb., or $\frac{1}{250}$th of the weight. The relative capacity of roads for traffic is therefore limited by their grades—that is to say, since only a certain number of trains can pass over the road yearly, that if the grades are such as to limit the load of the engine to a certain amount, the yearly tonnage, which is the total number of trains multiplied by the load of each, is limited in the same proportion. The capacity of railways is a subject of but little popular appreciation, but one of great importance in projecting new lines of roads.

The principle which obtains in calculating the effect of grades on the movement and weight of trains is briefly illustrated as follows: If a locomotive engine be prevented from advancing on the track, and at the same time the proportions of the machinery be such that upon the application of the power to the wheels the latter will revolve by slipping on the rails (as is usually the case), the engine is said to work up to its adhesion, and the latter becomes the limit of its tractive force. This adhesion varies, in different states of the rail-surface, from one-third to one-tenth of the weight on the driving-wheels, and may be taken ordinarily at one-sixth of the insisting weight. If, then, we know the amount of this and of the resistance to motion occasioned by the friction at the axles of the wheels of the engine and train, as also of the rolling of their surfaces on the rails, we may calculate the weight which the engine will draw on a level under the assumed condition of the rails and the machinery. Thus if it be found that 8 lb. per ton of the weight of the engine and train represents the resistance to motion on a level occasioned by all impediments to motion of whatever kind, disregarding the speed, then by dividing the adhesion expressed in pounds by 8 we obtain the gross weight in tons which the engine will draw upon a level; but where the train ascends a grade there will be, in addition to the resistance of friction on the level, the resistance arising from the gravity of the engine and its load, or its tendency if unresisted to move down the slope, explained above.

The resistance of gravity is the same on a given plane at all speeds, but is overcome twice as fast at 20 miles per hour as at 10 miles, and hence is said to vary with the speed. Friction varies with the load of the train and slightly with the velocity; concussion or resistance of the curves varies both with the weight and speed of the train. Atmospheric resistance varies with the speed and bulk of the train, but its value is not well established and has been estimated as dependent upon the area of the frontage of the train rather than its bulk. If we disregard for the present the various resistances in detail occasioned by curves, concussions, and that of the atmosphere, and consider them as included in a single factor per ton of train, the formula expressing the power of an engine on different grades is very simple and sufficiently accurate for relative comparison. Let E represent the weight on the driving-wheels of an engine in pounds; and let R represent the rise in feet per mile of a given grade; then the gross load, including engine and tender, in tons of 2,000 lb., which the engine will take up that grade will be represented by $\frac{{\cdot}2E}{{\cdot}3787R+8}$, the adhesion being one-fifth of the weight of the engine on the drivers. The following table shows the gross load, in tons of 2,000 lb., which, by the above formula, an ordinary freight-engine weighing 66,000 lb., 40,000 lb. on the driving-wheels, may be estimated to move on different grades in a good condition of the rails:

ON A LEVEL.	20 feet per mile.	30 feet.	40 feet.	50 feet.	60 feet.	80 feet.	100 feet.	150 feet.	200 feet.	250 feet.
1,000 ...	513·8	413·2	345·6	290·3	260·4	208·9	174·4	123·4	95·5	78·0

The most simple formula for the resistance of a train—for purposes of general comparison sufficiently accurate—is that of D. K. Clark, which is, where R is the resistance in pounds per ton (2,240 lb.) of engine, tender, and train, and V the velocity in miles per hour,

$$\frac{V^2}{171} + 8 = R.$$

The following table shows the resistance in pounds per ton (2,240 lb.) for different velocities, according to Clark's formula:

At 10 miles per hour.....	8·6 lb.	At 40 miles per hour.....	17·3 lb.
At 12 " "	8·8 lb.	At 50 " "	22·6 lb.
At 15 " "	9·3 lb.	At 60 " "	29·0 lb.
At 20 " "	10·3 lb.	At 80 " "	45·4 lb.
At 25 " "	11.7 lb.	At 100 " "	66·4 lb.
At 30 " "	13·3 lb.		

The resistance to motion as affected by the grade alone is had by multiplying the load by the rise in feet and dividing the product by the length also in feet. The following table shows by inspection the resistance in pounds on different grades, of loads varying from 1 to 500 tons:

GRADE IN FEET PER MILE.	1 ton.	50 tons.	75 tons.	100 tons.	250 tons.	500 tons.
10	4	212	318	424	1,061	2,121
20	8	424	636	848	2,121	4,242
30	13	636	955	1,273	3,182	6,363
40	17	848	1,273	1,697	4,242	8,484
50	21	1,061	1,591	2,121	5,303	10,606
60	25	1,273	1,909	2,545	6,364	12,727
70	30	1,485	2,227	2,970	7,424	14,848
80	34	1,697	2,545	3,394	8,485	16,969
100	42	2,121	3,182	4,242	10,606	21,212

The tractive or drawing power of an engine, called its *traction*, is directly as the diameter of the steam-cylinders, the steam-pressure, and the stroke of a piston, and inversely as the diameter of the driving-wheels; therefore we increase the tractive power of an engine by increasing either the diameter of cylinders, the steam-pressure per square inch, or the stroke, or by decreasing the diameter of the driving-wheels. The formula expressing this is as follows:

If d = diameter of a cylinder, in inches,
p = mean effective pressure of steam per square inch on the piston,
s = length of stroke, in inches,
D = diameter of the driving-wheels in inches,
then $\frac{d^2ps}{D}$ = tractive power.

This is upon the supposition that the adhesion of the wheels to the rails, taken at one-sixth of the weight in pounds upon the drivers, is in excess of the tractive power as above determined, the adhesions varying from as high as one-fourth to less than one-tenth of the weight on the driver. Thus the tractive power, with an effective pressure of steam on the piston of 80 lb., the stroke being 22 inches,

and the diameter of the cylinder being 16 inches, and diameter of wheel 60 inches, would be

$$\frac{16 \times 16 \times 80 \times 22}{60} = 7509{\cdot}8 \text{ lb.}$$

Therefore, if the weight of the engine on the driving-wheels is in excess of six times this, or = 45058·8. the engine would be said to work up to its adhesion, and locomotion would ensue.

Inclined Planes.—Before the locomotive had been perfected, and before even the question of locomotive- *vs.* stationary-engine power had been settled, it is not surprising that recourse was had to inclined planes (which were in fact the first form the railway assumed) for overcoming abrupt changes of level. Hence we find several examples, as that on the Mohawk and Hudson (Albany and Schenectady) road. The Columbia road (Philadelphia to the Susquehanna) had one at each end. The Alleghany Portage road, connecting two sections of the Pennsylvania Canal, had a number. The South Carolina road (Charleston to Augnsta) had one near the latter place, and the Baltimore and Ohio had one at Parr's Ridge, Md. On the Liverpool and Manchester road there were two, on the railway near Liège, Belgium, was one, and others existed elsewhere in Europe; but the neeessity of admitting much higher grades than had been supposed admissible and of overcoming them by locomotive power was speedily felt. The Baltimore and Ohio road was constructed to admit grades of 116 feet, and even heavier grades, though unadvisable, are yet to be found. All of the inclined planes above enumerated are now operated by the more modern locomotive engine. The grade of 116 feet per mile on the Baltimore and Ohio road is operated by two engines each 62 tons weight, which take a load of 600 tons, exclusive of the weight of engine and tender, up this incline at the rate of 15 miles per hour. For temporary purposes the engines have taken loads of 40 tons, exclusive of their own weight, up grades of over 500 feet to the mile. See INCLINED PLANE and MOUNTAIN-RAILWAYS.

Gauge.—It is not known what, if any, principle governed the determination in the first instance of the gauge between the rails of 4 ft. 8½ in. It was adopted in the roads from the collieries in the north of England, and believed to have arisen from the colliery-wagons in use on common roads having an outside width of axle of 5 feet; for as the tramroads had the flange on the outer edge of the rail these ordinary wagons could be used on them, and when the tramway was replaced by an edge-rail the same width of track was continued, but, measured from the inner edge of the rail, resulted in the 4 ft. 8½-inch gauge. Another reason, given by an authority, is that the tramways were 5 feet wide including the rails, and as the later edge-rails were 1¾ inches wide they practically determined the gauge at 4 ft. 8½ in. as soon as they were introduced. Be this as it may, Mr. Stephenson, engaged in these collieries, was selected to build the Liverpool and Manchester road, and seeing no reason to change the gauge with which he was familiar, it was adopted there. When once established on a line of road looking to future extension, it was apparent that unless some special advantage called for a change there was a manifest propriety in continuing its use; accordingly, the success of the Liverpool and Manchester road led to the general adoption of this gauge. As the weight of traffic increased, and a corresponding increase of power was called for in the locomotive engine, the impression prevailed that this could be best arrived at by increasing the space within which the machinery was placed, and an increase in the width of track on many roads was the consequence. In 1846 the inconvenience resulting from this lack of uniformity in the width of the railways in England led to the matter being brought before Parliament, and an inquiry was instituted as to the respective merits of the various proposed widths of tracks. The commotion which followed, known as the "battle of the gauges," led to experiments, investigations, and reports by a committee of Parliament, and every effort possible was made to arrive at a just conclusion in the premises, and the subject was exhaustively considered. The result was, that while Parliament declined to enact a law compelling all roads to adopt the narrow gauge, yet the evidence went to show that although for main-trunk lines of great traffic a wider gauge than the prevailing one of 4ft. 8½ in. would probably prove advantageous, yet the advantages were not then so apparent as were the disadvantages resulting from a lack of uniformity with the prevailing gauge of the kingdom; and the public mind settled generally to this belief. In the U. S. there were five different widths of track—from 4 ft. 8½ in. to 6 feet—and the advantages of uniformity of track again forcing itself upon the attention of railway proprietors resulted in the triumph of the 4 ft. 8½ in.; and for the same reasons as formerly, not its mechanical superiority to any other, but the expediency of its adoption in view of the extent of roads in operation of that width of gauge.

As before remarked, the grades, curves, and gauge of a railway are the elements of its capacity for transport. The relative effects of the first two are measurably well understood, but the precise value of the latter still remains a mooted question among engineers, although the general adoption of the standard gauge of 4 ft. 8½ in. in the U. S. has rendered such investigation of little practical interest.

Drainage.—The expense of the maintenance on any line will, other things being equal, vary very nearly in the proportion in which its drainage is good or otherwise. Water lying or running on the surface soaks and softens the road-bed, washes away the earth, and chokes the ditches. When saturated with water the road-bed loses its firmness, and the bottom sinks and deranges the tracks, thus adding to the shocks of the train and to the wear and tear of both the machinery and the track. The surface-drainage of the slopes of excavations is equally important, to prevent the velocity of running water from tearing up the soil and choking the ditches, which should be kept open and of a sufficient depth to drain the bottom of the ballast.

The cross-ties, upon which the rails rest, are generally of oak, chestnut, or other hard and durable wood, from 6 to 8 inches in depth, from 8 to 10 wide, and 8 feet in length, and are laid usually upon the road-bed at intervals of about 2 feet between centers. The ballast, or material upon which the ties rest, should be broken stone or gravel mixed with coarse sand free from loam or clay, and should extend to a depth of at least 18 inches below the bottom of the ties, and the space between the latter should be filled in nearly to the level of the bottom of the rail. The effect of this, besides securing the cross-ties and rails in their places, permits by its porosity the thorough drainage of the track, resists sinking of the ties, and enables them to be readily packed up, while it gives a proper amount of elasticity to the track, more conducive to durability than the plasticity of earth or the rigidity of rock, and secures them against the heaving action of the frost.

Rails and Cross-ties.—The early forms of strap-rails soon gave way to east-iron bars about 6 feet long, called fish-bellied rails, and these in turn were replaced by wrought-iron forms. The first steel rails were rolled in England in 1857, and the introduction of the Bessemer process (patented in 1856) produced a marked influence in cheapening the cost of construction of railways.

In Great Britain and on the continent of Europe it has been customary to make the rail double-headed, and when worn on one edge to reverse it, and thus double its duration; but this method, besides rendering an expensive cast-iron chair necessary, with its complication of fastenings (this item alone being estimated in Great Britain as amounting to over 1,000,000 tons), is of doubtful expediency, as the effect of the chair is in many cases to indent the lower face of the rail, which is subsequently liable to fracture. This has led to the use of the "bull-head" non-reversible rail, the lower head being only large enough to secure the rail in the chair. The system universally pursued in the U. S. of dispensing entirely with a chair, and making the base of the rail some five inches in width, resting on the timber cross-ties without other support, and secured to the latter by brad-headed spikes, is gradually gaining ground elsewhere as the most simple and efficient method of securing the rail.

For some years the use of steel cross-ties has been gaining ground, and is now advocated as conferring the requisite elasticity of track with economy of maintenance; and, what is very remarkable, as it is well known that rails subjected to the rolling traffic of the road do not deteriorate by rust, while a rail lying unused by the roadside is soon destroyed by rust, so it is found that the metal sleeper, or cross-tie of rolled iron or steel, while in use under the rails, does not suffer loss by rust to any appreciable extent, and does not require renewal from this cause. The extent of metal track in the world up to 1892 is shown in the following table (from official sources); it is scarcely to be regarded as experimental in countries where from scarcity of timber, climatic, or other considerations, the use of metal for the

support of the rails became almost a matter of necessity. This table also gives the miles of railway up to 1892:

COUNTRY.	Metal track, miles.	Total track, miles.	Per cent. of metal track.
Europe	10,400	135,000	7·70
Africa	1,330	5,300	25·09
Australasia	200	10,740	1·86
Asia	9,800	21,425	45·74
South America, Central America, West Indies, Mexico	3,850	21,000	18·33
U. S	20	171,000	.....
Canada	.....	14,635	.....
Totals	25,600	379,100	6·75

The average number of ties obtained from one acre of forest is 100, so that for new track with 2,640 ties per mile about 26½ acres of forest must be cleared to supply ties for each mile of track. The annual consumption of timber for railway purposes in the U. S. is about 365,000,000 cubic feet for ties, and 60,000,000 cubic feet for bridge and trestle construction of sawed material; so that the annual consumption of 500,000,000 cubic feet of wood in the shape of forest-grown (round) timber for railway purposes may be taken as a reasonable figure.

The first rails of rolled iron were not above 3 feet in length, while steel rails have been rolled over 80 feet in length. Common rails are rolled in lengths of about 30 feet, and the joints are secured by fish-plates—plain plates of rolled iron placed under the head of the rail, and secured to both rails by bolts—or by angle-plates, having the general sectional form of the rail and its flange, and secured in the same way by bolts. The joint being considered the weakest point of the track, every effort was made to stiffen it by clustering the ties near it, and making the joint-tie broader and heavier than elsewhere. Against this it was urged that the joint became stiffer than the remainder of the rail and to that extent objectionable, and the joint was then suspended by resting the angle-bar at each end on a tie, and dispensing with the support afforded by a tie immediately under the joint, thus giving elasticity to the joint. Each method has its advocates, and innumerable patents claiming to make a perfect joint have been issued. The rails are secured to the angle-plates by bolts passing through holes made oblong to permit the expansion and contraction of the rail occasioned by change of temperature. In the climate of the U. S. it is estimated that this variation in the length of a 30-foot rail will amount to $\frac{7}{16}$ of an inch. At or near the center of each rail the spikes are passed through nicks in the flange of the rail, instead of outside the flange as elsewhere, thus fastening each rail near the center of its length to the down grade by the action of the driving-wheels of the engines. The thorough draining and ballasting the track, it will be perceived, is relied upon to render the above precautionary measures of any service. Constant increase in the weight of rails has been going on for some years. Steel rails 6 inches high and of the same width of flange, and weighing 120 lb. to the yard, are now proposed, and 100-lb. rails are not uncommon. The main tracks of all the chief railways of the U. S. are of steel.

Electric Railways.—With the exception of variations in the width of gauge and weight of rail, and the details of the rolling stock, the railways of the U. S. present great uniformity of plan. To this statement an exception must be made in the case of the roads operated by electricity; for although the consideration of the motive power to be used on railways is in a measure foreign to the purpose of this article, yet the use of electricity has rendered some changes in the construction of the rail track essential, and still greater changes may be anticipated in the future.

The electrically operated railways have thus far been confined to the streets of cities and towns, and, as with other municipal roads, neither its construction nor its operation is embodied in the tabular statements herewith appended. See Electric Railways.

Statistics.—Nearly one-half of the railway mileage of the U. S. has been constructed since 1880. This great increase has been largely in the Southern and Western States. But this has been eclipsed by the increase in the magnitude of operations. The gross earnings of 1893 were $1,208,641,498, of which $808,494,668 were from freight, $311,978,347 from passengers, and $88,168,488 from miscellaneous sources. The net earnings were $358,648,918.

In addition to the cost of construction of new roads, a large amount of fresh capital is yearly expended on old lines; so that for many years past there has been expended upon railways over $1,000,000 for every working day in the year. Should much of the cost of new lines be lost to shareholders, the republic is undoubtedly the richer to a very large extent, possibly approximating the expenditure, from the incidental advantages growing out of opening new and extensive tracts of rich lands for settlement, and bringing within reach of markets products which would otherwise have had no commercial value. These railways during 1893 transported 757,464,480 tons of freight, an equivalent of 90,552,087,290 tons moved one mile, at an average charge of 0·89 cents per ton per mile; and passengers 628,965,973, equivalent to 15,246,711,952 persons carried one mile, at a charge of 2·05 cents per passenger per mile, the number of passengers carried equaling nearly nine times the entire population of the U. S. This is exclusive of elevated-railway travel in the cities. The value of the freight carried, at $25 per ton, would equal nearly $19,000,000,000.

COMPARATIVE STATEMENTS RELATIVE TO THE RAILWAYS IN THE U. S., GREAT BRITAIN, CANADA, AND THE BRITISH COLONIES, 1892.

SUBJECTS CONSIDERED.	United States.*	United Kingdom.	Canada.	Queensland.	New South Wales.	Victoria.	South Australia.	New Zealand.	India.	Natal.
Area, square miles	2,967,617	121,115	3,510,500	668,224	309,175	87,884	903,425	104,235	1,378,044	19,000
Population	62,622,250	38,000,000	5,000,000	393,938	1,145,400	1,137,272	328,000	623,000	234,490,000	481,362
Population per square mile	21·1	314	1·4	0·6	4	13	0·36	6	170	25
Population per mile of railway	367	1,900	370	179	536	412	197	338	13,790	1,800
Miles of railway	170,601	20,073	13,256	2,195	2,182	2,763	1,666	1,842	16,996	268
Gauge	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	3 ft. 5 in.	4 ft. 8½ in.	5 ft. 3 in.	3 ft. 6 in. / 5 ft. 3 in.	3 ft. 6 in.	5 ft. 6 in. / 3 ft. 3⅜ in.	.....
Cost per mile	$59,820	$223,550	$59,250	$34,400	$72,795	$65,765	$34,330	$38,760	$62,820	.....
Gross receipts per train-mile 1890–91	Cts. 135·60	Cts. 117·22	Cts. 112·30	Cts. 115·66	Cts. 169·76	Cts. 129·26	Cts. 155·88	Cts. 186·00	Cts. 186·00	Cts. .....
Operating expenses per train-mile 1890–91	93·43	63·64	86·80	82·18	104·52	90·54	78·60	116·18	93·00	.....
Net revenue per train-mile	42·17	53·58	25·50	33·48	65·24	38·76	77·28	69·82	93·00	.....
Percentage of operating expenses to earnings	68·90	54·30	77·29	71·05	61·57	70·05	50·42	62·46	50·00	60·00

* Exclusive of Alaska.

ties, and confining the action of contraction or expansion to each individual rail. This is the method relied upon also for preventing what is called the "creeping" of the rails

The following table, condensed from Poor's *Manual of Railroads* and other sources, exhibits the mileage of the railways of the world:

RAILWAY MILEAGE OF THE WORLD.

COUNTRY.	1840.	1850.	1860.	1870.	1875.	1880.	1885.	1890.	1893.
Germany and Luxemburg	219	3,635	7,021	11,715	17,519	21,200	23,535	25,608	27,100
Great Britain	1,331	6,635	10,410	15,310	16,650	17,935	19,169	20,073	20,325
France	265	1,865	5,860	11,010	13,420	16,100	19,300	20,743	21,788
Russia	14	310	989	7,005	12,180	14,600	15,939	18,059	19,651
Austria-Hungary	89	942	2,780	5,962	10,413	11,610	13,957	15,877	17,609
Italy	13	378	1,369	3,830	4,770	5,460	6,610	8,164	8,742
Spain	....	16	1,187	3,210	3,680	4,630	5,654	6,108	6,708

RAILWAY MILEAGE OF THE WORLD.—CONTINUED.

COUNTRY.	1840.	1850.	1860.	1870.	1875.	1880.	1885.	1890.	1893.
Sweden } Norway }	....	....	416	1,305	2,540	4,400	5,277½	5,983	6,225
Belgium	186	552	1,071	1,790	2,175	2,550	2,758	2,793	2,810
Switzerland	....	15	653	882	1,275	1,635	1,925	1,972	2,082
Holland	....	110	196	885	975	1,115	1,542	1,839	1,900
Roumania	....	....	....	152	767	860	1,100	1,590	1,598
Turkey	....	....	41	174	953	867	904	904	904
Denmark	....	....	69	473	785	985	1,214	1,214	1,289
Portugal	....	....	85	443	643	778	950	1,284	1,440
Greece	....	....	....	7	7	8	210	452	568
Servia	....	....	....	....	....	....	247	336	337
Malta	....	....	....	....	....	....	7½	7½	7½
Total Europe	2,117	14,458	32,147	64,153	88,752	104,733	120,299	133,006½	141,083½
British empire in India	....	....	840	4,774	6,517	9,147	11,993	16,095	18,042
Ceylon	....	....	....	73	91	135	178	191½	230½
Java and Dutch possessions	....	....	....	93	162	255	586	809	850
Asia Minor	....	....	....	145	219	244	347	392	974
Japan	....	....	....	....	41	75	250	1,437	1,877
Russia in Asia	....	....	....	....	....	....	....	890	890
Malay states	....	....	....	....	....	....	....	73½	118½
Siam	....	....	....	....	....	....	....	....	190
China and Cochin-China	....	....	....	....	....	....	....	137	180
Persia	....	....	....	....	....	....	....	6	11
Total Asia	....	....	840	5,085	7,030	9,856	13,354	20,031	23,363
United States	2,816	9,015	30,600	52,856	74,050	93,526	125,379	161,397	177,753
Canada and Newfoundland	....	....	1,880	2,670	4,430	6,886	10,773	13,436	15,330½
Mexico	....	....	....	215	369	654	3,662	4,648	6,900
Costa Rica	....	....	....	....	....	74	170	180	231
Nicaragua	....	....	....	....	....	....	93	99	99
Guatemala	....	....	....	....	....	80	99	99	118
Honduras	....	....	....	....	....	56	34	37	37
San Salvador	....	....	....	....	....	....	38	53	62
Cuba	....	....	....	....	....	860	900	1,000	1,000
Jamaica } Trinidad }	....	....	....	....	....	41	93	64	89
							51¼	54	54
Colombia	....	....	48	64	64	75	140	218	218
Venezuela	....	....	....	19	21	70	102	183	287
British Guiana	....	....	....	....	....	21	21	23	23
Brazil	....	....	133	504	1,030	2,170	4,379	5,582	6,651
Argentine Republic	....	....	25	612	1,168	1,530	4,150	5,798	8,023
Uruguay	....	....	....	61	189	268	271	707	974
Paraguay	....	....	....	44	44	44	45	152	157½
Chili	....	....	119	452	794	1,170	1,421	1,700	1,735
Peru	....	....	46	247	965	1,150	996	1,625	882
Bolivia	....	....	....	....	81	81	....	300	500
Ecuador	....	....	....	18	18	32	40	50	63
Barbados	....	....	....	....	....	....	....	24	24
San Domingo	....	....	....	....	....	....	....	....	71
Porto Rico	....	....	....	....	....	7	7	12	12
Hawaii	....	....	....	....	....	....	32	56	56
Total America	2,816	9,015	32,851	57,762	83,223	108,795	152,896½	197,497	221,350
Egypt	....	....	296	646	950	927	900	1,123	1,225
Cape Colony	....	....	....	69	148	903	1,599	1,785	2,252
Algeria and Tunis	....	....	....	164	373	875	1,533	2,170	2,216
Natal	....	....	....	5	5	99	174	259	399
Mauritius	....	....	....	66	66	66	92	92	92
Reunion	....	....	....	....	....	8	8	78	78
Senegal	....	....	....	....	....	....	....	164	246
South African Republic	....	....	....	....	....	....	....	....	200
Orange Free State	....	....	....	....	....	....	....	120	....
Total Africa	....	....	296	950	1,542	2,878	4,306	5,791	7,208
New South Wales	....	....	124	335	435	855	1,734	2,182	2,351
Victoria	....	....	176	275	617	1,195	1,743	2,341	2,903
Queensland	....	....	....	205	265	635	1,434	2,064	2,353
South Australia	....	....	47	133	250	678	1,063	1,756	1,810
West Australia	....	....	....	....	38	71	76	500	651
Tasmania	....	....	....	43	149	171	257	374⅓	475
New Zealand	....	....	....	44	542	1,253	1,654	1,912	2,036
Total Australasia	....	....	347	1,035	2,296	4,858	7,961	11,129½	12,579
Total world	4,933	23,473	66,481	128,985	182,843	231,120	298,816¼	367,455	405,583½

Since the opening of the Liverpool and Manchester Railway (1831) there have been built about 400,000 miles of railway, at an estimated cost of $40,000,000,000. The railway may therefore justly claim to be one of the most signal instruments—perhaps the most signal instrument—of civilization yet developed. J. W. Adams.

Railway Equipment: The track, shops, stations, and rolling stock of railways. The total railway mileage of the world has 74 per cent. of standard gauge (4 ft. 8½ in. in the clear between the heads of the rails), 12 per cent. of broader gauges, and 14 per cent. of narrower gauges.

Track.—The visible portion of the road-bed, consisting of rails and cross-ties, constitutes the track, which usually rests on a foundation of broken stone or gravel. About 90,000,000 of timber cross-ties are annually used on the railways of the U. S. Preserving wooden ties is commonly practiced in Europe, and to some extent in the U. S. The principal processes are as follows: Kyanizing (corrosive sublimate), burnettizing (chloride of zinc), Boucherie (sulphate of copper), Wellhouse (chloride of zinc and tannin), and vulcanizing (heating under pressure). Metal tie-plates are often used under T-rails to protect the wood. Metal ties are used very little in the U. S., but extensively in other countries.

The two forms of rails in most general use are shown in Fig. 1. The flange or T-rail was invented in 1830 by Col. Robert L. Stevens, of the U. S., for the Camden and Amboy Railroad. In Europe it is called the Vignoles rail, having been reinvented in England in 1836 by C. H. Vignoles. It is used exclusively in the U. S. and largely in other countries, and is fastened to the cross-ties by bolts, screws, or spikes. The bull-head rails used in Europe are secured by wooden or iron wedges or "keys" to cast-iron chairs fastened to the ties. Modern track is laid with steel rails, which resist strains and shocks far better than iron rails and have greater endurance, and in 1891 the railways of the U. S. had 82 per cent. of their mileage laid with rolled steel

rails, and the balance with iron. The first steel rails were laid at Derby, England, in 1857. Rails for main track weigh 70 to 90 or even 100 lb. per yard, and are usually 30 feet long. The average life of good steel rails is about 150,000,000 to 200,000,000 tons of traffic. For rail-joints short splice-plates or fish-plates were used in 1831 on the Camden and Amboy Railroad, and in 1847 the fish-plate joint was invented in England by W. Bridges Adams. The angle-bar now generally used is a development of the fish-plate, and is 20 to 48 inches long, with four or six bolts. Since 1890 there has been a growing tendency to use a "bridge-plate" under the rail ends to prevent the deflection which (and not the space between the ends) causes the shocks to car-wheels. The most approved form of switch is the split switch (Fig. 2), in which the switch-rails are planed to a taper, so that

Fig. 1.—Rails: *a*, T-rail; *b*, bull-head rail.

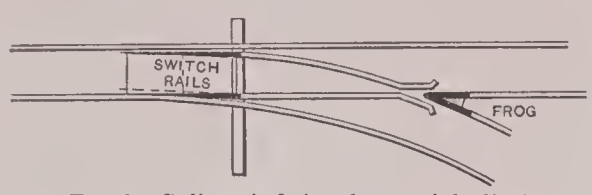


Fig. 2.—Split switch (set for straight line).

the ends will fit closely against the main or stock rails. This type was used in England before 1830. In the stub-switch (Fig. 3), still used in the U. S., the switch-rails are shifted

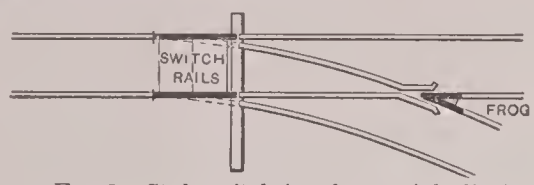


Fig. 3.—Stub-switch (set for straight line).

into line with those of one or other of the diverging tracks. The frog is placed at the intersection of the rails, and allows wheels to pass on either track.

Maintenance of Way.—Traffic causes wear and disturbance of the track; and climate and weather tend to rot the ties, shift the ballast, fill up the ditches, etc. The expense of maintenance is many times greater in the U. S. than in Europe, where, as a general thing, the roads are completed before being opened for use. Maintenance includes the periodical renewals of rails, ties, etc., and also the daily work of repairs and general attention to details. The work is of great importance to the safety and economy of traffic. A railway is divided into "sections" of 4 to 7 miles in length for single track, or 3 to 5 miles for double track, each section having a foreman and gang of 4 to 6 men, and the section is gone over daily from end to end to see that it is in good and safe condition.

Signals and Interlocking.—About 1841 the semaphore signal was introduced in railway service by C. H. Gregory in England, and it is almost universally used, although disks, etc., are used to some extent. It consists essentially of a post carrying a pivoted arm. When horizontal the arm indicates "track blocked" or "stop." When lowered to a vertical or inclined position it indicates "track clear" or "go on." Colored glasses attached to the arm move in front of a fixed lamp for the night-signals. Signals are of two classes: 1, those dividing the railway into sections or "blocks"; 2, those indicating the position of switches, drawbridges, etc. With block-signals a "distant signal" indicates the position of the "home-signal," but if the former is at "stop" a train may pass it, being prepared to stop at the home-signal if the latter has not in the meantime been lowered. A home-signal at "stop" must never be passed if the "absolute block" system is used, but with the inferior "permissive block" the train may pass after a certain interval, proceeding with caution. Block-signals are operated by wires, compressed air, etc., from towers placed at distances apart varying with the amount of the traffic. There is telegraph (and sometimes telephone) communication between the towers, and in the lock-and-block system invented in England in 1874 the apparatus of each tower is electrically interlocked with those of other towers, so that the signalman can not move the signals or switches until certain electrical operations have been performed by the other signalmen to release or unlock the levers for the movement he has notified them that he wishes to make. Automatic signals, worked electrically from track-connections by the trains, are used to a greater extent in the U. S. than in any other country, but are inferior to the lock-and-block system. The Westinghouse and Hall automatic systems are those most used. By a combination of the manual and automatic systems the signal is set at "stop" by the train, but must then be lowered by the signalman, who can not do so, however, until the train has passed the next signal. In 1843 the apparatus of a junction in England was so interlocked that conflicting signals could not be given. In 1856 John Saxby, of England, applied his invention of interlocking combined with the concentration of the operating levers, and in 1874 Mr. Stevens, of England, invented the interlocking by tappets, which is now generally used. In an interlocking plant the operating levers are connected to a series of bars or rods having notches and projections which engage with each other, and are so arranged that when switches and signals are set for a particular train movement no levers can be moved for any conflicting signal or switch. The first interlocking plant in the U. S. was used in 1874 by the New York Central Railroad, and in 1875 the Pennsylvania Railroad imported a Saxby machine from England. Such machines are now in extensive use at terminals, junctions, and track crossings. By Dec. 31, 1892, the railways in Great Britain had 97 per cent. of their switch and signal plant interlocked.

Water and Coal Stations.—The engine-tenders are generally supplied with water from a wooden or iron tank (one or more according to the number of engines) supported upon a stone, iron, or timber tower about 12 feet high. A hinged pipe at the base of the tank leads the water to the tender-manhole. A water-crane or column is an upright pipe beside the track with a swinging horizontal pipe to reach across to the tender-manhole, the water being taken from an underground pipe. It is very important to use good water. A plan for filling the tender-tank while the engine is running, invented by John Ramsbottom, of England, in 1861, is extensively used in Great Britain and the U. S. An iron track-tank about 18 inches wide, 6 inches deep, and 1,200 to 1,500 feet long is laid between the rails. In the tender-tank is an upright pipe, extended downward through the bottom and fitted with a movable curved end or "scoop." When running over the track-tank the scoop is lowered into it, and the motion forces the water up the pipe into the tender. Coal is loaded by shoveling, by cars or buckets, or from a coal-tipple, which is a structure fitted with rows of coal-bins at an elevation above the track. When an engine is under or alongside the tipple, gates are opened allowing the contents of the bins to flow down a chute into the tender. Coal is generally used for fuel, sometimes in the form of anthracite dust. Oil-fuel and bricks of pulverized coal mixed with tar or other cementing material are considerably used in Europe.

Stations and Shops.—The size of a station and the passenger accommodation and freight facilities provided depend upon the importance of the town and the traffic. Large stations generally have a train-shed covering the tracks and platforms, and at important terminals handsome buildings are frequently erected, containing the station and railway company's offices, hotel accommodations, etc. Union stations are for the use of two or more railways. At terminals and important stations extensive yards and side-tracks are required, and freight-sheds, warehouses, grain-elevators, stockyards, etc., must be provided according to the nature and extent of the traffic. In Europe hydraulic power is largely used for handling cars and freight at terminals. Some railways build locomotives and cars, and have therefore extensive works. Repair-shops for locomotive- and car-work, however, are required at different points on all roads. Engine-sheds in Europe are usually rectangular, but in the U. S. they are usually "roundhouses" of circular, annular, or segmental plan, with tracks radiating from a central turntable. Among the extra equipment required at terminal

and divisional points are the following, not all, however, being established at any but very important places: Repair-shops, engine- and car-sheds, storerooms for engine-supplies, sand-house (sand for engines), ice-house (ice for water-coolers, dining-cars, and refrigerator-cars), oil-house (for lamp-supply), gas or electric plant for car-lighting (where either system is used), coal- and water-supply, offices, rooms for employees, storerooms for parlor and sleeping-car supplies; side-tracks for storing, cleaning, inspecting, and repairing cars; turn-table or transfer-table, ash-pit, etc. The greatest terminal yards in the world are those at Buffalo, N. Y., which have about 100 miles of main track and 400 miles of side-track.

Cars.—The first passenger-cars resembled stage-coach bodies on four-wheel platforms, but as early as 1831 the American style of long car with trucks, or "bogies," end doors, central aisle, and seats all facing the same way, was introduced. In Europe the cars are generally short and light, divided into compartments having side doors, the passengers sitting face to face and knee to knee, but within recent years improvements have been made in introducing larger cars on trucks, and also parlor, dining, and sleeping cars. The smaller cars have four or six wheels, and are 26 to 34 feet long, while the larger ones on trucks are from 42 to 56 feet long. American cars are 50 to 80 feet long, wider and higher than European cars, and generally of stronger and heavier construction. The vestibule connections, or inclosed-end platforms, were used on mail-cars about 1852, and were first used on passenger-cars in 1886. They make a train practically one long articulated car, and afford increased safety in case of accident. Dining, sleeping, and parlor cars are run on most important trains, and are very luxuriously and elaborately finished and equipped. The first sleeping-car in the U. S. was run on the Cumberland Valley Railroad (Pennsylvania) in 1836–37. In 1856–57 Thomas L. Woodruff built a sleeping-car, and he was followed by Webster Wagner. In 1859 George M. Pullman began making improvements, and in 1864 he built for the Chicago and Alton Railroad the first real Pullman sleeping-car. European freight-cars are generally 12 to 18 feet long, with four wheels, weigh 11,200 to 18,000 lb., and carry 18,000 to 23,000 lb. Larger cars are used to some extent for coal, ore, etc. In the U. S. freight-cars are 30 to 36 feet long, with two four-wheel trucks, weigh 20,000 to 30,000 lb., and carry 40,000 to 60,000 lb. Refrigerator-cars for carrying meat, fruit, etc., have the sides, roof, and floor insulated by air-spaces, felt packing, etc., and are fitted with ice-chambers. Iron and steel are being largely used in freight-car construction, especially for the frames. The number of cars in the U. S. in 1891 was as follows:

CLASS OF SERVICE.	Total.	With train brake.	With automatic coupler.
Passenger	27,949	27,246	26,692
Freight	947,300	108,132	107,795
Company's	35,185	2,438	1,057
Fast freight	51,787	4,777	8,597
Total owned	1,062,221	142,593	144,141
Total leased	153,390	22,645	23,202
Grand total	1,215,611	165,228	167,343

TRAIN-SHEDS OF PASSENGER STATIONS.

CITY.	RAILWAY.	No. of spans.	Width.	Length.	Height.	No. of tracks.
Jersey City, U. S.	Pennsylvania Railroad	1	256 ft.	652 ft. 6 in.	86 ft.	12
Philadelphia, "	" " *	1	304 ft.	598 ft.	100 ft. 4 in.	16
" "	Philadelphia and Reading Railroad	1	266 ft.	506 ft. 8 in.	88 ft.	13
New York, "	New York Central Railroad	1	200 ft.	650 ft.	96 ft.	12
" "	" " " " (annex)	1	98 ft. 3 in.	650 ft.	22 ft. 6 in.	5
St. Louis, "	Union Station	5	601 ft.	700 ft.	75 ft.	30
London, England	Midland Railway †	1	243 ft.	600 ft.	100 ft.	10
Paris, France	Western Railway ‡	..	.....	.....	.....	30
Cologne, Germany	State Railways	3 { 1 / 2	209 ft. 8 in. / 44 ft.	836 ft.	78 ft. 7 in.	..

* Broad Street. † St. Pancras. ‡ St.-Lazare.

Locomotives.—British practice in the design and construction of locomotives is still mainly followed by all countries except the U. S. and Canada. North American practice employs bar-frames, outside cylinders, trucks, equalized springs, eight-wheel-tenders, and large cabs fitted with seats. European practice employs plate-frames (invariably), inside cylinders, rigid axles and unequalized springs (generally), and four or six wheel tenders, while the men have to stand up in cabs affording little shelter. North American engines are equally well adapted for light and rough track, and the best and heaviest track, and many features of American practice are widely adopted in Europe, while locomotives are extensively exported from the U. S. The truck, or "bogie," was invented by John B. Jervis, of the U. S., in 1831, and first used on an engine ordered by him from the Stephenson works in England. The North American "eight-wheel" type of engine (having four coupled driving-wheels and a four-wheel leading truck) was patented in 1836 by H. R. Campbell, of Philadelphia, and is extensively used in Europe as well as in the U. S. British express-engines have often but one pair of driving-wheels, 7 feet to 8 feet diameter, and have never more than two pairs, while in the U. S. they have never less than two pairs, and often three pairs for the heavy express-trains characteristic of North American railways. Freight-engines in Europe have generally six wheels, all coupled, while in the U. S. they have from eight to twelve wheels, with six to ten wheels coupled. In 1891 there were in the U. S. 32,139 locomotives, of which 8,901 were passenger, 16,696 freight, 4,321 switching, and 2,221 unclassified and leased. Of this total, 23,094 were fitted with train-brakes. In the compound locomotive the expanded steam from the high-pressure cylinder flows to a larger low-pressure cylinder, where it expands further before escaping to the atmosphere. This gets more work out of the steam, and effects an economy of 10 to 20 per cent. in fuel, the best results being obtained at moderate speeds. The invention dates from 1834, but the first practical engines were built in 1875 to the designs of A. Mallet, of France. Engines on the Mallet system have two cylinders, and can be run at will as simple engines by admitting steam direct to both cylinders. In the Worsdell (England) and von Borries (Germany) two-cylinder engines, live steam is only admitted to the low-pressure cylinder at starting, and is then shut off by an automatic intercepting valve. Four-cylinder compounds may be arranged with one pair of cylinders to each of two driving-axles (generally European), or with two cylinders on each side acting together in the same way as the usual single cylinder. Engines with two, three, and four cylinders are in service throughout the world, and in 1892 there were about 2,500 compound locomotives in use, of which over 500 were in the U. S., where they were more extensively used than in any other country. These U. S. engines are of various designs, but all with two or four cylinders, giving them extra power in starting, and on heavy grades, and are generally arranged to be run as simple engines at will. They are of all types and are used in every class of service. See LOCOMOTIVE.

Brakes.—In the U. S. hand-brakes have been almost entirely superseded on passenger-cars, and to a considerable extent on freight-cars, by continuous power brakes applied by the engineman to all the wheels of a train simultaneously. Power-brakes have been operated by air-pressure, vacuum, steam, hydraulic power, weights, springs, and electricity, but the two former are most generally used, and so applied as to act automatically in case of rupture of the hose connecting the train-pipes of the cars. The Westinghouse air-brake was first patented in 1869, and is universally used in the U. S. and largely in other countries. The vacuum-brake, dating from 1871, is used in many foreign countries, and is efficient, but is slower in action than the Westinghouse, and therefore not so well adapted for long, heavy, or fast trains. The Eames vacuum-brake is used on elevated railways in New York and Brooklyn, and air- and vacuum-brakes have been applied to horse-, cable-, and electric-cars. In 1887 George Westinghouse perfected his quick-acting freight-train brake, which will stop a fifty-car train at 30 miles an hour in 320 to 350 feet. Passenger-trains at 40 to 60 miles an hour may be stopped in 600 feet for the

former and 900 to 1,000 feet for the latter speed. In Feb., 1893, the U. S. Congress passed a law compelling the use of power-brakes and automatic couplers on freight-cars. Brakes are generally applied to the driving- and tender-wheels of American locomotives, and sometimes also to the engine-truck wheels. With the Westinghouse brake the engine has an air-pump, main reservoir, and engineman's valve ; and each car has a smaller reservoir, triple valve, and a horizontal brake-cylinder having two pistons connected by a spiral spring. A pressure of 70 to 80 lb. is maintained in the reservoir and train-pipe, the brake-cylinder being empty and the brakes off. When the pressure in the train-pipe is reduced (purposely or by a broken hose connection), the greater pressure in each car-reservoir moves the triple valve, opening a passage by which the air rushes to the brake-cylinder and forces the pistons apart, thus applying the brake-shoes forcibly to the wheels by means of a system of rods and levers. To release the brakes, air is admitted by the engineman's valve from the main reservoir to the train-pipe, moving the triple valves back, recharging the car-reservoirs, and opening an escape for the air from the cylinders, the pistons being then drawn back by the spring. With the vacuum-brake there is a steam-ejector and a brake-cylinder on the engine, and a vertical brake-cylinder and ball-valve on each car. A vacuum is maintained in the train-pipe and cylinders by the ejector, the piston then being at the bottom of the cylinder and the brake off. When air is admitted (purposely or by a ruptured hose), its rush moves the ball-valve, thus closing the pipe to the top of the cylinder, and the air-pressure therefore passes to the bottom, forcing the piston up and applying the brakes. When air is again drawn from the pipes and cylinders by the ejector, the ball-valve returns to its position, allowing the air to escape, and the brakes then come off by their own weight and that of the descending piston.

Car-couplers (Fig. 4).—The common form of coupling used in the U. S. is the "link and pin," consisting of a link with its ends resting in the hollow ends of the drawbars of the two cars, and held in place by a vertical pin through each drawbar. Coupling and uncoupling by hand is dangerous work, and in the year ending June 30, 1892, about 378 men were killed and 10,319 injured in it. Passenger-cars are generally fitted with the automatic coupler invented by Ezra Miller in 1863, and have also spring buffers, safety-platforms, and safety-chains. The Janney automatic coupler for passenger and freight cars was adopted by the Master Car-builders' Association in 1887. Each coupler has a vertical claw-shaped end with a movable knuckle, and when pushed together the knuckles interlock, and can not be pulled apart unless a vertical locking-pin is withdrawn, which can be done by a handle at the side of the car. The Miller hook-coupler is uncoupled by shifting the hooked drawheads sideways by a lever on the car-platform. In Feb., 1893, the U. S. Congress passed a law that by Jan., 1898, all freight-cars must be equipped with automatic couplers. In Europe passenger-cars generally have hooked drawbars connected by chains which are drawn tight by a screw, bringing into contact the long spring buffers at the ends of the cars. Freight-cars have either a similar coupling or a loose chain.

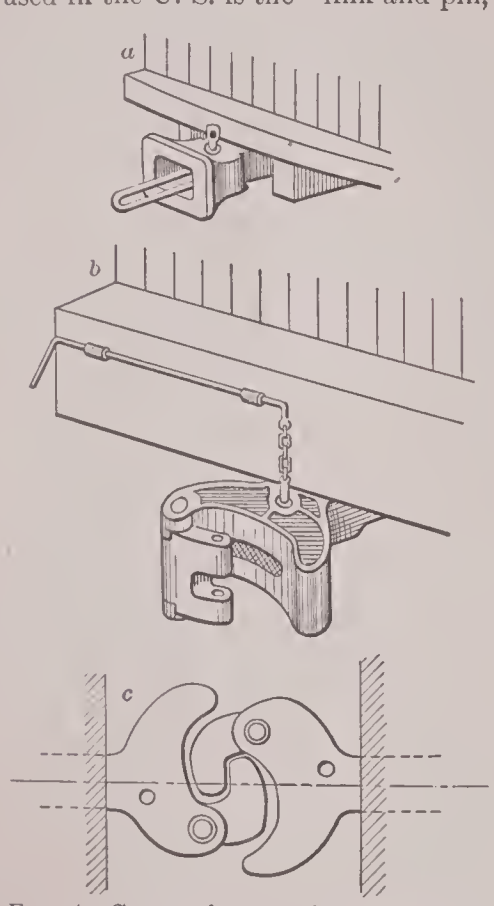


FIG. 4.—Car-couplers: *a*, link-coupler; *b*, Janney automatic coupler; *c*, top view of automatic couplers when coupled.

Car-lighting and heating.—Mineral-oil lamps are most used in the U. S., oil of 300° F. fire-test being the safest. In Europe vegetable oils are used, owing to the high price of kerosene, but they are inferior to the latter, and the cars are in general poorly lighted. Compressed oil-gas is extensively used in the U. S. and many other countries. The oil is distilled and vaporized in retorts, and the gas is forced into storage-tanks by compressor-pumps. It is then piped to the car-reservoirs, which usually hold 212 cubic feet at 150 lb. pressure, or enough for twelve lamps for sixteen hours. Gasoline-gas is used to a limited extent in the U. S. Electricity has been extensively experimented with, and is in use, but is expensive. It may be operated by storage-batteries, by a dynamo driven from a car-axle (with storage-batteries for use when the train stops), or by a separate engine and dynamo in one car. The ordinary stove has caused many fires in trains by being upset, especially in train-accidents, and in the U. S. its use is prohibited in some States. Improved stoves, with hot-water pipes, are used considerably, but the most approved system is that of leading steam from the engine through pipes in the cars, and it is very extensively used. In Europe stoves and steam and hot-water heating are used to a limited extent; but in Great Britain the primitive and inefficient plan of portable foot-warmers filled with hot water is the most common. The ventilation of American cars, especially sleeping-cars, is generally very poor, but in Europe fans and mechanical ventilators are largely used to draw out the foul air.

E. E. RUSSELL TRATMAN. A. M. WELLINGTON.

RAILWAY OPERATION: the conduct of the business of a railway, together with the methods and results of economic management. In all countries the government exercises the right to grant or refuse permission for the construction and operation of railways. The government may build and operate railways, as in France, Belgium, Germany, Australia, and South Africa, private lines being also generally permitted in the European countries. It may build and own the railways, but contract with private companies for their operation, as in France and Italy. It may own the railways, but allow private companies to construct and operate them, as to some extent in India. It may permit private companies to build, own, and operate railways, itself exercising a greater or lesser degree of control, as in the U. S., Great Britain, Canada, and many other countries. Railway companies claim that railways are purely private enterprises, but the courts in most countries have recognized them as being public highways, differing only in degree from roads or canals, the fact of a railway having its own equipment and using its collected tolls or rates for its exclusive use, not affecting the principle. The government assistance by land-grants, bonds, etc., is made in recognition of the railway as an improved highway. Abuses of railway management in the U. S. led to the "granger" movement in 1871, through which the granger or farmer element of the Northwestern States secured the passage of laws adverse to the railway companies, limiting rates and prohibiting discrimination. The resulting litigation led to an investigation by Congress, and in 1887 the Interstate Commerce Act was passed to regulate rates, prevent discrimination, etc., through the Interstate Commerce Commission. The principal executive head of a railway is the general manager, next to whom come the general superintendent (traffic), the chief engineer (civil engineering), and the superintendent of motive power (locomotives and cars), with their staffs of assistants. These attend to the handling of the business which is obtained through the general passenger agent and the general freight agent. In 1891 there were in the U. S. 784,285 railway employees (one man in 82, or over 1 per cent. of the entire population), exclusive of baggage-men and car-porters.

Traffic and Rates.—The relative importance of the passenger- and freight-traffic varies in different countries. Thus in Great Britain the proportion of freight to passenger earnings is about as 5 to 4, while in the U. S. it is about as 20 to 7. The following table, for 1890, gives the data from which this proportion is computed:

KIND OF EARNINGS, ETC.	United States.	United Kingdom.
Passenger earnings	$1,368,320,000	$171,640,000
Freight earnings	3,701,875,000	216,100,000
Miscellaneous earnings	360,000,000	17,000,000
Total earnings	5,430,195,000	404,740,000
Average rate per passenger	2·18 cts. per mile.	2·33 cts. per mile.
Average journey per passenger	24·18 miles.	7·20 miles.

There has been since about 1870 a steady reduction in rates in the U. S., due to the increasing competition, and in order to enable the railways to make a profit on their business the cost of transportation has had to be correspondingly reduced. This has been by (1) consolidation of railways and consequent lessening of expenses; (2) increase of locomotive power and mileage of each engine; (3) increase of capacity of freight-cars and decrease of proportion of dead load of trains; (4) improvements to track, terminals, etc. Passenger traffic does not show a similar reduction, owing largely to the increased weight of cars without increase in capacity. The following table may be instanced:

NEW YORK CENTRAL RAILROAD.	1875.	1891.
Rate per passenger mile.....cents	2·14	1·96
Expenses per passenger mile..... "	1·36	1·49
Rate per ton-mile..... "	1·27	0·74
Expenses per ton-mile..... "	0·90	0·57

Until about 1875 the railways made rates at their pleasure, making high rates on lines without competition to compensate for low rates on lines having competition, and discriminating between towns and individuals by special rates. This led to the enactment of the interstate commerce law (see INTERSTATE COMMERCE), which among other things prohibited pooling and discrimination. A pool is a combination of railways engaged in competitive traffic to maintain rates by suspending competition. The famous "long and short haul" clause forbids the practice of giving lower rates between certain widely separated points than are given to intermediate points, which are of course nearer together. Cheaper articles and the necessities of life must be carried at lower rates than expensive articles and luxuries, for the reason that the rates are necessarily based upon (1) cost of transportation (which varies with distance); (2) terminal charges (which are fixed rates); (3) market value of the freight. The reduction of passenger- or freight-rates does not necessarily mean a reduction of earnings, as the reduced rates may encourage additional traffic. The only correct basis of estimating the cost of railway service is the cost per passenger-mile and per ton-mile (or of hauling one passenger or one ton a mile), since it makes practically all the difference in cost of service whether they are hauled 1 mile or 100 miles. The car-mile may be used instead of the ton-mile. The zone-tariff system introduced in Hungary in 1890 divides the country into a series of belts or zones, with a uniform rate for each. Thus a person may travel a short or a long distance within any one zone for the same fare, but if his journey extends beyond its limits he must pay the rates for the two zones. It has caused a great reduction in rates and increase in traffic.

Train-dispatching.—This is the system of directing traffic most used in the U. S., by which the dispatcher at the principal station sends telegraphic orders to the agents or operators at the several stations. The operator writes out the order and hands a copy to the engineman or conductor of the specified train. The operator at the next stopping-place is notified to expect the train, and receives orders for its next movement. The principle is simple, but with heavy traffic, late trains, extra trains, etc., the operation is very intricate, and accidents are constantly occurring through carelessness, natural mistakes, or misunderstanding of orders. For the block system, see above (*Signals and Interlocking*); also the article BLOCK SYSTEM.

Loads and Speed of Trains.—Many of the long-distance express-trains in the U. S. are of very great weight, owing to the number of sleeping-cars, and such trains, with nine to twelve cars, weigh from 700,000 lb. to 950,000 lb. Short-distance expresses of four to six cars weigh from 280,000 lb. to 600,000 lb. Both light and heavy trains attain speeds of 45 to 60 miles per hour. In Great Britain the heavy trains of ten to fifteen cars weigh from 300,000 to 537,000 lb., while the lighter trains of about five cars weigh 168,000 lb. In other countries the train-loads resemble those of British trains, both in passenger- and freight-service. In the U. S. the freight-trains have from twenty-five to fifty large cars, and one of the heaviest trains ever hauled (Aug., 1892) consisted of forty cars carrying 2,640,000 lb. of grain. This train was 1,602 feet long and weighed 4,030,000 lb., including the engine, tender, and caboose. Trains of "fast-freight-line" cars with perishable freight are often run at as high speeds as passenger-trains, and the introduction of continuous freight-train brakes enables freight-trains to be run safely at much higher speeds than when hand-brakes alone had to be relied on, as is still generally the case in other countries. The highest records of express-train speed are held by the U. S., but the average speed (except on some of the principal lines) ranks below that of British express-trains, which have only to consider the signals and regular stops, while American trains have frequently to slow up for grade-crossings, etc. The fastest trains in the world are the Empire State Express and the Exposition Flyer, both of the New York Central Railroad, weighing about 140 net tons and 200 net tons respectively. The former runs daily between New York and Buffalo, 440 miles, in eight hours forty minutes, making four stops, or at an average speed of 51 miles per hour for the entire run. The latter ran daily between New York and Chicago during the summer of 1893, making the 980 miles in twenty hours, or at the rate of 49 miles per hour for the entire distance. Allowing for stops, slackening speed, etc., it is evident that very much higher rates of speed must be maintained in order to keep up the average, and 60 to 70 miles per hour are frequently made. With the former train in 1893 speeds were attained equivalent to 112 and 102 miles per hour; that is, a few miles were run in thirty-two and thirty-five seconds per mile. In the U. S. and Great Britain speeds of 50 to 60 miles per hour are of every-day occurrence, but in other countries the speeds are in general very much slower, and 50 miles per hour is a maximum very rarely attained on the Continent of Europe.

TABLE OF HIGHEST SPEEDS ON RAILWAYS.

RAILWAY.	Date.	Seconds per mile.	Equivalent to miles per hour.	No. of cars.	WEIGHT OF TRAIN IN LB.	
					Cars.	Engine and cars.
New York Central.....	May, 1893	32·0	112·0	4	340,000	540,000
" " "	May, 1893	35·0	102·0	4	340,000	540,000
Philadelphia and Reading...	Nov., 1892	37·0	97·3	4	280,000	485,000
" " " ...	Nov., 1892	38·0	94·8	4	280,000	485,000
Central of New Jersey.....	Feb., 1892	39·5	91·1	3	210,000	400,000
Philadelphia and Reading...	Aug., 1891	39·8	90·5	1	70,000	270,000
Northeastern (England).....	Jan., 1890	41·6	86·0	..	504,000	695,000
N. Y., West Shore, and Buffalo	July, 1885	42·6	84·0	3	153,660	310,960

Accidents.—In proportion to the extent of railway traffic, that is, the number of trains and passengers, the accidents are comparatively few. In the U. S. the train-dispatcher method of operation (the block system being but slowly introduced) is responsible for many accidents, great and small, particularly on railways having heavy traffic. In 1892 there were 2,327 train accidents, of which 1,062 were collisions, 1,165 were derailments, and 100 were from miscellaneous causes. The traffic that year amounted to 870,000,000 train-miles, and the number of persons killed on the railways was less than 1 for every 1,000,000 miles run by trains. The steady increase in the use of power-brakes and automatic couplers on freight-trains will tend to reduce very considerably the number of accidents to trains and to employees, and good discipline among the employees aids very materially in keeping down the number of accidents.

In Great Britain the train accidents have been reduced to a minimum by the enforced adoption of the block system, interlocking signals, and power-brakes, but, as in the U. S., many of the employees are killed in coupling and uncoupling cars. The following table shows the comparison between railway accidents of 1892 in the U. S. and Great Britain:

CLASS OF PERSONS.	Total number.	Number killed.	Number injured.	Killed, 1 in	Injured, 1 in
United States:					
Passengers.....	560,958,211	376	3,227	1,491,910	173,833
Employees.....	821,415	2,554	28,267	322	29
Others.....	.....	4,217	5,158	.....	.....
Total.....	.....	7,147	36,652	.....	.....
United Kingdom:					
Passengers.....	864,435,388	129	1,348	6,701,049	641,272
Employees.....	381,626	534	2,915	714	130
Others.....	.....	541	6,213	.....	.....
Total.....	.....	1,204	10,476	.....	.....

Relative Operating Expenses.—The following table, taken from Wellington's *Economic Theory of Railway Location*, was deduced by an analysis of the accounts of a large number of representative roads of the U. S. The various items of operating expense are expressed as percentages of the cost of running a train 1 mile, or a "train-mile," and the

table furnishes a good basis for comparisons irrespective of volume of business:

RELATIVE COST OF THE VARIOUS ITEMS OF OPERATING EXPENSES IN PERCENTAGES OF COST OF A "TRAIN-MILE."

				Per cent.
Train expenses, 47·0 per cent.	Engines, 18·0 per cent.	Road engines, 14·4 per cent.	Fuel	7·6
			Water	0·4
			Oil, etc	0·8
			Repairs	5·6
		Switching engines		3·6
	Train wages and supplies, 17·0 per cent.	Switching eng. wages		1·6
		15·4 per cent.	Eng. wages	6·4
			Car wages	8·5
			Car supplies	0·5
	Cars, 12·0 per cent.	Repairs and renewals		10·0
		Mileage (a practical equivalent for repairs)		2·0
Maintenance of way, 23·0 per cent.	Track between stations, 8·0 per cent.	Renewals of rails		2·0
		Adjusting track		6·0
	Road-bed, 7·0 per cent.	Renewing ties		3·0
		Earthwork, ballasting, etc.		4·0
	Yards and structures, 8·0 per cent.	Switches, frogs, and sidings		2·5
		Bridges and masonry		3·5
		Station and other buildings		2·0
Total of "line" or transportation expenses				70.0
Station, terminal, and general expenses and taxes				30·0
Total operating expenses				100·0

If $1 be assumed as the cost of a train-mile (i. e. 70 cents per train-mile transportation expenses proper), then these percentages will represent the cost of the various items per train-mile in cents. For any other cost per train-mile, either actual or assumed, multiply the items by this cost for its value in cents.

Operating Statistics.—The following statistics show the results of the operation of railways of the U. S. in 1891:

Single track, miles	161,275
Second track, miles	8,866
Third and fourth tracks, miles	1,562
Yard and side tracks, miles	35,742
Total of all tracks, miles	207,445
Total railway capital (45·28 per cent. stock, 49·24 per cent. funded debt, 5·48 per cent. other forms of indebtedness	$9,829,475
Passengers carried, number	531,183,998
Passengers carried 1 mile	12,844,243,881
Tons of freight carried, number	675,608,323
Tons of freight carried 1 mile	81,073,784,121
Passenger-train mileage	307,927,928
Freight-train mileage	446,274,508
Total train mileage	854,202,436
Average number of passengers per train	42·00
Average journey per passenger, miles	24·18
Average number of tons per freight-train	181·67
Average haul per ton of freight, miles	120·00
Revenue per passenger per mile	2·142 cents
Average cost of carrying one passenger 1 mile	1·910 "
Profit per passenger-mile	0·232 "
Revenue per ton of freight per mile	0·895 "
Average cost of carrying 1 ton 1 mile	0·583 "
Profit per ton-mile	0·312 "
Revenue per mile, passenger-train	106·111 "
Average cost of running a passenger-train 1 mile	80·453 "
Profit per passenger train-mile	25·658 "
Revenue per mile, freight-train	163·683 "
Average cost of running a freight-train 1 mile	106·172 "
Profit per freight train-mile	57·511 "
Revenue per train-mile, all trains	143·345 "
Average cost of running a train 1 mile	97·707 "
Profit per train-mile	45·638 "
Percentage of operating expenses to operating income	66·73 per cent.
Gross earnings per mile (26·1 per cent. passenger, 2·27 per cent. mail, 1·97 per cent. express, 67·4 per cent. freight, 2·18 per cent. other)	$6,800
Operating expenses per mile	4,538
Net earnings per mile	2,262
Net income per mile	682

See Poor's *Manual of the Railroads of the United States*, published annually, and Wellington's *Economic Theory of Railway Location* (New York, 1890). Also the articles MOUNTAIN-RAILWAYS and STREET-RAILWAYS.

E. E. RUSSELL TRATMAN.

Raimon'di, ANTONIO: geographer and naturalist; b. at Milan, Italy, in 1825. He went to Peru in 1850, and during the suceeeding twenty years visited every part of the republic, studying its geography, geology, and zoölogy; his last journey was through the region of the upper Amazon to the confines of Brazil. In 1873 he published a valuable account of the department of Ancach, dwelling particularly on its mineral riches. The Peruvian Government then engaged him to prepare a great work on the geography and natural history of Peru; three volumes on the geography, entitled *El Perú*, appeared in 1874, 1876, and 1880, and were to have been followed by others on botany, zoölogy, and ethnology; but the work was interrupted by the Chilian war, and when Lima was taken the printed portion of the fourth volume was destroyed. After the war Dr. Raimondi resumed his labors, but so much had been lost that there was much delay, and before new matter was ready for the press the author died at Lima, Dec., 1890. His manuscripts, maps, collections, etc., are in the possession of the Lima Geographical Society. HERBERT H. SMITH.

Raimondi, MARCANTONIO: engraver; b. at Bologna, Italy, 1488. He studied drawing in the school of Francesco Francia, and thus acquired the name of *Marcantonio del Francia*. He went to Venice as soon as he had acquired some proficiency in his art, and there he spent his savings in buying some plates after Albert Dürer, which he imitated so perfectly that his copies were taken for originals. Marcantonio then went to Rome and engraved a *Lucrezia* after Raphael, who got him to engrave, under his directions, the *Massacre of the Innocents*, *St. Cecilia*, and other works which brought him into great renown. Under Raphael's protection he founded a school for engraving. In 1527, during the sacking of Rome, he managed to save his life by giving up everything to the soldiers. A little before this he escaped another danger. For having engraved Giulio Romano's drawings illustrating the obscene sonnets of Aretino, Clement VII. had him put in prison, and only liberated him on account of his great talents. He then engraved for Baccio Bandinelli the *Martyrdom of San Lorenzo*. He is supposed to have been assassinated in Bologna in 1546. He engraved several Madonnas after Raphael, the *Life of the Virgin* in seventeen plates after Albert Dürer, the *Passion of our Lord*, *St. Paul preaching in Athens*, and many other biblical, historical, and mythological subjects, the greater part from drawings of Raphael. W. J. STILLMAN.

Raimundus Lullius: See LUL, RAIMON.

Rain: water falling in drops from clouds to the earth's surface. Rainfall, including rain, snow, hail, etc., depends on certain physical conditions and processes that are illustrated in a large way in the atmosphere. The amount of water-vapor that may exist in the atmosphere depends on the temperature of the vapor, and this depends, in turn, on the temperature of the air with which the vapor is mixed. It is therefore customary to speak of the *capacity* of the air for vapor. The capacity is small at low temperatures and rapidly increases in geometrical ratio at higher temperatures, doubling for a rise of about 18° F. at ordinary temperatures. When the capacity for vapor is satisfied, the air is said to be *saturated*. Saturation may be produced by the continual addition of vapor to a mass of air; and this condition is almost reached naturally in the excessively damp lower air of the doldrums or equatorial calms at sea; but as water-vapor slowly spreads or diffuses itself through the air, saturation is not usually attained in this way. It is more commonly attained by a reduetion of the temperature of a mass of air, already containing some vapor, until the capacity falls to equality with the amount of vapor present. The temperature then reached is called the *dew-point*, because any further cooling will eause the condensation of some of the vapor. Recent experiments, chiefly by Aitken, demonstrate that the condensation of vapor from damp air is favored, if not controlled, by the presence of excessive minute suspended particles, to which the term dust is rather inappropriately applied. Such particles are always present in the atmosphere. If condensation takes place above 32° F., the cloud-particles are minute droplets of water; if below 32°, they are spicules or crystals of snow. Much snow formed in the upper part of storm-clouds is melted into rain before reaching the ground. When a large mass of air is cooled, and a great cloud is formed, the initial cloud-particles may serve as centers of further condensation, or the smaller particles may coalesce to form larger ones. As snow-crystals appear to form by continual condensation of vapor about a single nucleus, it seems probable that rain-drops are likewise chiefly enlarged by continued condensation instead of by collision of separate droplets. As the cloud-particles fall, at first slowly, but faster as they grow still larger, they at last descend through and beneath the cloud-mass, and appear as rain or snow. There are various natural processes by which the air is cooled sufficiently to produce clouds and rain.

Mechanical Cooling of Air-currents by Expansion during Ascent.—Whenever a mass of air rises, either vertically or along an inclined path, the pressure upon it decreases; it expands and cools (see HEAT) at the rate of 1·6° F. for every

300 feet of vertical ascent. It is true that the capacity of the ascending and expanding air increases with gain of volume; but this is overcome by loss of capacity caused by decrease of temperature; hence if the ascent is carried far enough, clouds must be formed. When an ascending current of air becomes cloudy, the further cooling progresses at a slower rate than before, being retarded by the latent heat liberated from the condensed vapor. In this way the production of clouds and rainfall promote the ascent of the currents in which they are formed. Espy was the first to give this cause of rain its proper emphasis. The ascensional movement by which the air is cooled may be variously caused. It may be a spontaneous convectional ascent, dependent on the warmth and moisture of the lower air, and to this origin are ascribed the thunder-storms and violent cyclones of the torrid zone. The thunder-storms on land-areas of the temperate zone on summer afternoons are also convectional overturnings, their instability being generally dependent on warm southerly winds that flow obliquely toward the areas of low pressure (cyclonic storms) as well as on direct sunshine. It is chiefly in these summer storms that hail is formed, the freezing of the pellets being explained by the cooling of the active ascensional currents by which rain-drops are borne to a great altitude. The diurnal breezes that ascend mountain-slopes in fair summer weather frequently form clouds that grow to thunder-storms; thus many of the showers that are felt on the plains near the base of the Rocky Mountains are formed about the peaks of the front range.

The ascent of air-masses may in many cases be a constrained or driven ascent. Driven ascending currents are found where a general wind passes a mountain-range; hence mountainous districts are often rainy while the surrounding lowlands are dry (see DESERTS, PLATEAU, and SAHARA); hence the windward slopes of mountains receive a greater rainfall than the leeward slopes, as is illustrated in many parts of the world. (See chart of rainfall, article CLIMATE.) In the torrid zone, where the winds are prevalently from the east, the eastern coasts and mountain-slopes are well watered, as in Mexico and Brazil; but in the Indian monsoon region the western coasts are watered. (See WINDS.) In temperate latitudes, where the winds are prevalently from the west, the western mountainous coasts receive greater rainfall than the interiors, as on the Pacific coast of the U. S., British Columbia, and Alaska, compared to the interior of the continent; as on the Chilian slope of the Andes compared to the Argentine slope. The highlands of Western England receive more rainfall than the eastern lowlands; Norway is better watered than Sweden. Inasmuch as the general winds possess something of an eddy-like circulation around each of the several oceans, especially apparent in summer, and moving from left to right in this hemisphere, it follows that the southern coast of the U. S. receives the moist winds from the Gulf of Mexico, while in the Old World it is the northern slopes of the Pyrenees and the Atlas Mountains that receive the most rain.

The rainfall of the temperate zones that is received from cyclonic storms (areas of low pressure on the weather-maps) gives one of the most important examples of precipitation resulting from driven ascensional movements, according to the theory of the origin of these storms now generally accepted. They possess inflowing spiral winds beneath, outflowing clouds aloft, and heavy cloud-masses at intermediate altitudes from which much rain or snow is delivered. Hence an oblique whirling ascent of the inflowing surface winds is inferred about the central region. But as these storms occur in winter more frequently, and with greater strength, than in summer, they can not be well ascribed to spontaneous convectional overturnings like the tropical cyclones. They are better explained as gigantic driven eddies, resulting from the uneven flow of the general circulation of the atmosphere around the poles. On the lands, cyclonic storms are particularly rainy among mountains; indeed, it is generally only with the assistance of these stormy winds that the general winds are provoked to yield rainfall.

There is a certain altitude on mountain-slopes, varying with the season, at which the rainfall is heavier than either above or below. In the Alps, where the winter clouds hang low, the precipitation is greatest about 3,000 or 4,000 feet above sea-level in the colder season; but the mountains are not high enough to enable one to detect the altitude of greatest fall in summer. In the southern ranges of the Himalayas, on the other hand, the summer is the damper season; then the altitude of maximum rainfall is about 4,000 feet; while in the relatively dry winters it is estimated at about 20,000 feet.

An interesting contrast between the rainfall produced by the constrained ascent of air-currents over mountains and that caused by overturnings or eddies in the free atmosphere is that the first cause acts only over a rather definite and restricted area, while the second produces a trail of rainfall for hundreds or perhaps thousands of miles, as the storm-clouds are borne along in the general aërial currents. Thus the rains of wet-weather spells in the temperate zone may ordinarily be traced on the weather-maps while traveling from place to place, generally yielding greater rainfall over the ocean or along mountains than in the interiors or on lowlands, but continuing to water the surface more or less freely as they advance, as long as their commotion lasts. It may be seen from this that prognostics of rainfall based on the phases of the moon, or on the positions of the planets, which are the same for all parts of the world, can not have just application to a process that may be in operation in one place while absent from another.

In contrast to the cooling of ascending currents by expansion, there is the warming of descending currents by compression. Hence descending currents are prevailingly dry. Such are the anticyclonic weather-areas (areas of high pressure on the weather-maps), although local convectional showers may occur within them in summer. Such are the cold northern continental interiors of winter, in which the snowfall is very moderate, occurring only when a passing cyclone invades the region. Such are leeward mountain-slopes, where the air descends, clear and dry, after a cloudy and rainy ascent on the windward slope; as on many islands of the trade-wind zone, on the western slope of the equatorial Andes, the interior slope of the Sierra Nevada of California, and the southern slope of the Pyrences. Such are the tropical belts of high pressure, much interrupted by the lands, but more or less continuous around the oceans about latitude 30° or 35° in either hemisphere, although here local convectional action and passing cyclones may produce occasional rainfall.

Poleward Winds.—Air-currents flowing toward the pole generally become cloudy and rainy, as a result of cooling as they enter latitudes where sunshine is shorter and weaker, and where the surface of land or water over which they advance is colder than their source. The cloudiness and rainfall of poleward winds is especially favored in winter, when the poleward weakening of sunshine is rapid; it is favored when they blow from a warm sea over a cold land, as from the Gulf of Mexico or the adjacent Atlantic over the central or eastern parts of the U. S. in winter. On the other hand, this cause is weakened when poleward winds blow over warm summer lands, as the Mississippi valley in summer; for the lands may be for a certain distance warmer than the sea which the winds have left, and during a considerable distance of poleward advance the diurnal supply of sunshine may increase instead of diminishing. (See *Solar Climate*, under article CLIMATE.) It is noteworthy that nearly all poleward winds that yield rainfall are members of cyclonic storms, and hence that this cause of rainfall is for the most part only supplementary to the one already considered. On the other hand, equatorward winds are prevailingly dry, and the regions where they prevail, or the weather periods in which they occur, are comparatively rainless. Hence in the U. S. the dryness of the northerly winds which blow in the after part of the cyclonic areas, although flurries of rain or snow are often formed in them to leeward of the Great Lakes. Hence the dryness of the trade-wind belts, as long as the winds are not constrained to rise over mountains; hence the belts of greater salinity in the oceans (see OCEAN) and the deserts of the torrid zone are thus determined. Hence the aridity of coastal lands that are situated under the equatorward members of the wind-eddies that blow around the several oceans, as Lower California and Northern Chili, in spite of their being near the sea.

Mixture of Two Air-masses.—It is possible to produce condensation of vapor by mixing two masses of air, both saturated, but of unlike temperatures. The cause of rainfall was suggested by Hutton in the eighteenth century, but it is now regarded as ineffectual. It is true that some condensation must result from such a process, but the process must be of rare occurrence, because when two air-masses of different temperatures are brought together it is extremely improbable that they will both be saturated. If one wind be relatively dry, mixture may even result in dissolving the clouds of the other wind. Moreover, under the most

favorable assumptions, this process can not account for the large amount of rainfall frequently yielded from cyclonic areas in the U. S.; the part it plays in rain-making must be subordinate. Indeed, when it is remembered that damp winds are brought to saturation not by the addition of water-vapor, but more generally by some process of cooling, it is more reasonable to ascribe nearly all rainfall to a continuation of the processes of cooling, which are effective in producing clouds and rainfall as long as they last, instead of ascribing it to mixture, which can cause but little condensation at best, and whose cause of condensation ceases as soon as the mixture is completed.

Measurement and Record of Rainfall.—Rainfall is collected and measured by the rain-gauge, a cylindrical vessel of diameter advisedly not less than 6 inches, having a sharp upper rim and a vertical interior surface, converging below to a funnel, beneath which the gathered fall is protected from loss by evaporation. The gauge should be placed in open ground, removed from trees and buildings by a distance at least as great as their height. It should be securely fastened to avoid being overturned by the wind. Much care should be taken to select a place for the gauge where its surroundings will remain long unchanged. The rainfall is poured from the gauge into a vessel of smaller diameter, so that its depth is increased; it is then measured by a slender rod, properly graduated. Self-recording gauges are made, by which record is kept of the time and rate of fall of every shower. Snow is difficult to measure, as it is liable to gain or loss by drifting. The gathered snow is melted by adding a known amount of warm water, the total then being measured as before.

A hundredth of an inch or more of rainfall is taken to define "a rainy day." The total rainfall and the number of rainy days in each month and the year, the date of the first and last snow, and the amount of snow on the ground at the end of each month, are desired for rainfall records. Rainfall records vary greatly. Certain regions, like Arizona, may have no rain for months; others, like Western Scotland, may have many rainy days all through the year. In high latitudes the rate of fall is moderate; in hot regions excessive falls occur within brief periods, extreme falls being known as "cloud-bursts." Heavy falls cause great destruction by flooding rivers, as in Pennsylvania, May 30–June 1, 1889, when 8 inches fell over an area of 12,000 sq. miles. In Northern India, Sept. 17–18, 1880, 10 inches fell over an area of 10,000 sq. miles. In regions having under 18 inches of rainfall annually agriculture can not be safely practiced without irrigation; in such regions the fluctuation of the amount of rainfall from year to year is a large part of the total, thus giving rise to serious disasters or famines.

The distribution of rainfall over the world is illustrated in a map under the article CLIMATE (*q. v.*); it may be briefly classified as follows: First, a strong contrast between the torrid zone and the polar regions, the latter having a lighter fall because of the slow loss of capacity when air cools at low temperatures. Second, a contrast between continental borders and interiors, in favor of the former. Third, a contrast between high and low lands, with greater rainfall on the former. Fourth, a contrast between the windward and leeward mountain and continental slopes, the latter being drier. In all this it is perceived that the distribution of rainfall is not a fortuitous matter, but that it is closely dependent on the fixed order of nature. This is still better seen when comparing the distribution of rainfall and the general circulation of the winds. Around the belt of equatorial calms there is a plentiful rainfall, usually in the form of late diurnal showers or thunderstorms. The trade-wind belts are prevailingly dry, except where the winds rise over mountains, then giving what is called a tropical rainfall, as on the mountains of Brazil and Guiana. A supplementary cause of rainfall in this belt is found in the tropical cyclones that traverse it in the late summer. The stormy westerly winds have frequent showers or spells of rainy or snowy weather from passing storms, the amount decreasing toward the poles and toward continental interiors, and locally increasing on the windward mountain slopes. In consequence of the annual march of the sun and the associated shifting of the wind-system, the above simple scheme of rainfall may be further subdivided: First, the equatorial rain-belt travels N. and S. after the sun, thus extending its influence over a sub-equatorial belt. Along the axis of this belt there are two rainy and two dry seasons each year, as at Quito and in the Gulf of Guinea, but this subdivision is not apparent all around the world. Near the margin of the sub-equatorial belt there is a single rainy season followed by a longer dry season. Thus the equatorial forests of Africa and South America with plentiful rainfall lie between belts of more open country having a wet and dry season, and these open belts gradually merge into the deserts of the trade-winds so conspicuous in the Sahara. The annual overflow of the Nile depends on the northward march of the equatorial rains into the mountains of Abyssinia; the wet season of the llanos of Venezuela depends on the northward march of the rains from the Amazon valley. Second, the vague division between the trade-winds and the westerly winds, known as the horse-latitudes on the oceans, or the meteorological tropics all around the world, migrates N. and S. over a belt of variable width, called the sub-tropical belt; here the summers, chiefly under the control of the steady trades, are dry, while the winters have a sufficient rainfall from the passing cyclonic storms of the westerly winds. The winter rains of California, Spain, and the Mediterranean countries in the Northern Hemisphere, and of Chili, South Africa, and Southern Australia in the Southern Hemisphere, are all of this character. It is thus seen that the Sahara has rain on its northern and southern margins in winter and summer; the intermediate belt of absolutely no rain is very narrow, if existing at all. Finally, the rainfall of the westerly winds is greater on the western coasts in winter, when the cyclonic storms are stronger, but greater on the interiors in summer, when local convectional storms are more active. Thus Norway and British Columbia have more rain in winter, but Nebraska and Russia have more in summer. Florida is peculiar in lying in the latitude of the subtropical belt, but in having rainy summers, as if by local convectional action.

Rain-making.—The great loss to agricultural interests occasioned by droughts, and the limit set to agricultural occupation by the insufficient rainfall of arid regions, has at various times given rise to speculations and experiments concerning the artificial production of rain. It is unfortunate that the net result of all these efforts leads only to the conclusion that the order of nature can not be changed by any such means as have been proposed. The experiments may be divided into two classes—the first, including those which look for immediate results; the second, those which hope for a gradual but permanent improvement of the climate.

Under the first heading are fires and explosions. Fires were suggested by Espy as a means of establishing an updraught by which a more general convectional overturning of the air might be excited, and thus clouds and rain produced. It may, perhaps, be admitted that at times when the processes of nature are about to begin this operation it might be locally hastened by a considerable conflagration; but there is no reason to expect that combustible material can be supplied in sufficient amounts to produce valuable results. The favorable examples quoted by Espy would long ago have been repeated if the gain of the experiments had been more than their cost.

Explosions of cannon, dynamite, oxyhydrogen balloons, etc., have been proposed as a means of provoking rainfall, because battles have often been followed by rain-storms. This theory had been advocated particularly by Powers, and has thus secured congressional aid in the U. S. The relation of rainfall to battles appears to be highly fortuitous; no valid argument can be based on the facts as now reported. No shadow of evidence has been presented to show that the rain that occurred a day or two after a battle had its beginning over an area in any way related to the battle-field; indeed, the presumption is strongly in favor of the rain having begun at some indeterminate distance away from the battle-ground, perhaps even before the battle, and having reached the battle-field after the fight fortuitously, on its drifting course.

Other fanciful speculations might be quoted. There is no physical reason for thinking that explosions can cause the condensation of water-vapor into clouds and rain. The governmental experiments carried on in Texas by Dyrenforth in 1891, by which governmental science was seriously discredited, caused an excessive noise, but produced only a few drops of rain, and that only when rain-clouds previously formed drifted over the place of firing. Not the least care was taken by the experimenters to determine the place and time of beginning and subsequent movement of the rain-storms that in a few cases visited the field of experiment after firing had been many hours or days in progress.

The chief process by which a permanent improvement of an arid climate is hoped for is tree-planting. The belief in the efficacy of this process appears to be based on the misinterpretation of various facts concerning the relation of forests and rainfall. For example, the greater population of certain arid districts bordering on the Mediterranean has been ascribed to a formerly better climate, and the change from the former to the present time has been attributed to the deforesting of the region. There is, however, in the first place, no sufficient proof that the region has ever been seriously deforested by man; and no proof, in the second place, that the injurious change of climate has not been a natural one, under which the former tree-growth as well as the former greater population has naturally and gradually decreased. Again, excessive tree-cutting, as in Savoy and elsewhere, has allowed the rainfall to wash the soil from the mountain-slopes into the valleys, greatly to the injury of plant-growth in both places; it has also caused an excessive variation of stream-volume, between sudden floods at times of rain and dwindling streams in drier spells and seasons; but it is not shown that the destruction of trees has decreased the rainfall. There are indeed very few accurate records which can be appealed to in evidence of any such connection, and no decisive results can be claimed in any case. It is, therefore, premature to conclude that the climate of a region can be changed by planting trees, even in great numbers; but, on the other hand, it is highly probable that whatever rain falls would be better saved for springs and streams in a region with a good proportion of forest than in a barren region; and that the injurious action of hot winds and droughts, such as afflict the western part of the Mississippi basin, would be diminished if trees could be induced to grow there in abundance; but this need not be expected in a naturally semi-arid and treeless region, unless by aid of extensive irrigation. W. M. Davis.

Rainbow [O. Eng. *regenboga*: Germ. *regenbogen*]: a well-known optical meteorological phenomenon consisting of an arch of concentric colored bands arranged in the prismatic order, violet being innermost. It is sometimes simple, and sometimes accompanied by an outer, secondary bow, which is broader and fainter than the primary, and has its colors in the reverse order. A rainbow occurs when the sun or moon, not far above the horizon, throws its beams upon a sheet of falling drops on the opposite side of the heavens. A beam of light from the sun S falls upon a raindrop obliquely at R (Fig. 1, *a*); a portion is reflected; the remainder,

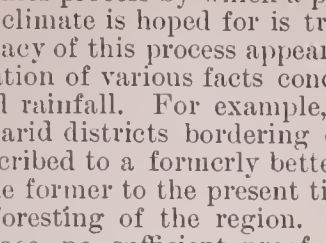


Fig. 1, *a*.

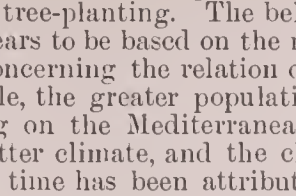


Fig. 1, *b*.

passing into a denser medium, is refracted toward the normal R C (see Refraction) and converged to a point; at A the portion not transmitted is reflected and diverges; at R' the beam is again refracted *from* the normal R' C, and reaches the eye at E. The rays of light emerging are usually so greatly dispersed as to be practically invisible. Calculation proves that for certain angles of incidence the emergent rays form a beam of rays distinctly visible; such rays are called effective rays. These rays emerge, not as white light, but they are spread out by the drop into their component colored rays. (See Light.) The angles of incidence and emergence vary for each color. After one internal reflection and two refractions the deviation of the violet ray forms an angle of 40° 13'. The deviation of the red from the same cause is 42° 39'.

Draw a line E D (Fig. 2) parallel to the sun's rays S A, S B, etc. (they being practically parallel with each other). Let the eye E take such a position that the angle A E D shall equal 40° 13'—the angle of deviation of the violet ray after two refractions and one internal reflection. S A E equals A E D, being alternate angles. The eye E therefore receives from the drop A a violet ray, while the other colors of the same dispersed ray fall below it. The angle of deviation of red is 42° 39'—2° 26' greater than violet. A drop B, 2° 26' above A, sends to E a red ray; all the effective intermediate rays produce the intermediate colors in their order. Every other drop in the sheet of falling water which has the same obliquity to the eye E as the drop A will also send to it a violet ray. The only drops which fulfill this condition are those which would define the base of a right cone whose apex is the eye, and the center of whose base is in a right line pass-

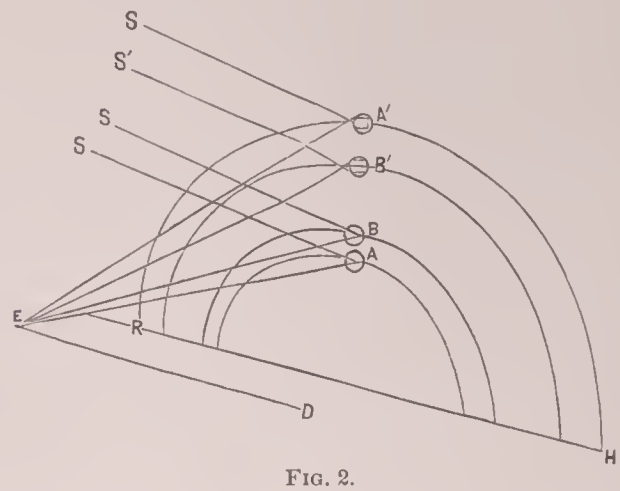


Fig. 2.

ing through the sun and the spectator's eye. The violet rays then, and all the other colors in their order concentrically arranged, form, when the sun is at the horizon, a semicircle, and when he is higher a proportionally smaller segment of a circle. The whole circle could be visible only to a spectator on the top of a very high and narrow peak, which elevated him while it did not obstruct the light. At a definite distance above the drop A and its series is another, B', at such an angle to the eye E that a red ray, after two refractions at R, R' and two reflections at A, A' (Fig. 1, *b*), is sent to E, and in the same way the other colors of the secondary bow. The angle of deviation of red, after two refractions and two reflections, is smaller than violet; red, therefore, is the innermost color of the secondary bow; the difference between the angles of the deviation of the extreme colors in this bow is greater than in the primary; it is therefore broader. The rays have been reflected one more time; it is therefore fainter. If the sun were a mere point, the primary bow would be 2° 26' wide from violet to red. The mean angular diameter of the sun is, however, 32', and each ray of light proceeding from it forms a separate bow, which partially overlaps, the violet apparently projecting 16' beyond the inner and the red 16' beyond the outer edge. The colors, being intermingled in the myriads of superimposed bows, are much modified. Between the primary and secondary bows are sometimes seen concentric bands of red, growing fainter and narrower as they approach the secondary; this phenomenon is explained by interference. (See Interference.) The lunar bow is like the solar, except that the colors are less distinct—sometimes not at all distinguishable, when it appears as an arch of white light. See Halo.

Revised by R. A. Roberts.

Rainey's Corpuscles: elongate protozoans belonging to the *Sarcosporida* (see Sporozoa) which occur as parasites in the muscles of birds, the pig, rat, etc. They vary in length from individuals of microscopic size up to those an eighth or even half an inch in length. D. S. J.

Rainfall: See Rain and Climate.

Rain-gauge: See Rain (*Measurement and Record of Rainfall*).

Rainier, rā-neer', **Mount**: a volcanic peak standing alone on the western slope of the Cascade Range in the State of Washington. Within a small crater at the top there is some solfataric action, suggesting that the volcano may not be extinct; but the date of the principal eruptions is so remote that subsequent erosion has scored the sides of the cone with deep cañons. In these are a series of glaciers, the largest in the U. S. south of Alaska. The mountain rises about 9,000 feet above its base, and its summit is 14,400 feet above the sea. Its lower slopes are densely wooded. Vancouver, the navigator, named it in honor of Admiral Rainier, of the British navy. Current usage is divided between this name and Tacoma.

Rains, Gabriel James: See the Appendix.

Rains, George Washington: See the Appendix.

Rainy, Robert, D. D.: minister and professor; b. in Glasgow, Scotland, Jan. 1, 1826; was educated in Glasgow University and New College, Edinburgh; minister of Free church, Huntly, 1851–54; of Free High church, Edinburgh,

1854–61; since 1861 Professor of Church History in New College, and since 1873 principal. Besides pamphlets and contributions to periodicals, Dr. Rainy has published *Three Lectures on the Church of Scotland* (Edinburgh, 1872; several later editions); *The Delivery and Development of Christian Doctrine* (Cunningham Lectures, Edinburgh, 1874); *The Bible and Criticism* (London, 1878); and *The Epistle to the Philippians* in *The Expositor's Bible* (Edinburgh and New York, 1893). C. K. Hoyt.

Rainy Lake: a large lake on the boundary between Minnesota and Canada; receives the waters of the Nameken and many other rivers, and discharges its own waters through Rainy Lake river into Lake of the Woods. It is in a marshy region, with few inhabitants. It abounds in small islands, and contains a great supply of fish of several species. Elevation, 1,035 feet.

Raisins [from O. Fr. *raisin*, cluster of grapes, grape, raisin: Ital. *racemo*: Span. *racimo* < Lat. *race'mus*, cluster of grapes or fruit, whence Eng. *raceme*]: the dried fruits of the sweeter sorts of grapes, grown in warm climates, and mostly dried in the sun. As this requires a practically rainless period of several weeks, the production of raisins on a commercial scale is limited to a few specially favorable climatic regions —viz., the south of Spain, Asia Minor, Greece, a portion of Calabria and Sicily, Southern California, and Chili. Three kinds of grapes are commonly used in making the raisins of commerce. The large Spanish raisins are made chiefly from the white *Muscat* (Muscat of Alexandria), in the provinces of Malaga and Valencia. The medium-sized or small, light-colored, seedless raisins of commerce are the fruit of the prolific *Sultana* grape, grown in Asia Minor and the Ionian islands; while the smallest of all, the so-called currants (properly *Corinths*), are derived from a very small berried but large bunched grape, grown in the same region, of which there is a black and a white variety, the former being the one generally used; hence the "black currants" of Zante. Raisin-grapes must be pulpy, and should acquire not less than 28 to 30 per cent. of sugar in their juice.

Drying in the sun is sometimes begun on the vine, the stalk being half cut. Mostly the fully ripe bunches are cut and spread (in Spain) on gravel-beds sloping toward the sun, and covered over at night or in case of rain; they are turned from time to time, avoiding the abrasion of the "bloom" as much as possible. In California, trays of wood or felt, set on the ground during the day and "stacked" and covered at night or in case of rain, are used; turning is done by inverting the full tray, previously covered with an empty one. The drying is frequently finished, or at times even entirely done, in ventilated drying houses or chambers, of which the temperature can be accurately regulated. In Greece and Asia Minor the bunches are sometimes hung on lines or spread on platforms. After drying, the moisture-condition of the small and large berries is equalized by placing the bunches in "sweating-boxes" while still warm. As large, complete bunches bring the highest price, such are carefully picked out from the first, and sometimes placed singly in ornamental paper packages. The next quality is packed, while still warm, into the well-known boxes containing about 20 lb., forming the several grades of "London layers"; lower qualities are detached from the stems and packed as "loose raisins" in barrels or bags. When the color of the stems is dark instead of light cinnamon, rain has fallen on them during drying and the commercial value is much diminished. In Greece and Asia Minor the berries are sometimes dipped in weak lye to facilitate drying, and some salt and oil is mixed with the raisins, which are, of course, devoid of bloom.

The raisin-product of California in the year 1892 was about 60,000,000 lb., and the area of raisin-culture is increasing rapidly, while that of Spain is diminishing in consequence of the ravages of the phylloxera. E. W. Hilgard.

Rajah [from Hind. *rājā* < Sanskr. *rājan-*, king; cf. Lat. *rēx*, king]: a title of many princes in the East, assumed by many of the Rajput caste, and by the great landowners, even of low caste. Many princes have assumed the title *mahârâjâh*, or great rajah.

Rajmahal: See Dravidian Languages.

Rajputana [deriv. of Hind. *rāj-pūt*, prince, son of a rajah < Sanskr. *rāja-putra*; *rājan-*, king + *putra-*, son]: the collective name of twenty native states of India, under the protection of the Indian Government, ruled by rajahs, covering an area of 130,268 sq. miles, mostly desert or semi-arid plains; E. of the lower Indus and S. of the Punjaub. Through the east run the Aravalli Hills, and fertile districts watered by streams from these hills contain the two largest and finest towns, Jaipur and Jodpur. The Thar, or great sandy desert of North India, lies in the west. The southeastern region is the most fertile. The chief British agent regulating these states resides at Ajmere, a small territory under the direct rule of the viceroy. Nine-tenths of the people are Hindus, and the Rajputs among them number only about 800,000, but they are the ruling element, and give their name to the territory. Pop. (1901) 9,811,032. C. C. Adams.

Rákóczy, rā̆a-kōt'sĕĕ: a celebrated Hungarian family, extinct in the male line. Francis II., Prince of Transylvania, b. in 1676, was a son of Francis I. and Helena Zrinyi. The father, early elected Prince of Transylvania, never occupied the throne; he died a few months after the birth of his son. Francis II. was educated from 1688 at the Austrian court and in Prague by the Jesuits, but continued a Protestant. After his marriage with a daughter of the Landgrave of Hesse he lived on his estates in Upper Hungary, but, suspected of conspiring against the Austrian Government, he was carried to Vienna in 1701 and confined in a dungeon. He escaped, fled to Poland, and lived in retirement until in 1703 he joined the Hungarian revolutionists. He proclaimed the independence of Hungary, and was placed at the head of the Hungarian confederacy, but was defeated in 1708 and fled to Poland. The peace of Szathmár (1711) marked the overthrow of the revolution. Rákóczy refused to accept this peace, and in consequence was excluded from the amnesty. He lived for a few years in France, and then went to Turkey, where he died at Rodosto, Apr. 8, 1735. He wrote *Mémoires sur les Révolutions de Hongrie* (The Hague, 1738).

Rákóczy March: a national air of Hungary and Transylvania, by an unknown composer, named in honor of Francis Rákóczy II. It has played a similar *rôle* in the history of Hungary to that played in the history of France by the *Marseillaise*, the anthem of the French Revolution.

Rákos: See Budapest.

Râle, raal [= Fr., liter., a rattling in the throat]: the rustling sounds heard in the lungs in various diseases. They are whistling, cooing, or wheezing in character when they are caused by spasm or narrowing of the bronchial tubes or small bronchioles; and crackling, bubbling, or gurgling in character when there is liquid exudation in the air-passages.

Rale, raal, Sébastien: missionary; b. in Franche-Comté, France, in 1658; became a Jesuit and a teacher of Greek in a college at Nîmes; went to Canada as a missionary 1689; labored at the Abenaki mission of St. Francis, near the falls of the Chaudière, and among the Illinois Indians, and settled in 1695 at Norridgewock on the Kennebec river, Maine. He built a church, converted many of the Abenaki Indians, learned their language, and acquired so great an influence that he was believed by the English settlers to be the cause of the frequent border forays. A price was set on his head, and the Indian village of Norridgewock was several times attacked; Father Rale's church was burned by Capt. Hilton in 1705, and having been rebuilt, was again destroyed in 1722, when the missionary escaped to the woods, but his papers were carried off. A third expedition from Fort Richmond surprised Norridgewock Aug. 2, 1724, and Father Rale was shot. Among his papers carried off in 1722 was an Abenaki dictionary, preserved in the library of Harvard College, and edited with notes by John Pickering in the *Memoirs* of the American Academy of Arts and Sciences for 1833. A *Life* of Father Rale forms a part of vol. vii., series 2d, of Sparks's *American Biography*.

APPENDIX.

Opzoomer, op'zō-mer, CORNELIS WILLEM: philosopher and jurist; b. in Rotterdam, Holland, Sept. 20, 1821; studied jurisprudence in Leyden, and attracted, even while a young student, much attention by his *Letter to Da Costa* and *Examination of the Annals of Dutch Theology*, in which he attacked the so-called orthodox dogma; was appointed Professor of Philosophy at the University of Utrecht in 1846, and acted as a leader in all movements of reform and progress in politics, religion, and science. His principal works are *Wetenschap en Wijsbegeerte* (1857): *Het Wesen der Kennis* (1863; 2d ed. 1867); *De Godsdienst* (1864).

Orangeburg: city; capital of Orangeburg co., S. C. (for location, see map of South Carolina, ref. 6–E); on the North Edisto river, and the South Carolina and Georgia Railroad: 51 miles S. of Columbia, 80 miles N. W. of Charleston. It is in an agricultural region; is an important market for cotton, rice, turpentine, and lumber; has a variety of manufactories; and contains Claflin University (non-sectarian, founded on the national land grant, and chartered in 1872), the State Agricultural College, two State banks with combined capital of $136,032, a private bank, and two weekly newspapers. Pop. (1880) 2,140; (1890) 2,964; (1900) 4,455.

Orange City: town (founded in 1870); capital of Sioux co., Ia. (for location, see map of Iowa, ref. 2–C); on the Chi. and N. W. Railway; 42 miles N. of Sioux City. It is in an agricultural and hog-raising region, is the seat of the Northwestern Classical Academy (Reformed, chartered in 1882), and has a State bank with a capital of $75,000, 2 private banks, and 3 weekly newspapers. Pop. (1880) 320; (1890) 1,246: (1900) 1,457.

Orinoco River The U. S. ship Wilmington made a trip up the Orinoco early in 1899 in the interest of American commerce. A correct chart of the river for the uses of navigation was made from the bar off Barima Point to Ciudad Bolivar. The ship reported that no charts had been made of some of the delta streams, including the San Juan river, and that the ships and cargoes of business enterprises established there were consequently endangered. The Orinoco is 20 miles wide at its mouth, and flows over an immense bar which it took the Wilmington an hour to clear. There are no steering-marks, lights, or lighthouses on this part of the Venezuelan coast. Considerable American interests have been established on or near the Orinoco, such as the Imataca iron mines, on the Imataca river, 5 miles above its confluence with the Orinoco. The mines are rich in ore of excellent quality. At Santa Catalina, on the river of that name, 3 miles from the Orinoco, is the headquarters of a company having a concession from the Venezuelan Government authorizing it to exploit 20,000 sq. miles of territory in the Orinoco valley. Much research has been carried out, and various enterprises, including mining, will be undertaken. The main product as yet is balata, a substitute for rubber. Barrancas, half-way to Ciudad Bolivar, has become an assembling and shipping point for cattle, most of which are sent to Cuba. St. Felix, above Barrancas, is the point of departure from the river for miners bound for the El Callao gold district, 150 miles distant. More than $40,000,000 in gold has been shipped from St. Felix in recent years. In 1897 Major Stanley Paterson, of England, spent several months on the Orinoco and its tributaries above Ciudad Bolivar, studying commercial opportunities. He reported that the country is of great value. "The rich rolling savannas," he wrote, "will support countless herds of cattle and horses. The forests yield large quantities of natural products, such as rubber, quinine, and other commodities. The upper waters of the Guanimo tributary are so affected by the sarsaparilla growing profusely along the banks that the natives drink the water and bathe there to cure skin diseases." He named many varieties of commercial woods, including mahogany and cedar, and several varieties of plants yielding rubber. The Orinoco has one tributary, the Guaviare, with an extent of navigable waters at least equal to that of the main stream, which, with its affluents, presents a navigable highway from the Atlantic to the foot of the Andes. Minister Loomis wrote to the State Department from Caracas that the visit of the Wilmington would undoubtedly stimulate U. S. commerce on the Orinoco.

C. C. ADAMS.

O'Shea, M. VINCENT, B. L.: educator; b. in Le Roy, N. Y., in 1866; prepared for college in Le Roy Academic Institute; B. L., Cornell University, 1892; Professor of Physiology and Pedagogy, State Normal School, Mankato, Minn., 1892–95; Professor of Educational Psychology and Child-study, Teachers' College, Buffalo, N. Y., 1895–97; Professor of the Science and Art of Education, University of Wisconsin, 1897; author of numerous magazine articles.

Ostend Manifesto: a memorandum regarding the acquisition of Cuba, drawn up by the U. S. ministers to England, France, and Spain in 1854. By the early fifties the slavery controversy in U. S. history had reached an acute stage. The Whig party had broken up with Scott's defeat. The Free-soil party was comparatively small. The Republican party had not yet appeared. The Democratic party was already preparing for the Kansas-Nebraska affair, which was to lead to Democratic disruption and the civil war. Territory for slavery was and had been the great desideratum of the Southern statesmen. Toward the lands southward, Mexican, Central American, or insular, these statesmen east longing eyes. Various filibustering expeditions—all unsuccessful—to Cuba and Nicaragua characterize the decade 1850–1860. But a more direct stroke than a filibustering expedition was now contemplated. The South had a sympathizer in the White House, President Pierce. His minister to Spain, Pierre Soulé, of Louisiana, was a French refugee from the restoration period; he had adopted the extreme political views of the section in which he had settled, and he was now the soul of a conference of diplomatists summoned by the President to discuss the acquisition of Cuba. A recent expedition was fresh in mind. Fears existed that Cuba might develop into another Santo Domingo. And the political and commercial aspects were ever present. Soulé, with his associates, James Buchanan, minister to England, and John Y. Mason, minister to France, deliberated at Ostend and later at Aix-la-Chapelle. They signed a memorandum which embodied their views, and is known as the Ostend Manifesto. It was sent to Secretary of State Marcy, and several months later was transmitted to Congress and published. Its substance is: The ministers urge the purchase of Cuba from Spain for $120,000,000. The island is regarded as necessary to the U. S., and the sale as advantageous to Spain. If the offer is refused, then "self-preservation is the law of nature." It will be necessary to consider whether Cuba is not essential to the welfare of the U. S. If this question is answered in the affirmative, then the U. S. is "justified in wresting it [Cuba] from Spain."

The manifesto was sharply criticised in the U. S. and unfavorably noticed abroad, in the London *Times* and elsewhere. It was denounced in the first Republican national convention in 1856, and was not expressly made a party plank by the Democrats. Historically it may be viewed in two lights: as a link in the chain of the slave power, whose development so greatly antagonized the North, and as a bold step in the path of territorial expansion.

EDMUND K. ALDEN.

Otis, ELWELL S.: soldier; b. in Maryland, Mar. 25, 1838; educated at Rochester University; studied law at Harvard College, and had just been admitted to the bar when the

civil war broke out. He entered the army as a captain in 1862, and became lieutenant-colonel Dec. 23, 1863, participating in all the general engagements of the Fifth Corps of the Army of the Potomac from 1862 to 1864, and was mustered out Jan. 24, 1865. On Mar. 13, 1865, he was breveted colonel of volunteers for gallant and meritorious services in the battle of Spottsylvania, and brigadier-general of volunteers for gallant and meritorious services in the battle of Chapel House. On July 28, 1866, he was appointed lieutenant-colonel of the Twenty-second Infantry, and on Mar. 2, 1867, was breveted colonel. He served as acting inspector-general in the department of Dakota from Mar. 16, 1874, to Jan. 26, 1876. On Feb. 8, 1880, he was appointed colonel of the Twentieth Infantry. He served as commandant of the U. S. Infantry and Cavalry School from Nov. 14, 1881, to June 29, 1885. He was appointed brigadier-general Nov. 28, 1893, and was in command of the department of the Columbia 1894–98, when he took command of the department of the Colorado. On May 4, 1898, he was nominated major-general, and on July 15 sailed in command of the fourth Manila expedition. On Aug. 30, 1898, he assumed control of the department of the Pacific, and on Sept. 16 was made acting military governor of Manila. He was succeeded by Gen. McArthur Apr. 7, 1900, and was placed in command of the department of the Lakes, Chicago.

Ottawa University: an institution of learning in Ottawa, Kan.; incorporated in 1865 jointly by the Baptists of Kansas and the Ottawa Indians, who were at that time occupying a reservation of 12 miles square, and most of whom had been converted to Christianity and had adopted the dress and the pursuits of the whites. By an act of the Legislature, which set aside 20,000 acres of the reservation for purposes of the university, 4 members of the board of trustees were Indians and 2 were white men. This relation, however, proved unsatisfactory, and by a readjustment the institution passed, in 1873, into the sole control of the whites. The school has an endowment of $80,000. Instructors in 1900 for all departments, 20; attendance in all departments, 504. The library contains 3,000 volumes, in addition to which students have the use, at a nominal cost, of the city library. Both sexes are admitted. J. D. S. Riggs, Ph. D., is president.

Pachmann, Vladimir, de: pianist; b. in Odessa, Southern Russia, July 27, 1848, of German parents named Bachmann; studied in Vienna from 1866 to 1869. His first appearance in London in 1882 created a great sensation. He taught there some time, and married his pupil Margaret Okey, from whom he was afterward separated. Since then he has devoted himself entirely to concert work. His travels have been all over Europe, and include several visits to the U. S. He is considered one of the greatest living Chopin players. D. E. Hervey.

Pago Pago: a harbor on the south side of Tutuila island, Samoan group. It is regarded as the safest and best inlet of the Samoan islands, and it would probably have replaced Apia as a port if it had not been about 25 miles off the convenient route of vessels plying between Honolulu and New Zealand. Pago Pago was secured by the U. S. as a coaling station, and the Government is establishing a wharf and coal-sheds there.

Paine, Robert Treat: philanthropist: great-grandson of the R. T. Paine who signed the Declaration of Independence; b. in Boston, Oct. 28, 1835; graduated at Harvard in 1855, where he afterward studied law, and then traveled abroad; was admitted to the bar in 1859; retired from practice in 1870, devoting himself to humanitarianism, becoming prominent in organizing the Associated Charities of Boston, of which he was made president; founded the Wells Memorial Institute, completed in 1883; to endow a fellowship "for the study of the ethical problems of society, the effects of legislation, governmental administration, and private philanthropy, to ameliorate the lot of the mass of mankind," gave $10,000 to Harvard in 1887; in connection with his wife, founded and endowed a trust of about $200,000, called the Robert Paine Association, in 1890; for the exclusive benefit of workingmen, built about two hundred dwelling-houses, purchasable on easy terms; was elected president of the board of trustees of the Episcopal Theological School of Cambridge, Mass., and became president of the American Peace Society.

Palmer, George Herbert, A. M., LL. D.; educator and author; b. in Boston, Mass., Mar. 19, 1842; prepared for college at Phillips Academy, Andover, Mass.; A. B., Harvard, 1864; A. M., Harvard, 1867; at Andover Theological Seminary as a student 1865–67 and 1869–70, and at the University of Tübingen 1867–69; LL. D., University of Michigan, 1894; LL. D., Union College, 1895; Litt. D., Western Reserve University, 1898; submaster Salem high school 1864–65; tutor in Greek at Harvard 1870–72, and in philosophy 1872–73; curator of the Gray collection of engravings 1872–76; Assistant Professor of Philosophy 1873–83; Professor of Philosophy 1883–89; Alford Professor of Natural Religion, Moral Philosophy, and Civil Polity 1889; author of *The Odyssey of Homer* (books i.–xii., text and translation, 1884); *Odyssey* (books i.–xxiv., translation, 1891); *The New Education* (1887); *The Glory of the Imperfect* (1891); *Self-Cultivation in English* (1897); *The Antigone of Sophocles* (translation, with introduction); and of many magazine articles.

Paraguay: Previous to 1897 Paraguay suffered for seven years from droughts and the ravages of locusts. The small rivers were so low that craft could not be used to bring down to the Paraguay river the crops of yerba mate, the staple article of export, and it therefore could not be shipped to any extent, even to the Argentine Republic, which is the chief buyer. In 1897–98 the rainfall was plentiful, locusts did no serious harm, and the tobacco crop was excellent. The Government is encouraging immigration by paying the passage of immigrants from Buenos Ayres, and supplying oxen and farming tools to be paid for in produce or labor. There are now nine colonies. The most convenient districts for agricultural pursuits are along the Paraguay river, because they are near the boats that carry produce to Buenos Ayres and Montevideo; but the best lands are some distance back from the river. Timber is becoming, next to yerba, the most important industry. The hard woods compare favorably with any timber in the world for durability and strength. They are chiefly exported in the shape of squared logs, are sent down the rivers in rafts or barges, and find a ready market in Rosario, Buenos Ayres, Montevideo, and Europe, more especially in Germany, Belgium, and France. Mineral resources are important, but are not yet worked. The production of sugar has begun. The exports in 1899 were valued at $2,021,023 (gold): the chief articles were yerba mate, $718,292; tobacco, $112,488; hides, $441,308; timber, oranges, and hair, $595,550. The total imports were $2,147,838 (gold), and were chiefly textiles, wines, and rice. About half the imports come from Great Britain. Trade with the U. S. is small, but increasing, the imports being chiefly agricultural machinery, sewing-machines, lamps, and household utensils.

C. C. Adams.

Parker, Francis Wayland, A. M., LL. D.; educator; b. in Piscataquog, town of Bedford, N. H., Oct. 9, 1837; educated on the farm, in the country school, at Appleton's Academy, Mount Vernon, N. H., in Hopkinson Academy, and in the University of Berlin. After teaching in New England for several years, he was at the outbreak of the civil war principal of the school in Carrollton, Greene co., Ill. Being unable to enter the army in Illinois, he returned to New Hampshire and joined the Fourth New Hampshire Regiment at Manchester as a private. Before the company was mustered he was made first lieutenant, and in the following winter captain. The first three years of the war he spent on the South Atlantic coast, taking part in the siege of Charleston. In 1864 his regiment joined Gen. Butler's command at Bermuda Hundred. During the great campaign of 1864 Capt. Parker was in many severe battles. After the crater fight at Petersburg he was put in command of his regiment. At Deep Bottom, while in command of a brigade, he was severely wounded. Leaving the hospital in Oct., 1864, he stumped New Hampshire in the second Lincoln campaign. Promoted to lieutenant-colonel, he rejoined his regiment after the battle of Fort Fisher. He marched with his regiment across North Carolina to meet Sherman, was taken prisoner, and while with Gen. Johnston's army heard the news of Lee's surrender and witnessed the downfall of the Confederacy. On leaving the army, in spite of strong inducements to enter politics and business, he again took up teaching; was principal of the grammar school, Manchester, N. H., 1865–68; principal of grammar school, normal training-school, and assistant superintendent of schools, Dayton, O., 1868–71; studied at the University of Berlin for two and a half years; superintendent of schools, Quincy, Mass., 1875–80; one of the supervisors of schools, Boston, Mass., 1880–83. He was

BADGES AND ROSETTES OF PATRIOTIC SOCIETIES

1. Sons of the American Revolution. 2. Society of the Cincinnati. 3. Sons of the Revolution. 4. Society of Colonial Wars. 5. The Society of the War of 1812. 6. General Society of the War of 1812. 7. The National Society of the Colonial Dames of America. 8. Aztec Club of 1847. 9. Society of the Colonial Dames of America. 10. Daughters of the Revolution. 11. Naval Order of the United States. 12. Daughters of the American Revolution.

principal of the Cook County (now Chicago) Normal School 1883–99. In 1899 he was elected president of a new school of pedagogy founded by Mrs. Emmons Blaine in Chicago, Ill. Col. Parker's work in Quincy attracted wide attention; during the years 1878–80 more than thirty thousand visitors inspected the work of the Quincy schools. He has traveled and lectured very extensively. He aims to apply the principles of Comenius, Froebel, and Pestalozzi, making no pretension to any new methods of his own. All that he does is nevertheless not only forceful, but original, strongly marked by his own personality. He has written *Talks on Teaching*; *How to Study Geography*; *Outlines in Geography*; *Talks on Pedagogics*; *Uncle Robert's Geography*, etc.

C. H. Thurber.

Parker, Horatio Gilbert: author; b. in Addington, Ontario, in 1859; studied for the ministry, spending two years, 1883 to 1885, in Trinity University, Toronto. In 1886 he was compelled by ill health to go to Australia, where he became associate editor of the *Sydney Evening Herald*, and wrote several plays. Later he went to England and devoted himself to authorship. Among his published works are *A Lover's Diary*; *Pierre and His People*; *An Adventurer of the North*; *The Translation of a Savage*; *The Chief Factor*; *Mrs. Falchion*; *A Trespasser*; *The Trail of the Sword*; *When Valmond Came to Pontiac*; *The Seats of the Mighty*; *The Pomp of the Lavillettes.*

Parker, John Adams: artist; b. in New York city, Nov. 29, 1829; was educated at New York University: engaged in merchandising 1850–57, then studied art, exhibiting first at the National Academy in 1858, of which he became an associate in 1869; was one of the founders of the Brooklyn Art Club. His paintings, which chiefly portray mountain scenery, include *Twilight in the Adiroudacks*; *Winter Twilight*; *Landscape in the Adirondacks, Twilight*; *A Winter Evening*; *The Gothics—Adirondacks*; and *Close of a November Day.*

Parkes, Sir Henry, G. C. M. G.; statesman; b. in Stoneleigh, Warwickshire, England, in 1815; was apprenticed to learn a trade in Birmingham; in 1839 went to Sydney, New South Wales, in 1848 was active in the election of Mr. Robert Lowe (afterward Viscount Sherbrooke) as a member of the local legislature, and later established a daily newspaper, the *Empire*; was elected a member of the Parliament of New South Wales in 1854, was sent to England in 1861 as a commissioner for emigration, and soon after his return to the colony, in 1862, was again elected to Parliament. In Jan., 1866, he became colonial secretary, in which office he passed the Public Schools Act, under which he was president of the Council of Education 1867–70. In May, 1872, he became premier of the colony, and held the office until Feb., 1875; was again premier four times, 1877–78, 1878–83, 1887–89, and 1889–91. During his last ministry he actively promoted the cause of colonial confederation. In 1877 he received the rank of K. C. M. G., and in 1888 G. C. M. G. In 1882 King Humbert conferred upon him the dignity of Commander of the Crown of Italy in recognition of services in behalf of distressed Italian emigrants to Australia. Two volumes of his speeches have been published, and he is the author of *Fifty Years in the Making of Australian History* (1892). D. in Sydney, N. S. W., Apr. 26. 1896.

Parrish, Stephen: artist; b. in Philadelphia, Pa., July 9, 1846; after brief experience in mercantile life, studied art; exhibited at the Pennsylvania Academy in 1878, and at the National Academy of Design in 1879; studied etching, producing his first work in 1879; exhibited in both branches of art at many art-centers both in the U. S. and abroad; traveled extensively in Europe 1885–86. Among his etchings are *A Northern Moorland*; *Low Tide, Bay of Fundy*; *Coast of New Brunswick*; *Winter Evening*; *London Bridge*; and *A Gloucester Wharf.* His paintings include *November*; *In Winter Quarters*; *Low Tide, Evening*; *On the Rance, Brittany*; and *The Road to Perry's Peak.*

Parsons, Albert Ross: pianist; b. in Sandusky, O., Sept. 16, 1847: educated in Buffalo, N. Y. In 1863 the family moved to New York, where he studied until 1867, when he went to Leipzig. He continued his studies in Berlin in 1870, and returned to New York in 1872, where he has since remained. His compositions are in the fashionable form for piano, but his chief fame is as a teacher and his critical and pedagogical works are esteemed very valuable. He was president of the Music-teachers' National Association in 1890.

D. E. Hervey.

Parsons, Charles: artist; b. in Manchester, England, May 8, 1821; early removed to the U. S., and received education in the public schools of New York city; studied lithography and became an expert illustrator; was placed in charge of the art department of Harper & Brothers in 1861; is an associate of the National Academy of Design, a member of the New York Water-color Society, and has exhibited in both oil and water-color at the Academy, among his notable paintings being *An Old Orchard* and *Amagansett.*

Parton, Arthur: artist; b. in Hudson, N. Y., Mar. 26, 1842; removed to New York city in 1865, before which his first pictures had been exhibited in Philadelphia; has exhibited often at the National Academy, of which he became a member in 1884; traveled in Europe 1870–71, studying chiefly in Paris. His pictures include *Evening, After the Rain*, for which he received a medal from the American Art Association; *November*; *On the Road to Mt. Marcy*; *A Mountain Brook*; *Sycamores of Old Shokam*; *Nightfall*; *The Morning Ride*; and *Winter on the Hudson.*

Parton, Ernest: artist; brother of Arthur Parton; b. in Hudson, N. Y., Mar. 17, 1845; early began to paint, without having studied the art, and at the age of twenty took a studio in New York city; visited Europe in 1873, and after travel opened a studio in London, where he was encouraged to remain. Among his best-known paintings are *Morning Mist*; *Sunny September*; *The High Hall Garden*; *Au Bord de l'Eau*; *Waning of the Year*; *Silver and Gold*; *Falling Leaves and Fading Trees*; *Where Memory Dwells*; *Vale of Light*; and *The Last of October.*

Partridge, William Ordway: sculptor; b. in Paris, France, Apr. 11, 1861; graduated at Columbia College; studied art in Rome, Florence, and Paris; became Professor of the Fine Arts at Columbian University and lecturer before the National Social Science Association and Concord School of Philosophy. His principal sculptures are a statue of Shakespeare, now in Lincoln Park, Chicago; a bronze statue of Alexander Hamilton; a bust of Edward Everett Hale; a bust of Whittier, in the Boston Public Library; and a colossal bronze equestrian statue of General Grant, purchased by the Union League Club of Brooklyn. He has published *Art for America* (1894); *Song-Life of a Sculptor* (1894); and *The Technique of Sculpture* (1895).

Pascal, Jacqueline: Jansenist educator; younger sister of Blaise Pascal; b. in Clermont-Ferrand, France, Oct. 5, 1625. She early displayed remarkable intellectual qualities, with tendencies toward a religious life, and in 1652, on the death of her father, she retired to the convent of Port-Royal des Champs. In 1655 she was in charge of the education of the children in the convent. She died at the early age of thirty-six, on Oct. 4, 1661, partly, no doubt, from sorrow caused by the persecutions of her sect. Her chief claim to interest in the history of pedagogy is as the author of the *Regulations for the Girls' Schools at Port-Royal*, written in 1657. These rules are very austere; the Jansenists solved the problem of the education of girls in a far less satisfactory way than that of the education of boys.

C. H. Thurber.

Patriotic Societies in the United States: In recent years the remarkable development of an interest in genealogical matters has given rise to a large number of so-called patriotic-hereditary societies, in which membership is restricted to descendants of those who participated in some one of the great military events of the country, or to actual participants themselves. There are a few exceptions to this general rule, such as are shown by the Society of Mayflower Descendants or Order of the Descendants of Colonial Governors. Of these societies, the oldest is the Society of the Cincinnati. (See Cincinnati, Society of the.) It was organized at the close of the Revolution. The war of 1812, the war with Mexico, the civil war, and the war with Spain have given rise to similar bodies. Subsequent to the centennial celebrations of the events of the Revolution, a number of these societies were organized in which membership was restricted to men, and societies of patriotic women also were formed. Each of these societies has its distinctive insignia, including a badge and ribbon, together with a button or stick pin bearing the colors that belong especially to the order.

An act of Congress approved Sept. 25, 1890, permits the badge of the men's societies to be worn by officers and enlisted men of the U. S. army and navy on occasions of

ceremony. The anniversary of some historic event is chosen for the annual meetings, and dinners or functions are given in honor of some important historic occasion. The demand for the records of the soldiers of the Revolution has led to the publication of muster-rolls and similar documents in Connecticut, Massachusetts, New York, and other States, and much historical and genealogical information has been issued by the societies. Monuments and tablets marking historic sites have been erected through the efforts of these organizations. The name, date of formation, objects, eligibility, and number of members of the more important societies are herewith given :

Colonial Period.—The *Society of Mayflower Descendants* was organized in New York city Dec. 22, 1894. Its objects are to preserve the memory, the records, the history, and all facts relating to the Mayflower pilgrims, their ancestors, and their posterity. It admits to membership any lineal descendant, either man or woman, more than eighteen years old, of any passenger of the voyage of the Mayflower which terminated at Plymouth, Mass., in Dec., 1620, including all signers of the compact. State societies exist in New York, Pennsylvania, Massachusetts, Connecticut, Illinois, District of Columbia, and Ohio. The membership is 1,470, of which number 230 claim descent from Bradford, 208 from Mullens and Alden, 207 from Tilly and Howland, and 200 from Brewster.

The *Order of the Descendants of Colonial Governors* was founded in Covington, Ky., Jan. 1, 1896. It commemorates the services of those men who exercised supreme executive power in the American colonies, and laid in them the foundations of stable governments, and of that respect for civil laws and authority which made the maintenance of their future independence possible. It admits to membership male or female descendants of colonial governors who are members of the Society of Colonial Wars, Society of Colonial Dames, or Society of Mayflower Descendants. There are State societies in New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, District of Columbia, Louisiana, Kentucky, Ohio, Michigan, Missouri, Arkansas, Colorado, California, Oregon, and Canada. The membership is about 400.

The *Society of Colonial Wars* was instituted in New York city Aug. 18, 1892, and has for its object the perpetuation of the memory of those events, and of the men who, in military, naval, and civil positions of high trust and responsibility, by their acts or counsel, assisted in the establishment, defense, and preservation of the American colonies. Male descendants of such persons are eligible to membership. State societies exist in New York, Pennsylvania, Maryland, Massachusetts, Connecticut, District of Columbia, New Jersey, Virginia, New Hampshire, Vermont, Illinois, Missouri, Ohio, Nebraska, Minnesota, Kentucky, California, Colorado, Iowa, Georgia, Michigan, Wisconsin, Delaware, Rhode Island, Washington, and Maine. The membership numbers more than 2,500.

The *Order of the Founders and Patriots of America* was incorporated in New York city Mar. 18, 1896. It has among its objects to teach reverent regard for the names and history, character and perseverance, deeds and heroism of the founders of the U. S. and their patriot descendants. Its members, called associates, must be lineally descended in the male line of either parent from an ancestor who settled in any of the colonies now included in the U. S. from the settlement of Jamestown, May 13, 1607, to May 13, 1657, and whose immediate ancestors, at the call of its colonists, adhered as patriots to this cause through the Revolutionary war. There are State societies in New York, New Jersey, Connecticut, and Pennsylvania. The membership is 442.

The *National Society of Colonial Dames of America*, organized in New York city May 23, 1890, has among its objects to collect manuscripts, traditions, relics, and mementos of bygone days, for preservation, and to commemorate the success of the American Revolution. It admits to membership (on invitation only) women who are legitimately descended in their own persons from some ancestor of worthy life who came to reside in an American colony before 1776. This society has chapters in the cities of New York, Baltimore, Philadelphia, and Washington. The membership is about 300.

The *National Society of the Colonial Dames of America* was organized in Wilmington, Del., May 19, 1892. Its objects include the collection and preservation of manuscripts, traditions, relics, and mementoes of bygone days, the preservation and restoration of buildings connected with the early history of the country, and the creation of a popular interest in colonial history. Membership is limited to women (on invitation only) who are descended in their own right from some ancestor of worthy life who came to reside in an American colony prior to 1750. State societies exist in Pennsylvania, Maryland, New Jersey, Delaware, District of Columbia, Rhode Island, Massachusetts, New York, Virginia, South Carolina, Connecticut, Georgia, New Hampshire, and North Carolina, and in the non-colonial States of California, Illinois, Michigan, Minnesota, Iowa, Ohio, Colorado, Maine, Missouri, Wisconsin, Tennessee, Louisiana, Kentucky, Indiana, Alabama, Arkansas, West Virginia, Mississippi, Oregon, Vermont, Texas, and Florida, with a total membership of 3,370.

The *Society of Daughters and Patriots of America* was organized in Washington city June 7, 1898. Its objects are to preserve unwritten colonial and Revolutionary history, to furnish supplies for field hospitals in time of war, and to inculcate patriotism among American women. It admits to membership descendants in the direct paternal line of either father or mother from an ancestor who settled in the colonies before 1687, and through an ancestor who was faithful to the cause of the colonies through the Revolutionary war. Its membership is 23.

The *Order of the Old Guard* was organized in Chicago, Ill., Oct. 15, 1896. It has for its purpose the establishing of a military society, with State organization, to which any male descendant, of twenty-one years, of a patriot who served in the colonial war, in the Revolution, or in the war of 1812, is eligible. The object is to organize a three-company battalion, the first company of which will wear colonial uniforms, the second the uniform of the Revolution, and the third the uniform of the war of 1812. Its membership is 83.

The *Holland Society* was founded in New York city Apr. 6, 1885. It has for its objects the collection and preservation of information, history, genealogy, documents, etc., relating to the early settlement of the Dutch in America, including Huguenots and persons of other nationalities who found homes in Holland, the perpetuation of the memory, as well as the fostering and promotion of the principles and virtues of Dutch ancestors, and to provide for social intercourse among its members. It admits to membership male descendants in the direct male line of a Dutchman resident in America before 1675. Its membership is 843.

The *Daughters of the Holland Dames* was incorporated in New York city Dec. 9, 1895. Its objects are to collect genealogical records, arms and crests of its members, papers, letters, and documents, preserving and arranging the same, thereby securing a true history honoring the memory of those who made the history possible. Membership, which is limited to residents of New York city and the Hudson river valley, including Albany, and must not exceed 100, is restricted to women who are lineally descended from a Hollander resident of the Dutch or English colonies in America which were established in New York before 1700. The membership is less than 100.

Period of the Revolution.—The *Society of the Cincinnati*, founded in Newburg, N. Y., May 13, 1783, by American and foreign officers who served for three years in the Continental army, has for its object the perpetuation of the mutual friendships that were formed under the pressure of common danger in the Revolution. Membership descends to the eldest lineal male descendant, and in failure of a direct male descendant to male descendants through intervening female descendants. Of the original thirteen State societies all have been re-established, although those in Delaware, Georgia, New Hampshire, and North Carolina were only provisionally admitted to the general society in 1899. The membership is 580.

The *Society of the Sons of the American Revolution*, organized in San Francisco, Cal., Oct. 22, 1875 (as the *Sons of Revolutionary Sires*, which on Apr. 30, 1889, became one of the State societies of the *Sons of the American Revolution*), has State societies in Arizona, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Florida, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, the Hawaiian islands, and France. Its chief object is to perpetuate the memory of the men who, by their services or sacrifices during the Revolution, achieved the independence of the American people. It ad-

mits to membership any lineal male descendant of an ancestor who was at all times unfailing in his loyalty to, and rendered actual service in, the cause of American independence. The membership is 9,690.

The *Society of the Sons of the Revolution* was organized in New York city Feb. 22, 1876. Its objects are to perpetuate the memory of the men in the military, naval, or civil service of the colonies, and of the Continental Congress, who, by their acts or counsel, achieved the independence of the country. Membership is permitted to any male person descended from one who as a military, naval, or marine officer, soldier, sailor, or marine, was in actual service under the authority of any of the thirteen colonies or States, or of the Continental Congress, and always loyal to such authority. There are State societies in New York, Pennsylvania, District of Columbia, Iowa, New Jersey, Georgia, Massachusetts, Colorado, Maryland, Minnesota, Ohio, California, Connecticut, New Hampshire, North Carolina, Illinois, Missouri, Florida, Alabama, West Virginia, Tennessee, South Carolina, Kentucky, Montana, Texas, Washington, Virginia, Indiana, Michigan, North Dakota, and Rhode Island, with a total membership of 5,950.

The *Naval Order of the United States* was organized in Boston, Mass., July 4, 1890. It has for its chief objects the encouragement of research and the publication of data pertaining to naval art and science, and to establish libraries in which to preserve all documents, rolls, books, portraits, and relics relating to the navy and its heroes at all times. The companions of the first class include commissioned officers who took part in the navy in the Revolution, in the war with France, in the war with Tripoli, in the war of 1812, in the war with Mexico, in the civil war, or in the war with Spain, also those participating in any war in which the U. S. navy may be engaged hereafter, or the eldest male lineal descendant of any such, or in default of a lineal descendant one collateral representative; and as companions of the second class enlisted men who have received the U. S. naval medal of honor for bravery in the face of the enemy. There are State commanderies in Massachusetts, Pennsylvania, New York, Illinois, and the District of Columbia. The membership is about 500.

The *Military Order of Foreign Wars* was instituted in New York city Dec. 27, 1894, as the *Military and Naval Order of the United States*, but on June 21, 1895, changed its name. It has for its objects the commemoration of the efforts of the forces in establishing and maintaining the principles contended for by the American colonies, and later by the U. S. in the Revolution, the war of 1812, the war with Tripoli, the Mexican war, and the war with Spain. It admits to membership commissioned officers who participated in any of these foreign wars as veteran companions, and direct lineal descendants in the male line of the foregoing as hereditary companions. Commanderies exist in New York, Pennsylvania, Connecticut, Illinois, California, Massachusetts, Florida, Maryland, District of Columbia, Vermont, Missouri, Virginia, and Ohio. The membership is nearly 1,300.

The *Society of American Wars* was founded in Minneapolis, Minn., Jan. 11, 1897. Its objects are the perpetuating among their descendants of the memory of the men who were instrumental in establishing the colonies of North America and were the founders of their nation: of the men who achieved American independence; and of the men who in military and naval positions of trust assisted in the preservation of the republic in the 1812, Mexican, and civil wars; collecting for preservation documents relating to those periods; providing suitable commemorations of the prominent events connected with those periods; and inspiring in its members the fraternal and patriotic spirit of their forefathers. It admits to membership, as companions, U. S. officers of the Mexican or the civil war, and lineal male descendants of colonial or Continental soldiers or civil officers prior to 1783, and of U. S. officers of the war of 1812, the Mexican war, or the civil war. The membership is 485.

The *Society of the Daughters of the American Revolution* was organized in Washington, D. C., Oct. 11, 1890. Its objects are to perpetuate the memory and spirit of the men and women who achieved American independence, by the acquisition and protection of historical spots and the erection of monuments, etc., and to carry out the injunction of Washington in his farewell address. Any woman who is of the age of eighteen years, and who is descended from a man or woman who with unfailing loyalty rendered material aid to the cause of independence, is eligible to membership. The membership is 27,432, distributed in the States and Territories of Alabama, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Idaho, Illinois, Indiana, Indian Territory, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, Wisconsin, and Wyoming, each of which is under the jurisdiction of a State regent. There are also individual chapters in Canada, in the Hawaiian islands, and in Europe.

The *Daughters of the Revolution*, organized in New York city Aug. 20, 1891, has for its object to keep alive among the members and their descendants, and throughout the community, the patriotic spirit of the men and women who achieved American independence. It admits to membership any woman more than eighteen years old who is a lineal descendant of an ancestor who was loyal to the colonies and was in actual service during the Revolution. There are State societies in Colorado, Connecticut, Delaware, Indiana, Iowa, Kentucky, Maryland, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Texas, Utah, Washington, West Virginia, and Wisconsin. The membership is 3,000.

The *Daughters of the Cincinnati* was incorporated in New York city Dec. 28, 1894. It has for its objects to renew and foster among its members the friendships formed and cemented amid the trying ordeals of the Revolution in the camp and on the battle-field, by their ancestors, who by wise leadership and study achieved the independence of the American colonies and established the government of the U. S. This society admits to membership (on invitation only) women who are direct lineal descendants of officers of the American army or navy who took part in the Revolutionary struggle with Great Britain, and who were entitled to original membership in the Society of the Cincinnati. Its membership is 90.

The *Dames of the Revolution* was organized in New York city June 25, 1896. It was established for the purpose of perpetuating the memory of those ancestors whose sacrifices and labors secured the existence of the republic, and to preserve the records of these men in the Revolution. It admits to membership any woman more than eighteen years old who is descended in her own right from an ancestor who, either as a military, naval, or marine officer, or official in the service of any one of the thirteen colonies, assisted in establishing American independence during the Revolution. The membership is about 50.

The *Society of the Children of the American Revolution* was organized in Washington, D. C., Apr. 5, 1895. Among its objects are the acquisition of knowledge of American history, the saving of the places made sacred by the American men and women who forwarded American independence, and the finding out and honoring of the lives of children and youth of the colonies and of the American Revolution. Membership is extended to any boy or girl who is descended from a man or woman who with unfailing loyalty rendered material aid to the cause of independence. There are 156 local societies, with a total membership of 4,250, distributed variously throughout the different States.

The *St. Nicholas Society of New York City*, organized in New York city Feb. 28, 1835, has for its objects to collect and preserve information respecting the history, settlement, manners, etc., of the city of New York, and to promote social intercourse among its native citizens. Membership is restricted to natives or residents of New York city who are descended from residents of New York prior to 1785. Descendants of members are preferred for membership, which is limited. The membership is 650.

Period of the War of 1812.—The *Society of the War of 1812*, instituted in New York city Jan. 30, 1826, has for its purpose the inspiration of the members and of the American people with the patriotic spirit of the men who, during the war of 1812, defended their country against hostile encroachments on its rights and interests. It admits to hereditary membership descendants of commissioned officers who actually served in the war of 1812. It absorbed the Veteran Corps of Artillery in 1848, and in 1892 adopted its present name. The membership is 100.

The *General Society of the War of 1812* was organized in Philadelphia, Pa., Jan. 8, 1891, by the Pennsylvania Asso-

eiation of the Defenders of the Country in the War of 1812 (organized in 1854) and the Association of the Defenders of Baltimore in 1814 (organized in 1842), and now includes State societies in Massaehusetts, Conneetieut, Ohio, District of Columbia, New York, and New Jersey. Its objeet is to perpetuate the memory and spirit of the men who completed the Revolution by the victories of the war of 1812. Membership is open to any male person above the age of twenty-one years who participated in or who is a lineal deseendant of one who served during the war of 1812. The membership is nearly 1,000.

The *Society of the United States Daughters, 1812*, was founded in Cleveland, O., Sept. 19, 1892, and has for its object to seeure the genealogies, facts, and traditions of the founders of Ameriea, where they came from, the vessels they arrived in, their deseendants, and reeord of serviee in the Freneh war, in the Revolution, and in the war of 1812. It admits to membership any woman more than eighteen years old who is a lineal descendant of an ancestor who assisted in establishing Ameriean independenee during the war of 1812. There are State societies in Maine, New Hampshire, Massachusetts, New York, Pennsylvania, Ohio, Miehigan, and Louisiana. Its membership is 479.

Period of the War with Mexico.—The *Aztec Club of 1847*, founded in the eity of Mexico, Oet. 13, 1847, has for its objeet to keep alive the traditions that eluster about the names of those offieers of the army and navy and marine eorps who took part in the Mexican war of 1846–48, and admits to membership as primary members offieers who participated in the war, and, as assoeiate members, sons or blood-relatives. Its membership is 235.

Period of the Civil War.—The *Military Order of the Loyal Legion* was organized in Philadelphia, Pa., Apr. 15, 1865. Its objeet is to hold in remembranee the sacrifiees made in eommon and the triumphs shared in maintaining the honor, integrity, and supremaey of the national Government at a critieal period of its history. Its membership is divided into companions of the first class, consisting of offieers who partieipated in the eivil war, and companions of the seeond class, consisting of the eldest sons of original companions. There are State eommanderies in Pennsylvania, New York, Maine, Massachusetts, California, Wiseonsin, Illinois, Distriet of Columbia, Ohio, Miehigan, Minnesota, Oregon, Missouri, Nebraska, Kansas, Iowa, Colorado, Indiana, Washington, and Vermont. Its membership is 9,071.

The *Grand Army of the Republic* was organized in Deatur, Ill., Apr. 6, 1866. Its principal objeets are to preserve and strengthen those kind and fraternal feelings whieh bind together the soldiers, sailors, and marines who united to suppress the rebellion, and to perpetuate the memory and history of the dead. It admits to membership any soldier or sailor of the U. S. army, navy, or marine eorps who served between Apr. 12, 1861, and Apr. 9, 1865, and who was honorably diseharged therefrom after sueh service, and of sueh State regiments as were called into active serviee and subjeet to the orders of U. S. general offieers between the dates mentioned. There are 7,213 Grand Army posts, contained in 45 departments, eaeh of whieh is a State or Territory, exeept in five eases where the department eonsists of two States or Territories, with a total membership of 305,603.

The *Woman's Relief Corps*, which is an auxiliary to the Grand Army of the Republie, was organized in July, 1883. Its objeets are to perpetuate the memory of the heroie dead, to extend needful aid to the widows and orphans, to eherish and emulate the deeds of the army nurses, and to ineulcate lessons of patriotism and love of eountry among the ehildren and in the eommunities. It admits to membership mothers, wives, daughters, and sisters of Union soldiers. The membership is 138,444, whieh is divided into 3,141 corps in 35 departments.

The *Sons of Veterans, U. S. A.*, was organized in Philadelphia, Pa., Sept. 29, 1879. It has for its objects the preservation of the memories of fathers and their sacrifiees for the Union in the eivil war, to aid members of the Grand Army of the Republie and members of the order, to assist in the observanee of Memorial Day, and to inculeate patriotism and a love of eountry among the people. It admits to membership any lineal deseendant more than eighteen years old of any honorably diseharged Union soldier, sailor, or marine, who served in the eivil war. The membership is about 30,000, divided among 1,017 eamps in 29 divisions, most of whieh have an area equal to that of a State or Territory.

The *Union Veteran Legion* was organized in Pittsburg in Mar., 1884. Its objects are the cultivation of true devotion to Ameriean government and institutions, and the preservation of friendly relations among those who fought for the safety of the Ameriean Union. It admits to membership any officer, soldier, sailor, or marine of the Union army, navy, or marine corps, during the civil war, who volunteered prior to July 1, 1863, for a term of three years, and was honorably diseharged, for any cause, after a service of at least two eontinuous years, or was at any time discharged by reason of wounds reeeived in line of duty; also those who volunteered for a term of two years prior to July 22, 1861; but no drafted person, no substitute, nor any one who has at any time borne arms against the U. S. is eligible. The membership is distributed among 152 encampments, whieh are organized in 21 States and the District of Columbia, and ineludes more than 20,000 veterans.

The *Ladies of the Union Veteran Legion*, which is auxiliary to the Union Veteran Legion, was organized in Newark, O., Feb. 20, 1890, and has for its objects the cultivation of trne fraternity and patriotism, and the moral, soeial, and intellectual development of its members, as well as the relief of its members, and of widows and orphans of members of the Union Veteran Legion and others in sickness and distress. It admits to membership the mothers, wives, widows, sisters, daughters, and granddaughters of soldiers, sailors, and marines of the Union army and navy who are eligible to membership in the Union Veteran Legion. Its membership is about 3,000.

The *Union Veterans' Union* was founded in Washington, D. C., in 1886. Its ehief objeets are to preserve and perpetuate, with firmness, but without animosity, the principles of the war for the preservation of the Union, contended for on many battlefields; to exact from the Government proper appreciation of the serviees of the Union soldier in the preservation of the integrity of the nation and just recognition of his claims, and effectively to eare for the members of the order and the widows and orphans of those deeeased. It admits to membership veterans who have served honorably in the army, navy, or marine eorps of the U. S., between Apr. 12, 1861, and Apr. 30, 1865, have participated in one or more engagements or battles, and have reeeived an honorable discharge. Its membership is 71,000.

The *United Confederate Veterans* was organized in New Orleans, La., June 10, 1889. Its ehief objects are to eneourage the writing of partieipants therein of accounts, narratives, memoirs, histories of battles, episodes, and oeeurrences of the war between the States; to gather authentie data, statisties, documents, reports, plans, maps, and other material for an impartial history of the Confederate side; to collect and preserve relics and mementoes of the war; and to make and perpetuate a record of the serviees of every member. It admits to membership any surviving soldier or sailor who served in the Confederate service during the civil war. The membership, whieh is nearly 50,000, is distributed among 1,250 eamps, whieh are organized in three departments, as follows: The Army of Northern Virginia Department, with divisions in Virginia, Maryland, North Carolina, South Carolina, Kentueky, and West Virginia; the Army of the Tennessee Department, with divisions in Georgia, Alabama, Tennessee, Mississippi, Louisiana, and Florida; and the Trans-Mississippi Department, with divisions in Missouri, Texas (Northwestern Texas, Southeastern Texas, Southwestern Texas, and Western Texas, subdivisions), Arkansas, Indian Territory, and Oklahoma.

The *United Sons of Confederate Veterans* was organized in Riehmond, Va., June 30, 1896. Its chief objects are to gather authentic data, statisties, documents, reports, plans, maps, and other material for an impartial history of the Confederate side; to eollect and preserve relies and mementoes of the war; to make and perpetuate a record of the services of every member of the United Confederate Veterans, and all living Confederate veterans, and, as far as possible, of those of their eomrades who have died. It admits to membership any male deseendant more than sixteen years old of those who served in the Confederate army or navy to the end of the war, or who died in prison or while in aetual service, or who were killed in battle, or who were honorably retired or diseharged. The society consists of 140 eamps, distributed so as to perpetuate the plan of the Confederate army, by being divided into three departments: Army of Northern Virginia Department, eonsisting of Virginia, Maryland, North Carolina, South Carolina, and Kentueky; Army of Tennessee Department, including Georgia, Tennessee, Mis-

sissippi, Louisiana, and Florida; Trans-Mississippi Department, including States west of the Mississippi, except Louisiana. The total membership is 8,000.

The *United Daughters of the Confederacy* was organized in Nashville, Tenn., Sept. 10, 1894. Besides cultivating ties of friendship among the women whose fathers, brothers, sons, and often mothers, shared common dangers, sufferings, and privations, as well as to perpetuate the honor, integrity, valor, and other noble attributes of true Southern character, this society has among its objects to instruct and to instill into the descendants of the people of the South a proper respect for and pride in the war history, with a veneration and love for the deeds of their forefathers, and to perpetuate a truthful record of the noble and chivalric achievements of their ancestors. It admits to membership the widows, wives, mothers, sisters, and lineal female descendants of those who served honorably in the army or navy of the Confederate States, or who served in the civil service of the Confederate States, or one of the Southern States, or gave personal services to the Confederate cause. There are 269 chapters, distributed in the following States and Territories: Alabama, Arkansas, California, District of Columbia, Florida, Georgia, Indian Territory, Kentucky, Louisiana, Maryland, Mississippi, Missouri, New York, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia (two divisions), and West Virginia, with a total membership of 14,186.

Period of the War with Spain.—The *Society of the Army of Santiago de Cuba* was organized in Santiago de Cuba July 31, 1898. It has for its object the recording of the history and conservation of the memory of the events of the campaign which resulted in the surrender on July 17, 1898, of the Spanish army in the city of Santiago de Cuba, and the military province to which it pertained. It admits to membership all officers and men (including acting assistant surgeons and volunteer aides) who participated worthily in the Santiago campaign at any time between June 14 and July 17, 1898. Its membership is about 500.

The *Naval and Military Order of the Spanish-American War* was organized in New York city Feb. 2, 1899. Its objects are to cherish the memories and associations of the war with Spain, to unite and promote the ties of fellowship formed by those who participated, and to advance the best interests of the sailors and soldiers of the U. S. It admits to membership any man who served on the active list or performed active duty as a commissioned officer, regular, or volunteer, during the war with Spain. Its membership is 270.

Miscellaneous.—The *Huguenot Society of America* was organized in New York city Apr. 12, 1883. It has among its objects to perpetuate the memory and to foster and promote the principles and virtues of the Huguenots; also to discover, collect, and preserve all existing documents, monuments, etc., relating to the genealogy or history of the Huguenots of America. It admits to membership all descendants in the direct male lines or through the female lines of the Huguenot families which emigrated to America prior to the promulgation of the Edict of Toleration, Nov. 28, 1787. Its membership is about 300.

The *National Society of New England Women* was organized in New York city Jan. 24, 1895. It has for its objects to promote social and intellectual intercourse among its members, and to offer advice and assistance to women of New England extraction residing in other parts of the U. S. It admits to active membership any woman more than eighteen years old who is a native of New England or one of whose parents and whose husband are or were natives of New England. Descendants of active members may become associate members. The membership is 586.

The *Order of the Indian Wars of the United States* was organized in Chicago, Ill., July 26, 1896. Its object is to perpetuate the memory of the services rendered by the American military forces in their conflicts and wars within the territory of the U. S., and to collect and secure for publication historical data relating to the instances of brave deeds and personal devotion by which Indian warfare has been illustrated. It admits to membership officers of the army, navy, and marine corps who have been or who hereafter may be engaged in the service of the U. S. in any grade in conflicts or actual field service against hostile Indians within the jurisdiction of the U. S. as first-class companions, and the sons of living members of the first-class companions as second-class companions. Its membership is 40.

Marcus Benjamin.

Patterson, Rev. George, LL. D.: historian; b. in Pictou, Nova Scotia, Apr. 30, 1824; entered the ministry in 1849. He received the degree of D. D. from Princeton Seminary, New Jersey, and that of LL. D. from Dalhousie College, Halifax. Among his writings are *History of the Country of Pictou*; *The Portuguese on the Northeast Coast of America*; *The Red Indians of Newfoundland*; *The Magdalen Islands*; *Sable Island, its History and Phenomena*.

Paur, Emil: conductor; b. in Czerowitz, Austria, July 29, 1855. His first musical studies were at home, next at the Vienna conservatory, where he graduated with high honors. He began conducting in Berlin, and when twenty-one years old was appointed court conductor in Cassel, going from there in 1880 to Königsberg, in 1891 to Leipzig as first conductor of the opera, and went to Boston to conduct the Boston Symphony Orchestra in 1893. In 1898 he was elected conductor of the New York Philharmonic Society to succeed the late Anton Seidl. He is also known favorably as a pianist, violinist, and composer.

D. E. Hervey.

Payne, Joseph: educator; b. in Bury St. Edmunds, England, Mar. 2, 1808. His opportunities for education were very limited, and at an early age he was under the necessity of supporting himself, relying partly on teaching, partly on newspaper writing, reading widely at the same time. At about twenty years of age he became private tutor in the family of Mr. David Fletcher, and succeeded so well that ultimately, in partnership with Mr. Fletcher, he founded and successfully carried on for some years the Denmark Hill Grammar School in Camberwell. In 1845 he set up a school of his own at Mansion House, Leatherhead, which he carried on for many years with great success. In 1872 the College of Preceptors in London took an important step in establishing the first English professorship of the Science and Art of Education, and to this chair Mr. Payne was called. He thus has the distinguished honor of being the first Professor of Education in England. At an early age Mr. Payne came under the influence of Jacotot, published an account of his system, and gave public lectures to arouse the teachers to a sense of its importance. To the enthusiasm inspired by Jacotot's methods he was always glad to attribute his intense and lasting interest in the science of teaching. He devoted the latter years of his life to the work of elevating the teacher's conception of his calling. D. Apr. 30, 1876. During his life he published little, but since his death two volumes, *Lectures on the Science and Art of Education* and *Lectures on the History of Education*, have been published, and have been recognized as forming an important contribution to educational literature.

C. H. Thurber.

Payne, William Henry: soldier; b. in Clifton, Fauquier co., Va., June 15, 1830; was educated at the University of Missouri, the Virginia Military Institute, and the University of Virginia; at the outbreak of the civil war, organized the Black Horse Cavalry for the Confederate service, and commanded that force as captain at the first battle of Bull Run, several weeks afterward being promoted to major; became lieutenant-colonel of the Fourth Virginia Cavalry in 1862, and colonel in 1863; advanced to brigadier-general in 1864, his brigade being composed of the 5th, 6th, 8th, 15th, and 36th Regiments of Virginia cavalry in Gen. Fitzhugh Lee's division; was three times seriously wounded in battle; became counsel for the Southern Railroad in 1898.

Peacock, Thomas Brower: poet; b. in Cambridge, O., Apr. 16, 1852; educated in Zanesville, O.; was for ten years associate editor of the Topeka *Democrat*. He is the author of *Poems* (1872); *The Vendetta, and other Poems* (1876); *The Rhyme of the Border War* (1880); and *Poems of the Plains and Songs of the Solitudes* (1888), the last-named volume being translated into German by Karl Knortz.

Pearl Harbor: an inlet on the south coast of Oahu, Hawaiian islands, 5 miles W. of Honolulu. By a convention between the U. S. and the King of the Hawaiian islands (1884), the king granted to the U. S. the exclusive right to establish and maintain at Pearl Harbor a coaling and repair station for the use of its naval vessels. U. S. war-ships made surveys of the harbor in 1873, 1875, 1887, and 1897, and from the standpoint of the navigator it is probably better known than any other harbor of no greater commercial importance. The depth of water is about 50 feet, but a bar running across the channel outside the entrance rises to within 10 feet of the surface. This obstruction has not been removed, and since the Hawaiian group was annexed

to the U. S. public attention has been less directed to Pearl Harbor, because the advantages sought there are present in a developed condition at Honolulu. C. C. Adams.

Pearse, Carroll Gardner: educator; b. in Tabor, Ia., Nov. 2, 1858; studied at Doane College, Crete, Neb.; superintendent of schools in Wilber, Kan., 1884–88; superintendent of schools in Beatrice, Neb., 1888–95; superintendent of schools in Omaha, Neb., since 1895; author of numerous occasional addresses.

Pearson, Sir Charles John, P. C., LL. D., D. L.: Scotch judge; b. in Midlothian, Nov. 6, 184–; educated at Edinburgh Academy and at Edinburgh and St. Andrews Universities, and afterward at Corpus Christi College, Oxford, at which last place he took high honors in Greek. He studied law at the Inner Temple, and was called to the Scotch bar as an advocate in 1870; took up the practice of his profession, in which he attained early eminence, and also devoted much attention to politics, in which he attained considerable prominence; was sheriff of chancery 1885–88, procurator of the Church of Scotland 1886–90, sheriff of Renfrew and Butte 1888, sheriff of Perthshire 1889. He was created queen's counsel and appointed solicitor-general for Scotland in 1890; was Conservative member of Parliament for Edinburgh and St. Andrews Universities 1890–96; was lord-advocate of Scotland 1891–92 and 1895–96, and also dean of the faculty of Advocates of Scotland 1892–95; and in 1896 was made judge of the Supreme Court of Scotland. His principal writings consist of addresses and a few essays. F. Sturges Allen.

Peary Land: the interior part of Northern Greenland, between 78° and 82° N. lat., explored and described by R. E. Peary, C. E., U. S. N., who crossed it four times, his first two transits being made in the spring and summer of 1892, and his last two in the spring and summer of 1895. His routes were over the compacted snow which has filled every valley and completely submerged every mountain, until the entire interior of Greenland is simply a huge snow dome, in places 10,000 feet high, absolutely devoid of life of any kind, and with a horizon as blank as that of mid-ocean. Over this frozen desert, at altitudes from 5,000 to 8,000 feet above sea-level, Peary traveled between the west and northeast coasts of Greenland. The region was named Peary Land by the Philadelphia Geographical Society. C. C. A.

Peck, William Henry: educator and author; b. in Augusta, Ga., Dec. 30, 1830; educated at Western Military Institute, Ky., and graduated at Harvard in 1853; was principal of a public school in New Orleans 1854–56, and Professor of Belles-lettres, History, and Elocution in the University of Louisiana 1856–58; after a brief residence in New York city, returned to Georgia and founded the *Georgia Weekly*, a literary publication; became president of the Masonic Female College in Greenville, where the *Georgia Weekly*, which had failed, was revived; was Professor of Languages in Le Vert Female College, Ga., to which place the *Weekly* was removed. He is the author of *The McDonalds, or the Ashes of a Southern Home* and *The Confederate Flag on the Ocean* (1867).

Peckham, Rufus William, LL. D.: lawyer; b. in Albany, N. Y., Nov. 8, 1838; received common-school education, and graduated at Union College. He took up the study of law in June, 1857, and was admitted to the bar, at the general term of the Supreme Court of New York, in Dec., 1859. He began the practice of law in Albany, where he was district attorney of Albany County, and later corporation counsel of Albany city; he was subsequently elected justice of the Supreme Court of the State of New York, and judge of the Court of Appeals of New York, which latter office he retained until he was appointed justice of the Supreme Court of the U. S. by President Cleveland. Justice Peckham is a brother of Wheeler H. Peckham, who was also nominated by President Cleveland prior to Justice Peckham's appointment, but whose nomination was not confirmed by the Senate. F. Sturges Allen.

Peckham, Stephen Farnum: chemist; b. near Providence, R. I., Mar. 26, 1839; after study and practice of chemistry at Brown University and at a laboratory in Providence, experimented with others in the manufacture of illuminating oils from petroleum; became hospital steward of the Seventh Rhode Island Regiment in 1862, continuing in military service until near the end of the civil war; had charge of the chemical department of the U. S. army laboratory in Philadelphia; served as expert for the California Petroleum Company, and prepared reports on the occurrence of petroleum for the Geological Survey of California, including an examination of the bitumen of that State; taught chemistry in Brown in 1867, and afterward in Washington and Jefferson College, the State Agricultural College of Maine, Buchtel College, and the University of Minnesota; was chemist to the Geological Survey of Minnesota; has devoted himself especially to the study of petroleum and its uses, writing much on that subject; was special agent for the national census 1880; wrote the article on *Petroleum* for the *Encyclopædia Britannica*, and is the author of *An Elementary Treatise on Chemistry* (1876).

Peckham, Wheeler Hazard: lawyer; b. in Albany, N. Y., Jan. 1, 1833; son of Hon. Rufus W. Peckham and brother of Rufus Wheeler Peckham, now (1899) justice of the U. S. Supreme Court; educated at Albany Academy and Union College, which he left owing to ill health; studied law and was admitted to the bar in the State of New York, taking up his residence in New York city in 1894; was one of the leading counsel in the Tweed prosecutions, and in various other important litigations, including the Bell telephone patent cases, and the Louisiana bond cases; was appointed district attorney of New York in 1884; was nominated by President Cleveland as justice of the Supreme Court in 1893, but his nomination was not confirmed by the Senate; was several times president of the Association of the Bar of New York City. F. Sturges Allen.

Peele, John Thomas: artist; b. in Peterborough, England, in 1822; early removed to the U. S. and began painting portraits; afterward devoted himself to genre work, especially the portrayal of children; opened a studio in New York city in 1846, and became an associate of the National Academy; finally returned to England in 1851. Among his paintings are *Children of the Wood*; *Music of the Reeds*; *A Highland Supper*; *The Little Laundress*; *Prayer for Health*; *Recitation for Grandpa*; *The Village School*; and *The Bird's Nest.*

Peffer, William Alfred: b. in Cumberland co., Pa., Sept. 10, 1831; at the age of fifteen, worked on his father's farm during the summer and taught school during the winter; removed to Indiana in 1853, to Missouri in 1859, and afterward to Illinois, where he enlisted for the civil war in 1862; was mustered out of service as a lieutenant in 1865, having studied law in leisure hours and acted as judge-advocate; practiced law in Clarksville, Tenn., in 1865, then removed to Kansas, where he founded the *Fredonia Journal* and the *Coffeyville Journal*, and was elected to the State Senate in 1874; was Republican presidential elector in 1880, editor of the *Kansas Farmer* in 1881, and was sent to the U. S. Senate in 1890 by the People's Party, his term of office expiring in 1897; was nominated for Governor of Kansas by the Prohibitionists in 1898. He has published *Myrioma*, a national poem (1869); *The Carpet-Bagger in Tennessee* (1869); *Geraldine, or What May Happen*, an historical story of Kansas (1882); *Peffer's Tariff Manual* (1888); *The Way Out* (1890); and *The Farmer's Side* (1891).

Penfield, Samuel Lewis, A. M.: mineralogist; b. in Catskill, N. Y., Jan. 16, 1856; graduated at the Sheffield Scientific School of Yale University in 1877. On the completion of his course he became one of the assistants in analytical chemistry, receiving more recently an appointment as Professor of Mineralogy in the university. His specialty is the chemistry of minerals, and in order to perfect himself in this branch he studied at the University of Strassburg in 1881, and at the University of Heidelberg in 1884. He received the honorary degree of A. M. from Yale in 1896. Prof. Penfield has made a high reputation for himself in his specialty, as is shown by the many papers on minerals that he has contributed to the *American Journal of Science*. He is also the author of *Determinative Mineralogy and Blowpipe Analysis* (New York, 1896).

Marcus Benjamin.

Penfield, Smith N.: musician; b. in Oberlin, O., Apr. 11, 1837, and after some study in New York continued in Leipzig and Paris. On his return he settled in Savannah, Ga., founded a conservatory of music there, and established and conducted for four years the Mozart Club. He finally settled in New York, and received the degree of Mus. Doc. from the University of New York. He was president of the Music Teachers' National Association in 1891 and also of the New York State Music Teachers' Association. He has com-

posed much good music, and as an organ-player he ranks very high. D. E. Hervey.

Penn College: an institution of learning in Oskaloosa, Ia. The predecessor of Penn College was Spring Creek Union College, incorporated in 1864. In 1866 the Friends united with the Spring Creek Union College Association, and acquired the right to nominate a part of the board of directors for the purpose of establishing a college to be conducted in accordance with the principles of the Society of Friends. Spring Creek Union College became Penn College in 1873, and the first college term was opened the same year. The institution has an endowment of $30,000. Four courses are offered—the classical, scientific, philosophic, and classical-biblical—which lead to the degrees of A. B., Ph. B., and S. B. Provision is also made for the degree of A. M. Of the 18 colleges comprised in the Iowa State Teachers' Association, Penn College is one of the six that rank highest for proficiency in instruction and standard of admission requirements to collegiate standing. The college has 14 instructors and about 400 students. Absalom Rosenberger is president.

Pennsylvania, Western University of: an institution of learning in Allegheny, Pa., founded in 1787 by the General Assembly of Pennsylvania as an academy or public school in the town of Pittsburg. It was the first school established by law W. of the Alleghany Mountains and N. of the Ohio river. In 1819 the Pittsburg Academy was reincorporated by the General Assembly as the Western University of Pennsylvania, and provision was made by the Assembly for its growth along university lines. The university building, with all its contents, was destroyed in the great fire that swept Pittsburg in 1845. On the destruction in 1849, by fire also, of the new building, which had been erected in another locality, instruction was suspended for five years. The institution is now prospering, its assets, including those of the affiliated schools, being very considerable. The instructors number more than 100 and the students nearly 800. Next to the University of Pennsylvania, Western University has the largest attendance of any institution of higher learning in the State. The university has departments of medicine, pharmacy, dental surgery, law, and mines and mining engineering, for which last the Legislature appropriated, in 1895, $50,000. W. J. Holland, D. D., LL. D., is chancellor.

Perfumery: perfumes in general; in commerce, substances either of animal or vegetable origin that are of value in consequence of the odor they impart. These substances by a natural process of slow evaporation or volatilization yield their perfume to the objects within reach, and so give to the person or surroundings an odor that is pleasing and agreeable to the cultivated taste. They have also some value as disinfectants, tending both to mask offensive odors and to oxidize deleterious organic compounds. Perfumes are either of animal or vegetable origin. Of the former, the ambergris from the spermaceti whale, the castor from the common beaver, the civet from the civet-cat, and the musk from the musk-deer are the most important. These four substances are commercial articles, and are made into extracts by treatment with alcohol, sometimes called *tincturation*, in which the crude substance is allowed to remain until all the odor has been taken up by the alcohol. These extracts are then sold in various degrees of dilution, and are also used in combination with other extracts to form perfumes. They are highly esteemed—not so much for their own odor as for the permanence which they yield to other compounds owing to their slight volatility and slow decomposition. Perfumes of vegetable origin include those from gums, such as myrrh and olibanum; from seeds, such as tonquin and vanilla; and from roots, such as orris; also the essential oils of all plants and trees, including those from flowers, as rose oil; from grasses, as lemon-grass oil; from leaves, as bay oil; and from wood, as cedar oil. The gums, roots, and seeds yielding solid perfumes are dried and ground into powder, and then made into incense, pastilles, sachets, and the like. The oils and volatile odors from plants and flowers are obtained by three principal methods—*distillation*, *enfleurage*, and *maceration*. In distillation the fragrant part of the plant is put into a still, covered with water, and then heated. The oily distillate, called *attar* or *otto*, passes over into a receiver, and is then condensed; thus rose-leaves, distilled, yield attar of roses and orange-flowers attar of neroli. As the attars are all slightly soluble in water, the distillate coming over contains a slight amount of perfume, and is known commercially as rose-water, orange-water, and the like. Enfleurage is used with flowers in which the odor is more volatile, and depends upon the fact that greasy bodies readily absorb and retain volatile odors which they will again readily yield when brought in contact with alcohol. The flowers from which it is desired to extract the odor are spread upon trays containing grease, or in some cases vaseline, and the spent flowers are replaced by fresh ones until the grease called *pomade* is considered saturated. Maceration is similar to the foregoing except that the grease is kept liquid by being heated over a water-bath. Sometimes both enfleurage and maceration are used, and at times only one process is desirable; thus tuberose and jasmine yield the better pomade by enfleurage, and rose, orange, and acacia give the better result by maceration; while the preferred jonquil and violet pomade is obtained by a combination of both—that is, enfleurage followed by maceration. The pomade when obtained by enfleurage is heated sufficiently to liquefy it, but not so hot as to destroy the odor, and then filtered through fine linen to remove any extraneous material into retainers, in which condition it is put upon the market. The final process is the making of the *essence*—as the commercial perfume is called. This is accomplished by dividing the solid pomade into small pieces and infusing it with strong alcohol until the odor has been entirely removed from the fat. These essences, combined in various proportions, yield the ordinary commercial product. The resources of modern chemistry have added to the compounds used by the perfumer, and synthetical products such as coumarin, nitro-benzol or false almond, and methyl protocatechnic aldehyde or vanillin now find extensive application in the art of perfumery. See Attar of Roses, Civet, Musk, etc. See the following books: *Perfumes and their Preparation*, by G. W. Atkinson; *A Comptete Practical Treatise on Perfumery*, by A. J. Cooley; *Manufacture of Perfumery*, by Dr. C. Deite; and *Art of Perfumery*, by C. H. Piesse.

Marcus Benjamin.

Perkins, Frederic Beecher: author; b. in Hartford, Conn., Sept. 27, 1828; studied at Yale, but left college in 1848 to study law; was admitted to the bar in 1851, afterward entering the Connecticut Normal School, where he graduated; became assistant editor of *Barnard's American Journal of Education*, and was made librarian of the Connecticut Historical Society, subsequently becoming secretary of the Boston Public Library, and in 1880 librarian of the San Francisco Free Public Library. Among his publications are *Scrope, or the Lost Library* (1874); *My Three Conversations with Miss Chester* (1877); *Charles Dickens, his Life and Works* (1877); and *Rational Classification of Literature for Shelving and Cataloguing Books in a Library* (1881–82). D. Jan. 27, 1899.

Perkins, George Henry, Ph. D.: naturalist; b. in East Cambridge, Mass., Sept. 25, 1844; graduated at Yale in 1867, and received the degree of Ph. D. there for post-graduate studies in 1869, when he was called to the chair of Natural History in the University of Vermont, and also became State entomologist of Vermont; has closely studied the archæology of the Champlain Valley, writing much on the subject for periodicals and scientific societies; has lectured on natural history. Reports of his published by the State of Vermont are *On the Injurious Insects of Vermont* (1876–78); *The More Important Parasites Infesting Man and the Lower Animals* (1880); and *The Flora of Vermont* (1882).

Perosi, Lorenzo: priest and composer; b. in Tortona, Piedmont, Italy, Dec. 20, 1872, the son of a village church organist. His first studies were with his father, then at the conservatory in Milan. At eighteen he was appointed organist at Monte Casino, and was subsequently musical director of the chapel at Imola, director of the Royal Chapel and organist of St. Mark's, Venice. He then took up the study of theology, and was ordained priest when twenty-three years old. The pope appointed him director of music in the Sistine Chapel, Rome. He has written four oratorios: *The Passion*, Sept., 1897; *The Transfiguration of Christ*, Feb., 1898; *The Resurrection of Lazarus*, Nov., 1898; and *The Resurrection of Christ*, Mar., 1899. *The Nativity of Christ* is still to be performed. His projected series of oratorios will cover the entire life of Christ, and will include twelve oratorios. The performance of these works in Italy, Paris, London, and New York aroused much enthusiasm. His style is that of Bach and Handel, modified by Italian melody. D. E. Hervey.

Perowne, John James Stewart, D. D.: Church of England, Bishop of Worcester; b. in Burdwan, India, Mar. 13, 1823; graduated B. A. at Cambridge 1845, and was elected fellow of Corpus Christi College; vice-principal of St. David's College, Lampeter, 1862–72; prælector in theology in Trinity College, Cambridge, 1872–78; Hulsean Professor of Divinity 1875–78. In 1878 he became Dean of Peterborough, and in 1891 was raised to the episcopate as Bishop of Worcester. He was a member of the Old Testament company of Bible revisers 1870–84, and of the royal commission on ecclesiastical courts 1881–83. He won great fame as a Hebrew scholar. Among his publications are *The Book of Psalms, a new translation with notes, critical and exegetical* (London, 1864–68, 2 vols.; 9th ed., in 1 vol., 1898); the Hulsean lectures on *Immortality* (1869); *The Remains, Literary and Theological, of Bishop Thirlwall* (1875–76, 3 vols.); *The Doctrine of the Lord's Supper* (1887); he edited *The Cambridge Bible for Schools* (1877, *sqq.*) and *The Cambridge Greek Testament for Schools and Colleges* (1887, *sqq.*). S. M. J.

Perry, Enoch Wood: artist; b. in Boston, Mass., July 31, 1831; after visiting New Orleans in 1848, went to Europe, studying in Düsseldorf and Paris 1852–53, subsequently going to Rome; was U. S. consul at Venice 1856–58, when he returned and settled in Philadelphia; went to the Sandwich islands in 1863, and in 1865 settled permanently in New York city; was recording secretary to the National Academy of Design 1871–73, holding the same position in the American Art Union; first exhibited at the National Academy in 1858, and became a member thereof in 1869. Besides many portraits, including those of Jefferson Davis, John Slidell, and John C. Breckinridge, he has painted *The Weaver*; *Lost Art*; *Thanksgiving Time*; *Young Franklin and the Press*; *The Sower*; *Mother and Child*; *Afternoon Nap*; *Solitaire*; *A Modern Eve*; *The Milkmaid*; *The Wicker-Workers*; and *The Cradle Song*.

Peru: The development of the rich part of Peru lying E. of the Cordilleras is likely to be hastened by communications now being established both with the Pacific and the Atlantic. A road is being constructed between the Oroya Railroad and the navigable Pichis river of the Amazon basin, by means of which a through route will be established across the continent from Callao to the mouths of the Amazon. This eastern part of Peru is rich in minerals, timber, and rubber, and has great agricultural possibilities. Its chief town is Iquitos, which is within reach of Atlantic commerce by the Amazon, and is 3,000 miles from Para. Water is abundant, and the climate is healthful, and is said to be sufficiently temperate at certain altitudes to encourage European immigration.

Peruvian cotton of the Pacific coast valleys is growing in importance as an article of export. It does not compete with American cotton, for it is used in the U. S. and elsewhere in manufactures for which the cotton staples of the Southern States are not suited. It is used by manufacturers of woolen goods, especially of underwear and hosiery. The staple is longer than that of U. S. upland or the Indian cotton, though shorter than sea-island or Egyptian. The total exports from New York to Peru in 1897 viâ the Straits of Magellan amounted to 15,612 tons. The principal U. S. articles sent to Peru are refined petroleum, lumber, railroad ties, and machinery. Two lines of steamers ply between New York and the western coast of South America. A line from San Francisco would increase the U. S. trade. Trade is now largely controlled by Europe. England sends more than a third of the imports, Germany about a sixth, France a ninth, and then follow Chile and the U. S. More than half the exports (sugar, cotton, wool, silver and copper and their ores, rubber, cocaine, and coca-leaves) go to England and a fourth to Chile. C. C. Adams.

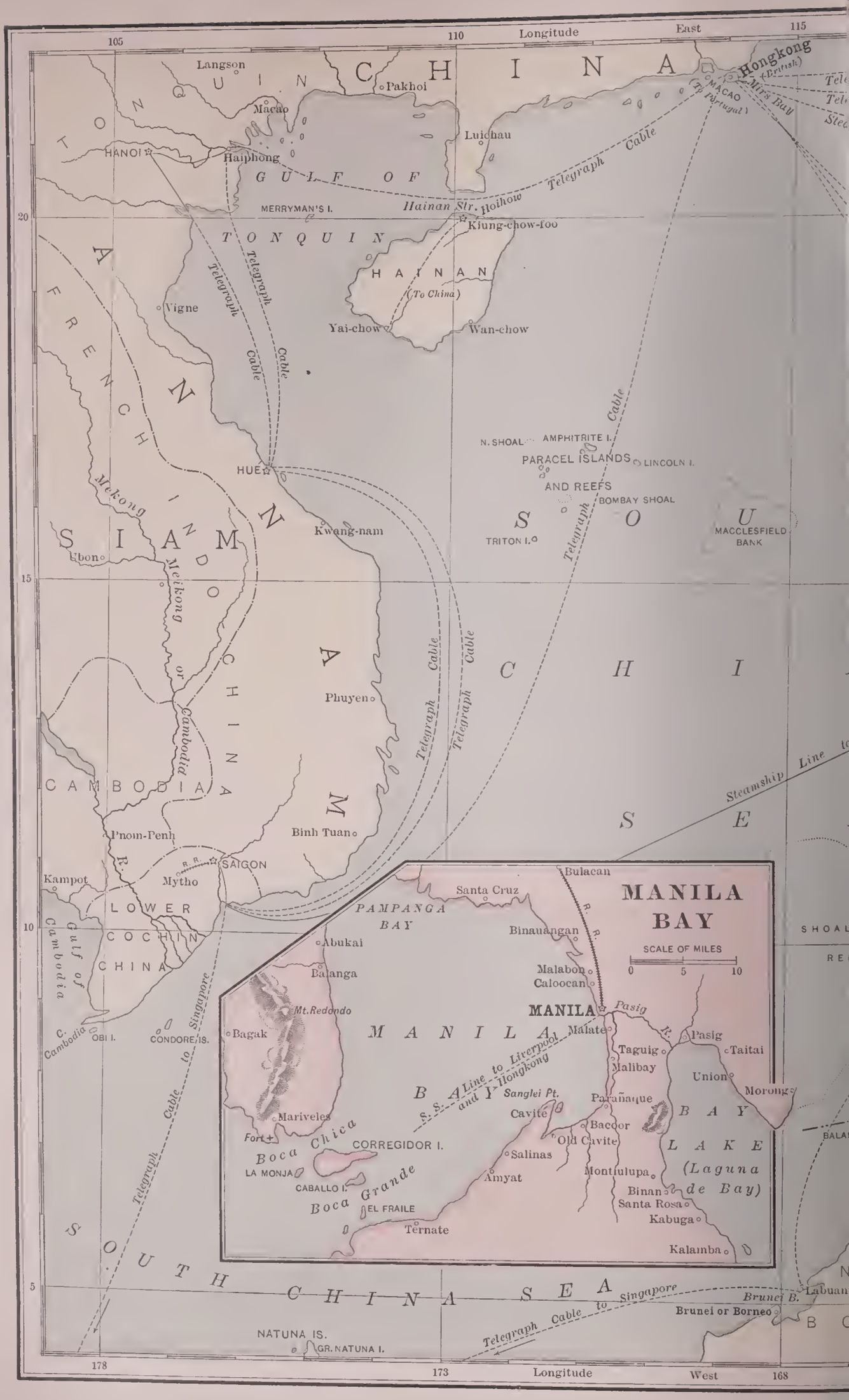
Petersen, Dory: pianist; wife of Richard Burmeister (*q. v.*), to whom she was married in 1883; b. in Oldenburg, Germany, Aug. 1, 1860, and for seven years a pupil of Franz Liszt. She appeared at many concerts in European capitals, and since 1887 has been head of the musical department of the Woman's College of Baltimore, Md.

Petersilea, Carlyle: pianist; b. in Boston, Mass., Jan. 18, 1844, and at twelve years of age was considered a musical prodigy. His entire career has been spent in Boston and vicinity as a pianist, teacher, and composer. In addition to his musical works and studies, he has written two books entitled *The Discovered Country* and *Oceanides: a Psychical Novel*.

Phelps, Thomas Stowell: naval officer; b. in Buckfield, Me., Nov. 2, 1822. He was graduated at the Naval Academy in 1846, and was promoted to lieutenant in 1855. He saw service in the Mexican war; engaged in fighting Indians in Washington Territory 1855–56; was with the Paraguay expedition 1858–59; served in the relief expedition dispatched to Fort Sumter at the outbreak of the civil war; assisted in surveying and charting the Potomac river in 1861 for the defense of Washington; in the same year, operating in the secret-service division, he examined a number of North Carolina inlets, and buoyed the Hatteras inlet to aid expeditions into the waters of that State, during which service he had frequent skirmishes with Confederate gunboats; took part in several engagements with the Yorktown and Gloucester Point batteries, and was instrumental in destroying two Confederate vessels; by timely and well-planned movement he prevented the conjunction of a large body of Confederate troops with the main army at the battle of West Point, Va.; was advanced to lieutenant-commander 1862; examined and surveyed obstructions dangerous to U. S. blockading vessels 1863–64; in 1865 commanded the Juniata at the capture of Fort Fisher; became commander 1865, captain 1871, commodore 1879, rear-admiral 1884, and was retired 1885. He wrote *Reminiscences of Washington Territory* (1882). D. Jan. 10, 1901.

Philip, John Woodward: naval officer; b. in Kinderhook, N. Y., Aug. 26, 1840; graduated at the Naval Academy, Annapolis, in 1860; was commissioned midshipman the following year and attached to the frigate Constitution. He was commissioned lieutenant July 16, 1862, was made executive officer of the Chippewa, the Pawnee, and the Montauk of the South Atlantic blockading squadron, and was engaged in the bombardment of Fort Sumter and the siege of Charleston. He was executive officer of the Wachusett of the East Indian squadron 1865–67, being commissioned lieutenant-commander July 25, 1866; was ordered to the flag-ship Hartford in 1867 and to the Richmond in 1868, where he remained until Nov., 1871. In 1872 he again became executive officer of the Hartford, from which he was detached to command the Monocacy. In 1874 he had leave of absence to command one of the steamships of the Pacific Mail Company. He was commissioned commander Dec. 18, 1874, and in 1876 his leave of absence was revoked and he was put in command of the Adams. The following year he was granted leave of absence to conduct the Woodruff scientific exploring expedition around the world. On his return he was put in command of the Tuscarora, and was engaged in surveying expeditions. In 1884 he became lighthouse inspector for the twelfth district, and in 1887 was ordered to the command of the receiving-ship Independence at Mare island navy-yard. Here he remained till 1890, receiving the commission of captain Mar. 31, 1889. He was in command of the Atlanta for a year, and then was made general inspector of the New York, which was not finished till 1893, when he was put in command. He had charge of the Boston navy-yard 1894–97, when he was put in command of the Texas. In the war with Spain in 1898 his ship took an active part in the battle of July 3 off Santiago. He was commissioned commodore Aug. 10, 1898, was ordered to the command of the Brooklyn navy-yard Dec. 23 of the same year, and soon afterward became a rear-admiral. D. June 30, 1900.

Phil'ippine Islands (Spanish, *Islas Filipinas*), named in honor of King Philip II. of Spain: a large archipelago between the Pacific Ocean and the South China Sea, ceded (with the Sulu group) to the U. S. by the treaty with Spain, signed in Paris by the peace commissioners of the two countries Dec. 10, 1898, and ratified by the Senate of the U. S. on Feb. 6 and by the Queen Regent of Spain on Mar. 17, 1899. The northern limit of the ceded territory is Bashi Channel, S. of Formosa, lat. 21° 20′ N., the most northern lands being the Batan or Bashi group of small islands, embracing about 130 sq. miles. The southern limit is Sibutu island, the southernmost of the Sulu group, in lat. 4° 30′ N. The possessions of the U. S. thus extend N. and S. a distance of about 1,160 statute miles, and are connected with Formosa by the reefs and islets of the Batan group and with Borneo by the chain of the Sulu islands, and farther E. by the island chain of which Palawan island is the largest member. The widest part of the U. S. domain is in the S., where the scattered islands from Palawan and Balabac in the W. to Mindanao in the E. extend about 715 miles E. and W. Most of the land area is included between


105
110
Longitude East
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Pakhoi
Macao
Luichau
HANOI
Haiphong
G U L F O F
T O N Q U I N
Hongkong (British)
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Mirs Bay
Tele
Tele
Stee
Telegraph Cable
MERRYMAN'S I.
Hainan Str.
Hoihow
Kiung-chow-foo
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T O N Q U I N
H A I N A N
(To China)
Vigne
Yai-chow
Wan-chow
A N N A M
F R E N C H I N D O C H I N A
Telegraph Cable
Telegraph Cable
N. SHOAL
AMPHITRITE I.
PARACEL ISLANDS
LINCOLN I.
AND REEFS
BOMBAY SHOAL
HUE
Mekong
S I A M
Kwang-nam
Ubon
S O U
TRITON I.
MACCLESFIELD BANK
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Phuyen
C H I
Telegraph Cable
Telegraph Cable
Steamship Line
C A M B O D I A
S E
Binh Tuan
P'nom-Penh
R.
R. R.
SAIGON
Kampot
Mytho
L O W E R
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Gulf of Cambodia
C. Cambodia
OBI I.
CONDORE IS.
to Singapore
Telegraph Cable
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Mt. Redondo
M A N I L A
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PAMPANGA BAY
Santa Cruz
Bulacan
Binauangan
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MANILA BAY
SCALE OF MILES
0 5 10
Malabon
Caloocan
MANILA
Pasig R.
Malate
Pasig
Taguig
Taitai
Malibay
Union
Morong
B A Y
Sanglei Pt.
Parañaque
Cavite
Bacoor
Old Cavite
L A K E
(Laguna de Bay)
Salinas
Montiulupa
Binan
Santa Rosa
Kabuga
Kalamba
Amyat
Ternate
Mariveles
Fort
Boca Chica
CORREGIDOR I.
LA MONJA
CABALLO I.
Boca Grande
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Telegraph Cable to Singapore
Brunei B.
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Labuan
NATUNA IS.
GR. NATUNA I.
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PHILIPPINE ISLANDS
SCALE OF MILES
0 50 100 150 200
Greenwich
120
125
FORMOSA (To Japan)
South Cape
BOTEL TOBAGO
Bashi Channel
MABUDIS I.
BATANES OR BASHI IS.
IBAYAT I.
BATAN I.
SABTAN I.
BALINGTAN IS.
Balintang Channel
CALAYAN I.
BABUYAN CLARO
BABUYAN OR FIVE IS.
DALUPIRI I.
DEDICAS
CAMIGUIN
FUGA I.
C.Bojeador
Aparri
C.Engano
Mt.Cagua (Vol.)
Mt.Cetaceo
Laoag
Vigan
Abra R.
Cagayan R.
Tuguegarao
ANSON OR CLARE SHOAL
S.Fernando
Balanan
C.Bolinao
Port Sual
Lingayen G.
Lingayen
Dagupan
St. Thomas
Dilasac B.
C.St.Ildefonso
Agno R.
Baler
LUZON ISLAND
Tarlac
San Isidro
San Fernando
POLILLO I.
Iba
Bacolor
Subig
Calumpit
Bulacan
Malolos
MANILA
SCARBOROUGH BANK
CORAL REEF
SOUTH ROCK
Subig B.
Manila Bay
Calamba
Taal
Tayabas
Morong
Batangas
Daet
St.Miguel B.
Maqueda Chan.
Mt.Isarog
CATANDUANES I.
Ragay B.
Logonoi B.
Calapan
Mt.Halcon
MARINDUQUE I.
St. Bernardino Str.
Albay
MINDORO I.
Mt.Mayon (Vol.)
Bulusan (Vol.)
Donjon
ROMBLON I.
BURIAS I.
BATAG I.
TABLAS I.
SIBUYAN I.
MASBATE I.
Calbayog
Pt.Binugayan
BUSUANGA I.
CALAMIANES IS.
CALAMIAN I.
SEMERARA I.
Mindoro Str.
Pandan
Capiz
Asid B.
BILIRAN I.
Catbatogan
SAMAR
SIBAY I.
LINAPACAN I.
VISAYAN ISLANDS
CUYOS IS.
CUYO
PANAY I.
Tacloban
Guiuan
Cook Channel
Tatay
Iloilo
Escalante
LEYTE
ZEBU OR CEBU I.
MALHOU I.
Surigao Str.
GUIMARAS I.
Bacolot
Zebu or Cebu
DINAGAT SURIGAO IS.
DUMARAN I.
NEGROS OR Malaspina Vol.
Babuan
NEGRO I.
BOHOL I.
SIARGAO I.
Surigao
CAGAYANES IS.
CAGAYAN
Honda B.
PALAWAN OR PARAGUA I.
Dumaguete
Tagbilaran
BUCAS I.
Tolon
CAMIGUIN I.
Sagay
Cantilan
Tago
Dahin
SIQUIJOR I. (FUEGO)
Ragacay
Butuan
Canay
Puerto Princesa
Dapitan
Iligan Bay
Macajala B.
Sindangan B.
Misamis
Illgan
Bislig
Mt. Humayaan
S.Nicolas (Cateel)
Danaan
MINDANAO
L. Mindanao
Illana B
Sibuco B.
Sibuguey R.
Macaturing (Vol.)
Caraga
Zamboanga
Cottabato
Mt. Apo (Vol.)
Davao
Balete
Davao Gulf
Bandaguitan
Basilan Str.
BASILAN I.
BASILAN IS.
Canaren
Bonoyan
C.St.Augustine
SULU OR SULUK IS.
Sulu
SULU ARCHIPELAGO
TAPUL IS.
Sarangani or Butulan (Vol.)
SARANGANI IS.
Siboye Pass
TAWI-TAWI IS.
Sibutu Passage
Darvel B.
CELEBES SEA
Washington
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the meridians 120° and 125° E. from Greenwich. The northern limit at the Bashi Channel was established by Spain at an early day. The Sulu Archipelago came into the possession of Spain by treaty with the Sultan of Sulu signed Aug. 15, 1882, and thereafter formed an administrative province of the Philippines Government. Parts of it had been occupied by Spain in 1876. The boundary between the Philippines and British North Borneo in the region of the Palawan chain of islands was established Mar. 7, 1885, by a treaty between Great Britain, Spain, and the Netherlands, which provided that the islands Balanbangan, Banguey, and Malavalli, together with all islands within 3 geographical miles of the coast of British North Borneo, should be a part of that colony.

Area.—The Philippines are very imperfectly known. Not even the larger islands have been accurately surveyed, and considerable parts of the interior have not been explored, the largest unknown regions being in Mindanao. That many of the coasts have been surveyed is due to the energy of maritime nations, particularly Great Britain and the Netherlands. The number of islands is not known. Hundreds are very small, and recent estimates have varied from 600 to 2,000. It is possible that, counting every islet, the latter estimate may not be very excessive, though the question can not yet be determined. The largest island, Luzon, about 41,000 sq. miles, is the fourteenth, and Mindanao, about 37,500 sq. miles, the sixteenth largest island in the world. The other large islands in order of size, with approximate areas (including where specified some of the most important small islands near them), are: Palawan and Calamianes, 5,500 sq. miles; Samar, 5,200; Panay, 4,860; Negros, 4,700; Mindoro, with Marinduque and Lubang, 3,900; Leyte, 3,060; Cebu, with Bantayan, 1,800; Bohol, with Siquijor, 1,600; Sulu and Basilan (Sulu group), 1,450; Masbate and Ticao, 1,300. It is thus seen that the twelve largest islands with their main dependencies contain approximately about 111,870 sq. miles; and as it is estimated upon the best data now attainable that the total area of the land surface is not more than 115,000 sq. miles, it is evident that most of the large number of islands are very small. The estimates of area given above are based upon computations made in the Gotha Geographical Establishment, and are smaller than the Spanish estimates.

Distribution of Islands and Population.—The land area may be divided into six groups of islands: (1) The Luzon group, including the Batan islands, Luzon, and the islands Polillo and Catanduanes, E. of Luzon. (2) The Mindoro-Masbate group, including the islands Mindoro with Marinduque and Lubang, Romblon with Tablas and Sibuyan, Burias, Masbate, and Ticao. (3) Group of the Visayas islands, including the islands Samar, Leyte, Bohol with Siquijor, Cebu with Bantayan, Negros and Panay. (4) Mindanao. (5) Calamianes and Palawan. (6) Sulu islands, of which Basilan and Sulu or Jolo are most important. The latest census, for purposes of taxation and very imperfect, was taken in 1887, and indicated that the islands had a population of about 7,000,000. It is believed that the population in 1899 is between 7,000,000 and 8,000,000. The best data as to density of population indicate that the Visayas group is most thickly settled, with a density of 114 to the square mile. Then come Luzon and its dependencies, with a density of 85; Sulu group, 57; Mindoro-Masbate group, 39; Mindanao, 15; Calamianes and Palawan, 13. These figures are merely more or less valuable approximations accepted for the time while no satisfactory data exist. The known facts, however, show that the Philippines have a comparatively dense population, about 60 to the square mile, according to the estimates given.

Geology and Topography.—Little study has been given to the geology of the archipelago, and that chiefly to economic geology. Most of the islands appear to have been lifted above the sea at a comparatively recent epoch, as is shown by raised beaches and coral reefs, now a little inland, which contain shells similar to those of marine animals now living in those waters. Some islands, like Cebu, have a cap of limestone deposited when they were below sea-level. Underlying the sedimentary rocks, and also spread over large areas of the surface, schists, granite, gneiss, diabase, volcanic minerals, etc., have been traced. The development of railroad-building and mining will promote geological study by opening cuttings and excavations. The islands are connected with Borneo and Celebes by three ridges, partly submarine and partly emerged, forming island chains between the northern and southern lands. These three lines of ridges are continued N. through the Philippines, and form a large part of their relief, the whole orographic system of the islands coinciding with or being parallel to these lines. Mountains are the predominant topographic feature. Very few summits much exceed 8,000 feet in height, and the loftiest peaks yet known are Apo (more than 10,000 feet) and Malindang in Mindanao, Halcon in Mindoro, and Mayon in Luzon. The plains are alluvial districts on the middle and lower courses and at the mouths of the rivers. The alluvial districts are of considerable extent, particularly in Luzon, whose broad low plains N. of Manila, between the coast mountain ranges, are very productive. There is much tillable land in the valleys, but the total cultivable area is not more than a third of the land surface.

Volcanoes and Earthquakes.—The Philippines are a region of considerable igneous energy. Extinct craters are numerous, and seem to be disposed in regular axes coinciding with those of the islands. Most of these volcanoes are now extinct, and the three active volcanoes that attract most attention are in South Luzon. Bulusan (5,327 feet), at the southern end of Lusan, was long inactive, but has had periods of mild eruption since 1852. Mayon or Albay (7,786 feet), 27 miles N. of Bulusan, is the most active and destructive in the archipelago. It is an almost perfect cone, rises from a base covering 80 sq. miles, and no trace of a crater properly so called has been discovered. Forests cover its sides to a height of 2,000 feet, and the scoria above is difficult to scale. It ejects little lava, but enormous quantities of ashes. In the last century thousands of people have been killed and many villages destroyed by its eruptions, and the ejected matter has been blown as far away as Manila, 200 miles distant. Taal is 45 miles S. of Manila, only 850 feet above the sea, on an island on Bombom Lake, and its crater is about 800 feet deep and a mile in diameter. It was most active in the eighteenth century, but is still steaming, and the eruption of 1885 destroyed all vegetation on the island. There are smoking cones in the northern part of Luzon and on the islands farther N., and also on Negros and Mindanao. In spite of the vents afforded to the subterranean forces by active volcanoes, some part of the archipelago is almost continually in a state of tremor. The seismic vibrations normally run from W. to E., and nearly every year some disaster is caused by earthquakes. In 1880 the cathedral and other massive buildings in the old city of Manila were completely wrecked, but the effects of this shock were less disastrous than those of 1863, when nearly the whole of Manila was destroyed, with great loss of life. The liability to great damage has since been lessened by erecting buildings that can better withstand the shocks.

Drainage.—The islands are well supplied with rivers, smaller streams, and lakes. Many lakes are large. Laguna de Bay (Bay Lake), which nearly bisects Luzon, S.E. of Manila, is 25 miles long by 21 miles wide, covers an area of 350 sq. miles, and is a commercial convenience. Its outlet is the Pasig river, which enters Manila Bay through the city. The parallel mountain ranges give space for important rivers both in Luzon and Mindanao. The largest is the Cagayan or Rio Grande, which has a course of more than 200 miles and carries the drainage of Northern Luzon, between the coast cordilleras, to the northern coast. It has numerous affluents, and the system supplies the wide valleys with abundant water. South of this system the Abra and the Agno carry the rainfall of a large area to the China Sea, and the Pampangan, which traverses the vast plain of that name, empties into the northern side of Manila Bay, where its broad delta, with more than twenty mouths, projects beyond the old coast-line. These delta streams are much used to carry produce to market at Manila. All these lowlands are dotted with lakes. The Pasig is only 12 miles long. Small steamers ply on it between Bay Lake and the sea. The longest river of Mindanao flows N. in a wide valley between the mountain ranges. It is the Agusan or Batuan, and is navigable for a few miles. The Rio Grande is navigable for about 70 miles and flows S. and W. into the Celebes Sea. There are many crater lakes on this island.

Climate.—Though the Philippines are within the tropics, their north and south extension of nearly 1,200 miles, N. of the equator, and the differing altitudes, give them considerable variety of climate, which, however, is essentially tropical, the normally high temperature oscillating between narrow limits. The fact that the climate is also insular gives the island an advantage over continental areas within the tropics, and the nights often afford relief from the trying heat of the day by temperatures 10° to 20° cooler. Tem-

perature records have been kept only at the Meteorological Observatory in Manila, and these show that in that city the mean annual temperature is 80° F., and the extremes are 60° and 100°, or an annual range of 40°. The hottest season is from March to June, and the greatest heat is generally felt in May, when the maximum ranges from 80° to 100° in the shade. The maximum in every month of the year is 91° or more, but the records show no temperatures higher than 100°. The coolest weather is in December and January, when the temperature falls at night to 60° or 65° and seldom rises in the day above 75°. The cool season lasts from November to February inclusive, when the sky is bright, the atmosphere cool and dry, and the weather delightful. As, however, the temperature varies only by a few degrees from month to month, it is useless to distinguish seasons, and the year is divided into the wet and dry monsoons, the dry polar current from the N. E. prevailing from October to April and the moist southwest monsoon for the rest of the year. From July to October inclusive the rains are very heavy, and large tracts of lowlands are flooded. The mean annual rainfall at Manila is 75 inches, and the extremes of annual precipitation have ranged from 121 to 36 inches. The roads are almost impassable in the rainy season, and many forms of business are much retarded. Typhoons occur between May and November, but are most frequent in July, August, and September. They develop in the Pacific and sweep over the China Sea during the southwest monsoon. They affect the Philippines as far S. as Mindanao, wrecking vessels, destroying villages, and often killing hundreds of people. The most dangerous time at Manila is about the end of October. The typhoon which struck that city in 1882 was one of the most terrific on record, and its velocity was 140 miles an hour. Hongkong now gives cable notice of the approach of these storms, and much property is thereby saved. On the whole, the islands are, for a tropical region, considered healthful for people of the white race if the hygienic observances required in such regions, now fairly well understood, are observed.

Flora.—In 1882 botanists had already recognized 4,583 species of plants belonging to more than 1,200 genera. The forest growths are an important factor in the natural riches of the islands. They cover very large areas, but are unequally distributed, and Cebu and Panay have been nearly denuded of trees by the conversion of the land into farms. Many varieties of little-known trees are useful for many purposes, and ebony, cedar, ironwood, sapanwood, logwood, gum-trees, the cocoanut and areca palms, and the bamboo abound. Gutta-percha is found in some places. Every part of the cocoanut-palm is turned to account, and the oil expressed from the nut was the only substance used for lighting before the introduction of kerosene. There are numerous varieties of the bamboo, which grows profusely everywhere and serves a great many purposes. Among the particularly useful hard woods are the *molave*, a brown timber of great strength and hardness, which is proof against the attacks of the white ant; the *dongon* and the *ipil*, which are much used for buildings, vessels, and furniture. Nearly all tropical fruits are grown, but the orange, pineapple, banana, and some others are by no means of the best quality. The cacao-tree, the mango, and guavas flourish. The yam and sweet potato are everywhere raised; wheat is cultivated to some extent in the more elevated regions; maize is grown a little, but does not thrive; and the cucumber, onion, melon, pumpkin, and some other vegetables, introduced long ago by the Spanish priests, are now widely cultivated. White potatoes are beginning to be raised to a small extent.

Fauna.—There are no beasts of prey except the ngiao, a species of wild cat, and this is not very plentiful. The *Macacus cynomolgus* and other apes and monkeys are found, and also the wild East Indian buffalo, deer, and hogs, which probably have descended from domestic animals. Goats, sheep, dogs, and cats are numerous, and so are flying squirrels and very large bats. The tame buffalo, called the water-buffalo because it delights to wallow in mud and water, is used everywhere in agricultural work, and also as a pack and draught animal in freight transportation. It is the most useful domestic animal. Many cattle are raised in some islands for beef. All the venomous snakes are represented, crocodiles grow to enormous size, and white ants, mosquitoes, tarantulas, and other large spiders are among the insect pests. About 600 species of birds are known, and bird-life is very abundant. The surrounding seas abound with life and some of the rivers teem with fish.

Minerals.—Only about a score of islands are known to contain valuable minerals. Their geographical distribution is shown in the following table prepared by Mr. George F. Becker, of the U. S. Geological Survey. All the mineralogical data here given are taken from his report, which is the latest and fullest summary:

ISLAND.	Latitude (north end).		Character of mineral resources.
	°	′	
Luzon	18	40	Coal, gold, copper, lead, iron, sulphur, marble, kaolin.
Catanduanes	14	8	Gold.
Marinduque	13	34	Lead, silver.
Mindoro	13	32	Coal, gold, copper.
Carraray	13	21	Coal.
Batan	13	19	Coal.
Rapu-Rapu	13	15	Coal.
Masbate	12	37	Coal, copper.
Romblon	12	37	Marble.
Samar	12	30	Coal, gold.
Sibuyan	12	30	Gold.
Semarara	12	7	Coal.
Panay	11	56	Coal, oil, gas, gold, copper, iron, mercury (?).
Bilaran	11	43	Sulphur.
Leyte	11	35	Coal, oil, mercury (?).
Cebu	11	17	Coal, oil, gas, gold, lead, silver, iron.
Negros	11		Coal.
Bohol	10	10	Gold.
Panaon	10	10	Gold.
Mindanao	9	50	Coal, gold, copper, platinum.
Sulu Archipelago	6	30	Pearls.

The coal might better be characterized as a highly carbonized lignite. It may supplant imported coal for most purposes. The finest beds thus far found are in the small island of Batan, E. of the southern part of Luzon (lat. 13° 19′), the heating effect being about three-fourths that of Cardiff coal. Large deposits in Southern Mindoro and Semarara are said to be similar to those of Batan. The deposits thus far known in Masbate and Panay are not of much importance. A high quality is reported from Leyte. The maximum thickness of the seams on Cebu is 15½ feet, and ten analyses of Cebu coal indicate a caloric effect of two-thirds that of Cardiff coal. The occurrence of lignite along the entire eastern coast of Mindanao is probable, judging from the outcrops already known.

In Cebu petroleum has been found associated with coal at Toledo, on the west coast, and is also reported from Asturias, N. of Toledo, on the same coast, and from Alégria to the S. Natural gas is said to exist in the Cebu coal fields. On Panay, oil is reported at Janiuay, province of Iloilo, and also gas on the same island. Petroleum highly charged with paraffin is found on Leyte.

Gold is found at a vast number of places from North Luzon to Central Mindanao. It is usually detrital, and either in existing watercourses or in stream-beds now dry. In Mindanao some gravels are elevated and adapted to hydraulic mining. There are no data to determine decisively the value of these placers. They are washed by natives, largely with cocoanut-shells for pans. In Abra province, at the northern end of Luzon, are placers, and the gravel of the Abra river is auriferous. In Lapanto are gold-quartz veins as well as gravels. Gold is obtained in this province close to the copper mines. In Benguet the gravels of the Agno river carry gold. There is also gold in Bontoc province and in Nueva Ecija. The most important of the auriferous provinces is Camarines Norte. Here the townships of Mambulao, Paracale, and Labo are especially well known as gold-producing. Mr. Drasche, the German geologist, says 700 natives were at work on rich quartz veins at the time of his visit twenty-five years ago. Many other places in this province have been worked by the natives. At the south end of Panaon, just S. of Leyte, there are gold-quartz veins, one of which, 6 feet thick, has yielded from $6 to $7 to the ton. In Mindanao are two known gold-bearing districts, one in Surigao province and the other in the province of Misamis. Near Imponan and on the Gulf of Macajalar there are said to be many square miles of gravels carrying large quantities of gold, with which is associated platinum. The product of this district was estimated some years ago at 150 oz. per month, all extracted by natives.

Copper ores are reported from a great number of localities. Northern Luzon contains a copper region which is unquestionably valuable. The best-known part of this region lies about Mt. Data, lat. 16° 53′, long. 120° 58′ E. of Greenwich. Here copper ore has been smelted by the natives

from time immemorial. Reports indicate that there are copper mines in various parts of the Cordillera Central, but the only deposits examined with care are those at and near Mancayan (5 miles W. of Mt. Data). The deposits of Mancayan are described as veins of rich ore, reaching 23 feet in width and arranged in groups. Mean assays are said to show over 16 per cent. of copper, mainly as tetrahedrite and allied ores. The gangue is quartz. The country rock is described as a large quartzite lens embedded in a great mass of trachyte. An attempt has been made by white men to work these deposits, but without much success. The failure was not due to the quality or quantity of ore.

A lead mine has been partly developed near the town of Cebu. The most important deposit of argentiferous galena is said to be at Torrijos, on Marinduque. A metric ton, or 1,000 kilogrammes, is said to contain 96 grammes of silver, 6 grammes of gold, and 565·5 kilogrammes of lead. In Camarines, a province of Luzon, lead ores occur, but are worked only for the gold they contain.

There is iron ore in abundance in Luzon, Carabello, Cebu, Panay, and doubtless in other islands. In Luzon it is found in the provinces of Laguna, Pampanga, and Camarines Norte, but principally in Bulacan. The finest deposits are in the last-named province, near Camachin, where a small industry exists, wrought iron being produced in a sort of bloomery, and manufactured into plowshares. It would appear that charcoal pig iron might be produced to some advantage in this region. The lignites of the archipelago are probably unsuitable for iron-blast furnaces.

Sulphur deposits abound about active and extinct volcanoes. In Luzon the principal sulphur deposits are in Daclan, province of Benguet, and at Colasi, in Camarines. The finest deposit is said to be on the little island of Bilaran, N. E. of Leyte. Marble of fine quality occurs on the small island of Romblon (lat. 12° 37′). It is much employed in churches in Manila for baptismal fonts and other purposes. Marbles are also quarried at Montalban in Manila province, and at Binangonan in Marong province. There are concessions for mining kaolin at Losbanos in Laguna province. Pearl-fisheries exist in the Sulu Archipelago, and are said to form an important source of wealth.

Inhabitants.—All immigration into the islands in early times must have come from the W., and there is reason to believe that it was partly through a great emigration from the Philippines to the E. that the Polynesian islands were populated. Most of the native population is of Malay origin and may broadly be divided into three great groups: (1) Those who have become considerably advanced in civilization, and were called by the Spanish Indios or Indians, by which term they are distinguished from (2) the Moros or Moors, the name given by the Spanish to the Mohammedans who entered the archipelago from Borneo about four centuries ago, and occupy some of the southern islands; and (3) the savage or semi-savage tribes that have maintained their independence in the interior of Luzon and other islands, have never paid tribute to the Spaniards, still practice their pagan rites, and are called *Infieles* or Infidels. Besides these large groups is a small one, the Aetas or Negritos (Little Negroes), believed to be the remnant of the aboriginal inhabitants who were driven back or exterminated by the intruding Malays. The most potent forces in the development attained have been immigrants settling in the islands within a comparatively recent period, chiefly Spanish, Chinese, and traders of other nationalities.

There are perhaps 20,000 persons of pure Spanish blood, most of them in Manila and its neighborhood, though priests are widely scattered on their large land-holdings, and until after the Spanish-American war the Spanish official class represented the Government wherever Spain had acquired a foothold. The governmental and religious institutions had practically co-ordinate power. All inhabitants who could be reached by the tax-gatherer contributed to the revenues. Ports were opened to foreign trade only when the moral suasion of Europe compelled this step. The principal duty of the governors of the provinces was the collection of taxes, and the judicial machinery was so dilatory and inadequate as to give rise to complaints that justice could not be obtained in the courts. The Spanish Roman Catholic religious orders gained a large measure of control over the more advanced Filipinos, claimed some millions of converts, had enormous holdings of the finest lands which they leased to the natives on onerous terms, and while many of the clergy were men of excellent character and intentions, there were many others whose disreputable character and policy of oppression were detrimental to the natives. The chief reasons assigned by the Filipinos for their various revolts against Spanish rule were the oppression of the Church authorities, excessive taxation, and the injustice of the courts. Considerable Spanish capital is invested in sugar-raising and tobacco-manufactures, but the foreign trade of the islands except with Spain has been chiefly stimulated by British, German, and American merchants. The Spaniards have had no influence in improving the very backward position of agriculture. The descendants of Spanish fathers and native mothers are numerous, and many of the merchants and landed proprietors are of this class. The total European population is estimated at 25,000.

The Chinese are the most numerous among the foreigners in the Philippines. They number about 50,000, and in many of the towns most of the retail trade, banking, and money-lending is in their hands. Some of them also do a large wholesale business, sending agents through the country districts to collect produce which they export on their own account. Their persistent industry and economy have made them helpful to the natives and to business, and many of them have amassed considerable fortunes. Very few Chinese women go to the islands. Thousands of the native women have married Chinese, and their children, Chinese mestizos (half-breeds), numbering about 200,000 and inheriting to a large extent the excellent qualities of their fathers, are a most useful class. They share the business of their fathers, who, besides commercial pursuits, devote themselves to many trades.

The Indios or more or less civilized natives are divided into four groups, the Tagals, Vicols, Visayas, and Ilocanes. The Tagals, on the whole, are furthest advanced in civilization, number about 1,500,000, and the revolt against Spanish rule, and later against the U. S. Government in its efforts to restore order, has chiefly been confined to a part of them. Most of them live in Luzon in the low-lying plains, in the towns, and near the streams and sea. They are also found in Mindoro, Marinduque, and some smaller islands farther S. They are the chief native pioneers of civilization. Most of them live by raising rice and cattle, and by fishing. They are nominally Roman Catholics, are indolent like most tropical peoples, and welcome all the Church holy days as festive occasions. Physically they are well developed, and the Tagalog language is more widely spoken in the archipelago than any other. The Ilocanes, a comparatively small tribe, live in Northwestern Luzon, and differ from the Tagals chiefly in dialect. The Visayas, who give their name to the central group of islands, are estimated to number 2,500,000. The leading distinction between them and the other branches of the Malayan family in the archipelago is their language. The Vicoles occupy the Camarines peninsula, with the islands of Catanduanes, Burias, Ticao, and half of Masbate, greatly resemble the Tagals, and number about 400,000.

The Moros occupy the Sulu chain of islands and a large part of the coasts of Mindanao, Balabac, and the southern part of Palawan. They brought with them from Borneo their Mohammedan faith and social usages, have nothing in common with the peoples living farther N., have always resisted to the utmost the attempts of the Spaniards to convert them to Christianity, and formerly preyed severely upon the trade and natives of the northern islands until their reverses, due to primitive weapons and methods of warfare, restrained their piratical ardor. The work of keeping them in order and developing their islands appears practicable if no attempt is made to interfere with their religious belief.

The hill tribes and other wild tribes in parts of the interior of Luzon and a few other islands live as they did before the Spanish occupancy. They have many languages and dialects, probably number at least 500,000 souls, and Prof. Worcester and others who have visited some of the tribes found them quite simple and harmless, though others are warlike. They are most numerous in the interior of Mindanao. The Negritos are almost wholly confined to the higher mountain ranges in Luzon and Negros, are blacks, of almost dwarfish stature, and are likely to become wholly extinct. There is considerable admixture of blood among the Indios, the wild Malayan tribes, and the Negritos.

Agriculture.—Farming in the three centuries of the Spanish *régime* has been characterized by utter lack of

progress. Most of the people till the land as their ancestors did before the invasion from Europe. Only a ninth of the area is now cultivated, though agriculture is the chief industry. About 8,000,000 acres are under cultivation. The total production could be increased from ten to fifteen fold. There are scarcely any well-kept farms. Outside the hemp, coffee, sugar, and tobacco plantations tillage is confined to garden-patches around the huts, and the natives raise little more than their families require. A great part of the cultivated lands is owned by the religious corporations, Spaniards, and half-breeds, is usually worked on shares, and the produce of the plantations is sent direct to Manila, Iloilo, or Cebu. Much of the export products—hemp, sugar, coffee, and tobacco—is bought on the land by Chinese speculators, who ship it down the rivers or creeks in flat-bottomed canoes or barges. There is little agricultural machinery except sugar-mills and engines, and a sharpened stick often does duty as a plow. The most unique product, because it is a commercial success only in the Philippines, is Manila hemp (native name *abaca*), *Musa textilis*, a variety of the banana family, one of the most useful of fiber-plants, each plant yielding two qualities of fiber, one of which is the best material used for sail-cloths and cordage, and from the other is woven fabrics superior in softness and lightness to those made of the best Russian hemp. It produces under the best conditions as high as 3,000 lb. of fiber to the acre, most of which is exported, 6,528,965 bales having been sent abroad in ten years, the U. S. taking on an average 41 per cent. of the total exports. Rice, the staple food of the natives and of most of the Chinese, is grown in many varieties, some maturing within three months of planting, two crops being raised in a year. In some years, however, $2,000,000 worth of rice has to be imported, and most of it is brought from Cochin-China. The average annual production of rice is 36,000,000 bush. Sugar is grown very extensively, but most of it is poor and coarse and brings a low price because of slovenly cultivation and manufacture and lack of high-grade machinery. The sugar exports from Manila are mostly produced on Luzon, while those of the Visayas are for the most part shipped from Cebu. The best tobacco grows in the northern part of Luzon, in the provinces of Isabella and Cagayan, and is sent in covered boats down the Rio Grande to Aparri, and there shipped by steamer to Manila. The tobacco of Northwestern Luzon and the Visayas is of inferior quality, and has seldom been manufactured at Manila, but has usually been shipped to Spain. Manila cheroots and cigars are as famous and highly appreciated E. of the Cape of Good Hope as the Havana product is among Western nations. About 20,000 persons are employed in and near Manila in making cigars. The Philippine islands cotton staple is about an inch long, smooth, and of good color, but is not yet extensively raised. Coffee is grown, but has not had a fair trial, as the plantations are not well managed. The cocoa-palm attains perfection in these islands, and copra, one of its products, is exported in considerable quantity. The banana is most prolific and useful, yielding a larger amount of food from a given area than any other crop.

Manufactures.—Cigar-making at and near Manila is the largest industry. Small ships for the coasting trade are built to some extent. A cotton-mill costing $200,000, with 6,000 spindles, is an English enterprise at Manila, where there are also two sugar-refineries, some distilleries, a German cement-factory, Swiss umbrella and hat factories, carriage-factories, and ropewalks. In some villages of Luzon and Panay almost every family has a hand loom, and cotton and sail-cloths, quilts, coverlets, etc., are produced in considerable quantities. Cotton rugs of handsome designs are made in some of the islands, and fabrics of hemp, silk, and piña, the fiber of the pineapple-leaf, are also produced. There is room for splendid development in the island industries.

Commerce.—It was only after steam-navigation began, and particularly after the opening of the Suez Canal, that commerce developed in the Philippines. The export products have been mostly handled by large British, German, and Spanish houses and Chinese traders. These houses have usually advanced considerable money to producers in order to secure their crops, a procedure involving large capital and some risk, but very profitable. The British, Germans, and Belgians have sold a great deal of iron, zinc, machinery, guns, and hardware in the islands. Watches, cheap jewelry, shoes, oilcloth, varnishes, paints, and carriage fittings are among the articles in large demand. The following statistics show the amount and distribution of foreign commerce in the latest years reported:

COUNTRIES.	Imports from Philippines.	Exports to Philippines
Great Britain (1897)	$6,223,426	$2,063,598
France (1896)	1,990,297	359,796
Germany (1896)	223,720	774,928
Belgium (1896)	272,240	45,660
Spain (1895)	4,819,314	4,973,589
Japan (1897)	1,332,300	92,823
China (1897)	56,137	97,717
India (1896)	7,755	80,156
Straits Settlements (1896)	274,130	236,001
New South Wales (1897)	119,550	176,858
Victoria (1896)	180	178,370
United States (1897)	4,383,740	94,597
Total	$19,702,819	$9,174,093

The chief articles of export in 1897 were Manila hemp, $6,745,177, of which Great Britain took $3,694,214 and the U. S. $2,701,651; tobacco, $3,435,552, of which Spain took $2,533,150 and Great Britain $716,767; cocoanuts and copra, $2,009,602, of which France took $1,787,198; and sugar, $4,282,110, of which Great Britain took $1,512,703, Japan $1,156,411, the U. S. $1,199,202, and Spain $413,794. The principal imports were cotton manufactures, $1,524,622, of which Great Britain supplied $1,268,087; metals and metal manufactures, $337,216, of which Great Britain supplied $185,413; machinery, $191,269, of which Great Britain's share was $151,630; and provisions, $118,538. The total value of imports for the ten months ending October, 1900, was $20,143,152; of exports, $19,372,830.

Foreign commerce got a foothold in the Philippines in spite of long Spanish opposition. Foreign vessels were not permitted to enter Manila Bay nor foreign merchants to live in the city until the nineteenth century. The heavy protective tariff levied by Spain in 1891 diverted most of the trade to the home country, Manchester cottons being largely replaced by Barcelona goods. Later Great Britain regained the cotton trade, which is the most important feature of the imports. The trade of the U. S. with the islands fell off steadily during the last years of the Spanish occupancy. The import trade from the Philippines fell from $10,268,278 in 1888 to $4,383,740 in 1897; but it is now recovering.

Communications.—In 1899 Manila was in frequent but not regular communication with the U. S. by steamers. The only large line of ships connecting Manila with Europe is that of the Compañia Transatlantica, which has a monthly service to Liverpool, calling at Singapore, Colombo, Aden, Suez, Port Said, and Barcelona. Three steamship lines plying regularly between Australia, China, and Japan began calling at Manila in 1899. Several steamers under the British flag do a brisk business between Manila and Hongkong. A steamer runs to Singapore to meet the French mail-steamers, which carry the larger part of the Western mails. Manila is connected with the ports of the provinces by 35 steamers and a large number of small sailing vessels. The only railroad in operation is between Manila and Dagupan, 123 miles, connecting the capital with the rice-growing districts of Pangasinan. It is a single-track road, well and substantially built. The highways are very poor, and the streams are usually bridgeless. Travelers in the interior find no hotels, but every village has a public building, often a very rude structure, where free shelter may be had and food may be bought at a fixed scale of prices. Manila is connected with Hongkong by cable, and the U. S. is extending the land and cable lines on and between the islands.

Chief Ports.—The islands have an immense coast-line and a large number of good harbors, but the exclusive policy of Spain, which opened to foreign trade only five ports, has prevented the others from being well known except to coastwise traders. The treaty ports were Manila, Iloilo, Cebu, Sual, and Zamboanga. The last-named is on Mindanao and its trade is insignificant, and so is that of Sual. Manila Bay is one of the finest in the world, embraces 120 sq. miles, and the water is deep almost everywhere except in front of the city. The harbor works have not yet been completed, and one of the first needs is safe landing-places for the larger steamers, which now have to discharge part of their cargo by lighters. Manila's situation fits it to occupy a commanding position in Oriental trade. (See MANILA.) Iloilo, near the southeast end of Panay, is the second port in importance and is 250 miles from Manila. The approach to the harbor is a channel between a sandbank and Guimaras island, which is 2½ miles from the shore. The well-protected anchorage

is outside the Iloilo river, but small vessels enter and discharge their cargoes at the wharves. Cebu, on the island of the same name, formerly surpassed Iloilo in commercial importance, but for some years has held the third place. It chiefly exports sugar, hemp, tobacco, and sapanwood. Aparri, at the northern end of Luzon, the port from which the tobacco crop is shipped to the capital, is destined to become a place of large importance. A rich area is tributary to it, and it is 250 miles nearer Hongkong and 400 miles nearer San Francisco than Manila.

History.—The islands were discovered by the Portuguese sailor Ferñao de Magalhães (Magellan) in 1521, when he landed on the eastern coast of Mindanao. He then sailed to Cebu, where he was received in a friendly manner by the ruler and accompanied him on a war expedition in which the explorer was killed. Spain sent a number of expeditions to take possession of the islands, but all failed until 1565, when Philip II. sent Miguel de Legaspi to seize the islands, which had been named in his honor. Legaspi secured a foothold in Cebu, and later removed to Luzon, where Manila was founded in 1581. The coasts were gradually brought under the dominion of Spain, but the interior of the larger islands and some of the smaller ones were never subjected to her authority. For a long time the islands were attacked frequently by the Portuguese, who were jealous of the growing power of Spain in the Orient, and later by the Dutch, who wished to add the Philippines to their Eastern empire. None of these attacks, however, were of a formidable character, and Spain's most serious troubles with external enemies in the Philippines were the invasion of the Chinese pirate Li Ma Hong in 1754, when he attacked the Spanish with a powerful fleet of nearly 100 war-junks, but was finally defeated; and in 1762 when England captured Manila and held it with the surrounding country for two years, when, peace having been restored between the two countries, the territory was returned to Spain. The more civilized natives, including the half-breeds, were long greatly discontented with the government given them by Spain, and there were revolts from time to time, the most serious of which began in Aug., 1896, and continued, with one slight interruption, until the end of the Spanish rule. The capture of Aguinaldo March 23, 1901, was practically the end of the armed revolution, chiefly of the Tagals, against the American occupancy, which had been carried on with ever-decreasing success during 1899–1900. In March, 1900, President McKinley appointed a second commission, which arrived in Manila June 3, to organize the civil government of the islands. April 7, 1900, the Military Governor Major-General Otis was relieved at his own request. He was succeeded by Major-General MacArthur. On June 21 a proclamation of amnesty was issued, and in the following months many Filipinos took advantage of its provisions. On July 4, 1901, the military government was discontinued, excepting in such provinces as still remained in insurrection, and the Hon. William H. Taft, the president of the commission, appointed Civil Governor June 22, entered upon his duties.

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C. C. Adams.

Phillips, Claude: lawyer and art critic; b. near Manchester, England, about 1855; received a school and university education, and after taking his degree of bachelor of arts studied law, and was called to the bar at the Inner Temple in 1883. He practiced his profession but little, giving his attention to art criticism and history. He was formerly art critic for the *Manchester Guardian*, and is now (1899) art critic for the *Daily Telegraph*; he is a frequent contributor to the *Fortnightly Review*, *Art Journal*, *Magazine of Art*, the *Quarterly Review*, *Edinburgh Review*, *Nineteenth Century*, *Portfolio*, *Gazette de Beaux-Arts* of Paris, and other periodicals; is now (1899) keeper of the Wallace Collection. He has published *Life of Sir Joshua Reynolds*; *Life of Frederick Walker*; *Life of Antoine Watteau*; *The Early Work of Titian* and *The Later Work of Titian*, and other art criticisms and writings.

F. Sturges Allen.

Phillips, John Arthur: author; b. in Liverpool, England, Feb. 25, 1842; began his literary work in 1865 as a journalist in New York. In 1870 he moved to Canada, where he has continued his journalistic work. He has written many short stories, among which are *Thompson's Turkey, and other Christmas Tales* (1873); *Hard to Beat* (1877); *Bad to Worse* (1877); *The Ghost of a Dog* (1885); *Out of the Snow, and other Stories* (1886).

Phororhach'idæ: a family of gigantic extinct South American birds, characterized by the great size and massive structure of the skull, and especially of the beak, which is high, compressed, and terminates in a sharp hook. The nostrils are high up in the basal portion of the beak; the mandible is truncated at the back and curved upward toward the front, this being a very uncommon thing in birds. The sternum is unknown, but well-formed wings were present, although far too small to have been of any use for purposes of flight. The legs were massive, comparing in this respect with Dinornis and Æpyornis (*qq. v.*), and the character of the caudal vertebræ indicates that there was no external tail. The size of the skull may be appreciated from the fact that the first specimen discovered, the anterior portion of a lower jaw, was believed to belong to some great extinct sloth. In the best-known species, *Phororhachos inflatus*, the cranium was 13 inches long and the beak 4 inches deep, while the skull of *P. longissimus* attained a length of 21 inches; a neck-vertebra of this last species has a width of 5 inches. *Brontornis*, whose entire skull has not been found, was a still more massively built member of the family, the bones of the leg having the following measurements: femur, 17 inches; tibia, 30 inches; tarsus, 16 inches; or a combined length of 5 ft. 3 in. The width of the tarsus at its upper end is 5¼ inches, the leg of this bird being thus much larger than that of a horse. The remains of these birds are found in Tertiary deposits in Patagonia, considered by Florentino Ameghino, by whom the birds were first described, as Eocene. Other authorities, however, consider them to be not later than Oligocene and more probably Miocene, a supposition borne out by the specialized structure of the birds, which, in spite of their great size, are in no way related to the ostriches. They were assigned by Ameghino to a special order called *Stereornithes*, on the supposition that they were totally different from any existing forms; but while their relationships are still uncertain, they present no characters entitling them to rank as an order, and have affinities with the herons, and probably with the trumpeters (*Psophia*). From the structure of their beaks it is possible that the *Phororhachidæ* were to some extent carnivorous, although this is purely a matter of conjecture, while a published figure of *Phororhachos* attacking a *Hadrosaurus* is entirely misleading, since the two forms were separated by an immense interval of time.

Skull of *Phororhachos longissimus*, ⅛ natural size.

F. A. Lucas.

Picking, Henry Forry: naval officer; b. in Somerset co., Pa., Jan. 28, 1840; graduated at the Naval Academy in 1861; served in the North Atlantic blockading squadron 1861–62; was commissioned lieutenant in 1862, and took part in the engagement with the Confederate ram Merrimac and the batteries at Sewell's Point; was made lieutenant-commander in 1866, commander in 1875; served on the Kearsarge 1879–81, and afterward commanded the Michigan; advanced to captain in 1889, commanding the

naval forces of the South Atlantic station, where he rendered notable service in obviating a rupture between the U. S. and Brazil, receiving the commendation of the President and of the State and Navy Departments for his judicious course, after which he was relieved, his term of service having expired; afterward served on various boards: became commodore in 1898, rear-admiral and commandant of the Boston navy-yard in 1899. D. Sept. 8, 1899.

Pictet, Raoul: physicist and engineer; b. in Geneva, Switzerland, in 1842; educated at the university of his native city and subsequently for many years Professor of Physics in its faculty. He is the author of numerous papers on scientific subjects, and is best known for his successful attempt to liquefy oxygen and nitrogen in the winter of 1877–78. This famous experiment was announced at the meeting of the Academy of Sciences in Paris, Dec. 24, 1877, at which meeting the French physicist Cailletet reported a similar result reached by him independently and by the use of an entirely different method. The priority in this matter was given to Cailletet because he had previously made a demonstration of his method privately before certain members of the Academy. (See Liquefaction of Gases; also Liquid Air, in the Appendix.) These researches led Pictet to the development of the industrial applications of his apparatus for the production of artificial cold, and he has thus become one of the chief authorities upon refrigerating machinery and upon all subjects relating to cryogenic processes. E. L. N.

Pinar del Rio: a western province of Cuba and the most famous tobacco-growing region of the world. The chief seat of its cultivation is along the southern slopes of the Cordillera de las Organos, the famous Vuelta Abajo region. This tobacco is usually bought up in advance by speculators, and the manufactured product is retailed at very high prices. The land on which this tobacco grows has been cleared of forests and is covered with siliceous alluvial deposits. The Western Railroad traverses the Vuelta Abajo tobacco district, and extends to the city of Pinar del Rio, which is 104 miles S. W. of Havana. Other products of the province are coffee, corn, cotton, sugar, rice, and fruits. Pop. (1899) province, 173,064; city, 8,880. C. C. Adams.

Pinchback, Pinckney Benton Stewart: politician; b. in Macon, Ga., May 10, 1837; of African descent; attended school in Cincinnati, O., in 1846; became a river boatman in 1848; ran the Confederate blockade at Yazoo City and reached New Orleans, then in possession of Union troops, in 1862; by authority of Gen. Banks, raised a company of colored cavalry. He was active in politics in 1867, and was made inspector of customs; was a member of the State constitutional convention in 1867, and State Senator in 1868; appointed by President Grant register of the land office of New Orleans in 1869; founded the New Orleans *Louisianian* in 1870; was appointed a school director for New Orleans in 1871, and in the same year was elected president *pro tempore* of the Senate and became Lieutenant-Governor; was acting Governor during the impeachment of Gov. Warmoth, 1872–73; elected to the U. S. Senate in 1873, but was never admitted; was appointed commissioner to the Vienna Exposition from Louisiana in 1873, and was made a member of the State board of education in 1877; elected a delegate to the constitutional convention of the State in 1879, appointed surveyor of customs at New Orleans in 1882, and was a trustee of the Southern University 1883–85; was admitted to the bar in 1886, having graduated in the law department of Straight University.

Pirbright, Henry de Worms, First Baron, D. L., F. R. S.: English lawyer and statesman; b. in Egham, England, in 1840; educated at King's College, London, of which he was made a fellow in 1863, in which year he was called to the bar at the Inner Temple. He took up the practice of his profession, but became prominent chiefly in political affairs, and especially in matters relating to the foreign policy of Great Britain. He was Conservative member of Parliament for Greenwich 1880–85, and for Liverpool 1885–95; was parliamentary secretary to the board of trade of Liverpool 1885–88, and Under-Secretary for the Colonies 1888–92; in 1888 was made British plenipotentiary and president of the conference on sugar bounties. He has published *England's Policy in the East*; *The Austro-Hungarian Empire*; *Memoirs of Count Beust*; and also some articles and brochures on scientific subjects, including *The Earth and its Mechanism*.
F. Sturges Allen.

Pitt-Lewis, George: English lawyer and law-writer; b. in Honiton, Dec. 13, 1845; received his early education from private instructors at Honiton grammar school, where his father was head master; obtained studentship of the Inns of Court 1869, and was called to the bar; was made queen's counsel in 1885; was Liberal member of Parliament for Devonshire 1885–86, and Liberal-Unionist 1886–92; retired from the Liberal-Union party organization in 1894. He is now (1899) recorder of Poole. He assumed the maternal name Pitt in 1876 by royal license, being descended on his mother's side from William Pitt. He has published several works on local practice, and is also the editor of the ninth edition of *Taylor on Evidence* (1895), and joint author of *The Insane and the Law* (1897), a compendious treatise on modern lunacy legislation. F. Sturges Allen.

Plaisted, Harris Merrill: soldier; b. in Jefferson, N. H., Nov. 2, 1828; graduated at Waterville College (now Colby University) in 1853, and at Albany Law School in 1855; admitted to the bar and began to practice in Bangor, Me., in 1856. He became lieutenant-colonel of a volunteer infantry regiment in 1861, was promoted colonel in 1862, and took part in the Peninsula campaign, the siege of Yorktown, the seven days' battles, and the battles of Williamsburg and Fair Oaks; commanded a brigade in the siege of Charleston, and served with Grant in the Richmond and Petersburg campaigns. He was breveted brigadier-general of volunteers in Feb., 1865, and major-general in March. In 1865 he resumed his law practice in Bangor. He was twice elected to the Legislature, was attorney-general of Maine 1873–75, and was elected to Congress in 1874 to fill an unexpired term, but declined a re-election. He was Governor of Maine 1881–83, after which he edited and published the *New Age*, a Democratic weekly, in Augusta, which is now controlled by his son. D. in Bangor, Jan. 31, 1898.

Platt, Charles Adams: artist; b. in New York city, Oct. 16, 1861; studied art at the National Academy of Design and in Paris, giving special attention to etching, in which branch of art his works include *Fishing-Boats*; *Provincial Fishing-Village*; *Old Houses near Bruges*; *Deventer, Holland*; and *Dieppe*. He has exhibited in oil and in water-color at the Paris Salon, the National Academy, and elsewhere.

Platt, William Henry, D. D., LL. D.: b. in Amenia, N. Y., Apr. 16, 1821; was admitted to the bar in 1840, practicing for four years in Alabama; was ordained deacon in the Protestant Episcopal Church in 1851, priest in 1852, and held rectorships in Selma, Ala., Petersburg, Va., Louisville, Ky., San Francisco, Cal., and Rochester, N. Y.; received the degrees of D. D. and LL. D. from the College of William and Mary in 1878. His publications include *Art Culture* (1873); *Influence of Religion in the Development of Jurisprudence* (1877); *After Death, What?* (1878); *Unity of Law, or Legal Morality* (1879); *God Out, and Man In*, a reply to R. G. Ingersoll (1883); and *The Philosophy of the Supernatural* (1884).

Platter (or **Plater**), Thomas: humanist educator; b. in a hamlet in the mountains of Valais in 1499. He spent his early days in tending the herds in the wild country around his home, but being intended by his mother for the priesthood, he was set to study with the local pastor. Soon, however, in order to pursue his studies further, he adopted the only course then open to him, and became a wandering scholar, joining himself to a cousin who was visiting his home at that time. With his cousin he went from town to town, leading the picturesque but wretched life of the wandering students of that day, called *bacchants*. These bacchants went from town to town, seeking alms, and not scrupling to steal if necessary. They took with them children whom they trained for mendicants, and who served them as a sort of fags. Platter's cousin was a bacchant and led his small relative a sorry life. Finally Thomas separated from his cousin, who made desperate efforts to recover so valuable a servant, but in vain. He was received into the school of Jean Sapidus at Schlestadt, where he studied Latin. Later he went to Zurich and studied with Myconius, at the same time learning the trade of rope-maker. By working at his trade he continued his studies, learning Greek and Hebrew. He settled at Bâle, worked some years at his trade, and then became proof-reader in a printing establishment, and in 1541 was nominated Professor of Greek in the gymnasium in that city, which position he filled until 1578. At the age of sixty-three he had written

his autobiography, addressed to his eldest son, Félix. This autobiography is a very interesting document for the history of education in the sixteenth century. The author tells with charming simplicity all his adventures and travels, and shows in all its detail the miserable life of the poor scholars at the time. This was first published in its original text in 1840. The story is told in brief but interesting fashion in Lagrange, *Les Écoles au moyen âge*. Platter is one of the most curious and interesting figures of the epoch of the Renaissance and the Reformation. D. in Bâle in 1582. C. H. Thurber.

Poland, John Scroggs: soldier; b. in Princeton, Ind., Oct. 14, 1836; graduated at the U. S. Military Academy in 1861, and appointed first lieutenant in the Second Infantry June 6, 1861. He served in the Army of the Potomac in the battle of Bull Run and until after the battle of Gettysburg, having meantime been promoted captain and breveted major and lieutenant-colonel, and was afterward engaged in the defenses of Washington. He was Assistant Professor of Geography, History, Ethics, and Drawing in the Military Academy 1865–69, and during the following ten years was employed principally in frontier duty. He became a major Dec. 15, 1880. He was chief of the law department of the U. S. Infantry and Cavalry School in Leavenworth, Kan., 1881–86, and also in charge of the department of military drawing 1881–83. On Mar. 1, 1886, he was made lieutenant-colonel of the Twenty-first Infantry. He published *Digest of the Military Laws of the United States from 1861 to 1868* (Boston, 1868) and *The Conventions of Geneva of 1864 and 1868*, and *St. Petersburg International Commission* (Leavenworth, 1886). D. in Asheville, N. C., Aug. 8, 1898.

Polar Research: The chief results of the three years' explorations of Mr. Frederick G. Jackson in Franz Josef Land in 1894–97 are that it is found to be an archipelago of comparatively small islands, there being no large land-masses; the discovery of a considerable number of islands and of Victoria Sea N. of the archipelago; proof that Gillis Land, if it exists, is not in the position where it has been shown on the maps; and the complete mapping of the western part of the region. In 1898 the party led by Mr. Walter Wellman, of Chicago, erected its house at Cape Tegetthoff, Franz Josef Land, within 594 geographical miles of the north pole, with the intention of advancing N. by sledge and boat in an effort to reach the pole. In June, 1899, the Duke of the Abruzzi, a prince of Italy, sailed from Norway with a well-equipped expedition. He returned Sept. 6, 1900, having reached 86° 33′ N. lat., the highest point then touched. In 1898 two expeditions, one American, led by Robert E. Peary, C. E., U. S. N., and the other Norwegian, led by Capt. O. N. Sverdrup, sailed up the west coast of Greenland, hoping to reach and define the northern coast of that island, to explore the islands near it, to make scientific observations, and to reach the pole. Hope for the safety of the Arctic aeronaut S. A. Andrée and his two companions not having been entirely abandoned, Prof. A. G. Nathorst and his expedition sailed from Stockholm on May 20, 1899, on the steamer Antarctic to search for the missing men on the east coast of Greenland between 73° and 76° N. lat., and also to carry out explorations there and make deep-sea investigations during the journey.

Some unusual achievements in Spitzbergen waters in 1898 were due largely to the remarkably favorable conditions for navigation. The prevailing western drift usually packs the ice solidly against the east coast, and it was not until about 1870 that the world learned something about the contour of that coast. In 1898 Prof. Nathorst, on the Antarctic, carried out two undertakings never before accomplished, circumnavigating Northeast Land, one of the largest islands of the Spitzbergen group, passing unimpeded through Hinlopen Strait, which is usually choked with ice, and then sailing completely around the entire Spitzbergen group. He made a survey of the coasts of the three King Charles islands, much of which had been shown by dotted lines on the maps, and also explored White island, 100 miles N., that had hitherto been marked "existence doubtful."

In 1895 and later the idea of renewing Antarctic exploration received much support from geographers, particularly those of Great Britain and Germany. It was urged that Antarctic research had been entirely neglected for about sixty years; that the known north polar area was as large in the seventeenth century as the known south polar area in the nineteenth; that the unknown Arctic was now only as large as European Russia, while the unknown Antarctic was twice as large as Europe; and that important problems of physical geography could not be solved until more study was given to the south polar regions. The agitation was promoted by the success of some ventures in Antarctic waters, notably the outlining of a part of the east coast of Graham Land by the sealer Jason, under command of Capt. C. A. Larsen, from Nov., 1893, to Jan., 1894; and the attainment of Victoria Land in Jan., 1895, by the steam-whaler Antarctic, the first time this most southern known land had been visited since its discovery by Sir James Ross in 1841. Mr. C. E. Borchgrevink and a party from the whaler were the first to land on the coast of the mainland. A Belgian expedition on the steamer Belgica has passed the first winter ever spent by men in the Antarctic regions. The party, which was commanded by Lieut. de Gerlache, was frozen in the Antarctic ice a full year, from Mar. 10, 1898, to Mar. 14, 1899, during which time the vessel drifted with the ice between 70° and 71° 36′ S. lat. and 85° and 103° W. lon. Before penetrating the ice the party had spent three weeks to the S. of the South Shetland islands and in the neighborhood of Hughes Gulf, where twenty landings were made and many specimens illustrating flora, fauna, and geology were collected. During the winter drift the ice-field extended from 50 to 60 miles N. of the vessel. South winds brought very cold clear weather. North winds, coming from the open sea, brought cloudy weather and frequent fogs, with temperatures rising to zero or even to the thawing-point. The ice was incessantly in slow motion, drifting with the wind. The prevailing direction of the wind was toward the W., and the Belgica emerged from the ice about 500 miles W. of the point where she had entered it. The drift to the S. under the propulsion of the north winds was as rapid as the drift to the N. when the south winds were blowing, from which fact, and also from the very deep soundings, it was inferred that if there is an Antarctic continent the vessel was far from its northern edge on the South American side of the polar area. The sun disappeared on May 17 and rose sixty-five days later, on July 21. High gales and heavy snowfalls were frequent, rendering work outside the ship impossible. The pack-ice felt the influence of the ocean swells as well as of the winds, and its aspect was constantly changing. The ice was generally compact, but sometimes there were wide areas of open water or long channels or narrow veins of water. When the openings closed by pressure, instead of freezing, ridges of hummocky ice marked the line of contact. In the openings of the ice seals and penguins appeared, particularly late in the winter, and they were a desirable addition to the bill of fare. The polar night was marked by more or less impairment of heart-action among the men, and Lieut. Danco succumbed to the malady. Collections were made of pelagic and deep-sea fauna and sediments. One of the sailors was accidentally drowned. The party, thus deprived of two of its members, reached Punta Arenas in Magellan Straits fourteen days after the vessel escaped from the ice.

On Aug. 22, 1898, the steamer Southern Cross, purchased and fitted by Sir George Newnes for polar work, sailed from London for Victoria Land in the Antarctic. The expedition is in charge of the young Norwegian C. E. Borchgrevink. The party of 11 men with their equipment, including 75 dogs, were landed on Feb. 28, 1899, on the shore of Victoria Land at Cape Adare, 71° 23′ S. lat. and 169° 56′ E. lon. The vessel was sent to Australia to winter. With the dawn of the Antarctic spring Borchgrevink intended to make a sledge-journey overland as far S. as possible. The vessel was to call for the party in the autumn and carry it home.

The German deep-sea expedition on the steamer Valdivia late in 1898 made an excursion into the Antarctic area S. of Africa, and skirting the edge of the pack-ice from W. to S. E. through 50° of longitude, where a submarine plateau was supposed to exist, took 14 soundings, 5 of which revealed depths of more than 18,000 feet, and others nearly reached this figure.

In 1899 Germany and England were preparing to send large expeditions to the south polar area. It was expected that the German expedition under the command of Dr. E. von Drygalski, the explorer of glacial phenomena in Southern Greenland, would start in the autumn of 1901, penetrate the polar area on the meridian of Kerguelen island, establish a station on Victoria Land, and spend a year in its work, which will include a sledge-journey to or toward the pole, the fixing of the location of the magnetic

pole, the exploration of the west coast of Victoria Land, and the making of scientific observations and collections. In 1899 the British and German Governments agreed to give large financial support to the expeditions of their respective countries, and it was expected that the necessary outlay for each of these enterprises would be more than $250,000. C. C. Adams.

Police Power: in law, a power inherent in every sovereignty or government to do and enact such things as may be necessary to the protection and preservation of the lives, well-being, and property interests of the members of the community and its own entity. The exact boundaries of the police power of a state can not be, or have never been, definitely marked, nor the limits of its exercise exactly prescribed; it is broadly defined and broadly exercised, and has been defined so as to include "the authority to establish such rules and regulations for the conduct of all persons as may be conducive to the public interest."

The police power of a state is distinguished from the broad rights of eminent domain and the right of taxation, although these are essentially based upon the necessity of the preservation of the state and its well-being. The now obsolete or obsolescent laws regulating the expenditures and apparel of private individuals, interfering with or prohibiting the worship or practices of religious or other sects, restraining or prohibiting speculation in the necessaries of life, and engrossing or forestalling the market, are all included under what is now recognized as the police power of the state, although the recognition of this power as such, and the development of the law upon it, belongs chiefly to the nineteenth century, and especially the period subsequent to 1840. The broad scope of the power and the nature of the occasions which justify its exercise are best shown by citing some of the specific instances of its application.

Under the name of "the law of overruling necessity," the police power of states was early exercised to destroy houses and other buildings to prevent the spread of fire. Its exercise here does not come under the right of eminent domain, but is broader and more absolute, and pertains, as in the following examples, to the preservation of the property, health, morals, and general well-being of the community. When its exercise requires the taking or destruction of private property, no right of compensation accrues to the person or party deprived of it, unless such right is expressly created by statute. The rights and privileges of private corporations are subject to reasonable regulation by the state under its police power, so long as no essential right or privilege conferred by the charter is taken away. Thus the speed at which trains may be run on a railroad, the grade of its crossings, the forbidding of unreasonable charges or discrimination, the requiring of employees to submit to examination as to fitness for their places where involving the public safety, as engineers or brakemen, the requiring of the redemption of tickets, etc., are all instances of the exercise of this power over corporations.

In its care over the health and morals of the community it may establish mortuary laws; may provide for and regulate the confinement and care of the pauper sick and the insane, require persons practicing professions, such as medicine, surgery, dentistry, midwifery, etc., affecting the public health and morals to pass examinations to prove their fitness and competency to carry on properly the practice of their profession; may prohibit the employment of children below a certain age, and regulate the hours of employment of women and children; may prohibit the carrying on of trades or manufactures in such a manner or in such a place as to be likely to injure the health of the community or to prove a public nuisance; may prohibit the sale, or even the manufacture, of liquors or poisons, or of adulterated or harmful foodstuffs, etc. Under this same power belongs the right to establish quarantine stations, to control and regulate navigable waters, enact game and fishing laws, require licenses from peddlers, regulate the use of the highways, and, in short, the right to do all those things necessary to the self-preservation of the body politic.

In the U. S. the exercise of this power by the individual States is limited by those powers the exercise of which has been exclusively vested in the Federal Government by the Constitution of the U. S. Where the Federal Government is vested with the power of co-ordinate control which becomes exclusive when exercised by it, as in the case of quarantine laws, the State may exercise its control until its legislation is superseded by that of the Federal Government. The vesting of control of any subject-matter in the Federal Government, however, does not deprive the States of the right to pass any laws whatever affecting the subject where such laws are necessary to the preservation of health, life, or safety of the inhabitants of the State; thus although the subject of interstate commerce is regulated by the Federal Government, the State, for the preservation of the existence and well-being of its members, may make laws indirectly affecting the subject-matter under federal control. But the State may not carry this to such a point as under cover of the police power to hinder or obstruct the exercise by the U. S. Government of the power vested in it by the Federal Constitution, nor may it in this way deprive any citizen of rights guaranteed to him by the Federal Constitution.

For a full exposition of the subject, see Cooley's *Constitutional Limitations*; Prentice on *Police Powers* (1894); Tiedeman's *Limitations of Police Power in the United States*; Thayer's *Cases on Constitutional Law* (1894–95). Compare also the articles on Taxation, Eminent Domain, and Lunacy Laws. F. Sturges Allen.

Polonium: a metallic element found in the mineral pitchblende by P. Curie and Mme. S. Curie. Its discovery was announced at a meeting of the French Academy of Sciences, July 18, 1898. The discoverers in studying this complex mineral, the analysis of which is somewhat difficult, owing to the many rare elements that it contains in small quantities, found a body that was exceedingly active from the point of view of the emission of the new rays described by Becquerel. In analyzing the mineral it was found that the active material referred to separated out with the bismuth; but as yet no means of separating it from that volatile element in the wet way has been found. But when heated *in vacuo* in a Bohemian glass tube to about 700° C. the active substance is deposited in the form of a black film in that portion of the tube which is between 250° and 300° C., while the bismuth sulphide remains in the warm part of the tube. By continuing this operation products were obtained of which the activity was found to be 400 times greater than that of uranium. As no known elements have any such activity, it is believed by the discoverers that the substance which they have isolated contains a hitherto unknown metallic element very similar to bismuth in its analytical properties. If the existence of this new metal be confirmed, it is proposed that it be called *polonium*, after the native country of one of its discoverers. Marcus Benjamin.

Polo y Bernabe, Luis: diplomat; b. in Spain in 1858; after receiving education, he accompanied his father to the U. S., in 1872, as *attaché* of the Spanish legation at Washington, his father, José Polo, being minister, upon whose retirement, in 1875, he was made third secretary of the legation, holding that position until 1881, when he was transferred to The Hague as second secretary, remaining there until 1885, when he was recalled to Madrid, serving in the foreign office, in charge of consulates and commercial affairs; later was sent to Cairo as minister resident in Egypt, afterward being transferred to Brazil and again recalled to Madrid; succeeded Enrique Dupuy de Lome as ambassador to the U. S. in 1898, but soon asked for his passports, in view of the impending war between the two countries, and went to Canada, where his presence was alike objectionable to the U. S. and to the British Government; on returning to Spain became under-secretary to the foreign office in Madrid.

Ponape Island: an island in the eastern part of the Carolines group; the largest and one of the most important of the islands. It has been of special interest to archæologists since the exploration in 1896 by Mr. F. W. Christian of the remarkable prehistoric works known to exist there. Mr. Christian found that columnar shafts of basalt, many weighing several tons each, were transported from 20 to 30 miles to build up defenses, tombs, and other structures. A still more remarkable fact is that the little islands off the east coast of Ponape, on which these structures were reared, are mainly artificial, having been built up out of the shallow waters of the lagoon by the heaping up of these shafts of basalt. These artificial islands cover an area of about 9 sq. miles and there are between 50 and 60 of them. No basalt is near them, but the explorer found the quarries whence it was obtained more than 20 miles away. Many of the shafts and blocks weigh at least 3½ tons. They may have been rolled with the aid of levers to the water's edge, but the means employed to place them on the rafts and to

lift many of them to a height of 20 or 30 feet to form the top of the walls on the islets has not been discovered. Mr. Christian traced the course of the rafts from the quarries to the stone islands by the blocks of basalt that are strewn over the bottom of the lagoon. They had evidently fallen from the rafts or sunk with them. The islands were reared above the water from 5 to 10 feet, and on this foundation great walls were erected, the largest of which is 30 feet high and 10 feet thick. The prisms of basalt were placed closely together, alternating lengthwise and crosswise. Many walls inclose large spaces, one of which is 185 by 115 feet. Tombs were found in some of them, and it is believed the inclosed spaces were used for tombs, treasure-chambers, and forts. The native tradition as to the origin of these structures is that they were built by all the tribes of the island at a time when it was much more populous than at present. Finally there was a great invasion of peoples from the S., who overturned a part of these artificial walls, killed all their defenders, and blotted out the ancient civilization. Other ruins, not so extensive, are found on some other islands of the group. The opinion is expressed by some that no people of the present race could have constructed these immense works. See Christian's report in *The Geographical Journal*, Feb., 1899. C. C. Adams.

Pond, Frederick Eugene (*Will Wildwood*): sporting author; b. in Packwaukee, Wis., Apr. 8, 1856; received a common-school education; was instrumental in organizing the National Sportsmen's Association, and active in forming the Wisconsin Sportsmen's Association for the protection of fish and game; was field editor of *Turf, Field, and Farm* 1881–86, associate editor of the *American Field* in 1883, and later conducted *Wildwood's Magazine*, in Chicago; besides edited Frank Forrester's *Fugitive Sporting Sketches* (1879), his *Sporting Scenes and Characters* (1880), and Isaac McLelland's *Poems of the Rod and Gun* (1886). He is the author of *A Handbook for Young Sportsmen* (1876); *Memoirs of Eminent Sportsmen* (1878); and *The Gun-Trial and Field-Trial Records of America* (1885).

Poore, George Vivian: English physician and professor of medical jurisprudence; b. in Andover, Sept. 23, 1843; was educated in the royal naval school at New Cross, and at University College, London; after graduating at the latter he took up the practice of medicine in London; was medical attendant to the late Prince Leopold, Duke of Albany, 1870–71, to the Prince of Wales 1872, and the Duchess of Cumberland; was made physician to the University College Hospital in 1876, in which year he was also appointed Professor of Medical Jurisprudence and Clinical Medicine in University College, and this position he still (1899) retains. He was honored with the Dannebrog for professional services to the Duchess of Cumberland in 1872; in 1891 was made secretary-general to the sanitary congress, besides which he has held numerous other positions of high professional standing. His publications include, besides works and papers of a purely professional nature, *Essays on Rural Hygiene* (2d ed. 1894). F. Sturges Allen.

Pope, Franklin Leonard: electrical engineer; b. in Great Barrington, Mass., Dec. 2, 1840; educated in his native town, and became a telegraph operator, and assistant engineer of the American Telegraph Company and the Russo-American Telegraph Company; in the latter capacity made with George Blenkinsop the first exploration, in 1866, of the region about the sources of the Skeena, Stickeen, and Yukon rivers, in British Columbia and Alaska; settled in New York city as an electrical engineer and expert. In 1870 he was associated with Thomas A. Edison in inventing the one-wire printing telegraph, known as the "ticker," that is used for telegraphing exchange quotations, etc. In 1872 he invented the rail circuit for automatic control of electric block signals on railroads, and he patented many other improvements for railroad and telegraph service. He also practiced as a patent attorney. In 1885 he was elected president of the American Institute of Electrical Engineers. Since 1884 he had been editor of the *Electrical Engineer*, and he wrote, besides many articles for periodicals, *Modern Practice of the Electric Telegraph* (1871) and *Life and Work of Joseph Henry* (1879). D. Oct. 13, 1895.

Port-Royal, Little Schools of: One feature of the counter-reformation, or the reaction against Protestantism, was the organization of the teaching congregations, namely, the Jesuits, the Brethren of the Christian Life, and the Jansenists. The Port-Royal schools represent the educational activities of the Jansenists in France. The foundation of the schools dates back as far as 1637, which marks the beginning of the celebrated community of recluses founded outside the monastery of Port-Royal. This community brought up in the knowledge of letters and Christian piety a few children of good birth, whom it wished to spare the dangers attending the usual college course, but the schools were not definitely organized until 1656, and they were finally closed by the king's command in Mar., 1661, having had a checkered and peripatetic existence, owing to the continued opposition of the Jesuits. The idea of the foundation of these schools belongs to the illustrious Duvergier de Hauranne, Abbé of Saint-Cyran. The attendance of the schools at their most flourishing period probably did not exceed fifty, and the entire number of children that passed through the schools was possibly not more than a hundred. Their influence is, however, not to be measured in this way. Compayré says of them: "Singular destiny that of those teachers, whom a relentless fate permitted to exercise their functions only for five years, yet who, through their works, have remained perhaps the best authorized exponents of French education!" Their most notable contribution to pedagogy is probably the introduction of the new system of teaching reading, which has become celebrated under the name of the Port-Royal method. The originator of this system seems to have been Pascal himself. For the first time in France they made the French language the subject of serious study. The discipline was mild, but gravity and dignity were enforced to the extent of producing a repellent formalism. The spirit of emulation was purposely suppressed. The general judgment of their work is thus summed up by Compayré: "Ardor and sincerity of religious faith; a great respect for the human person; the practice of piety held in honor, but kept subordinate to the reality of the inner feeling; devotion advised, but not imposed; a marked mistrust of nature, corrected by displays of tenderness and tempered by affection; above all, the profound, unwearied devotion of Christian souls who give themselves wholly and without reserve to other souls to raise them up and save them—this is what was done by the discipline of Port-Royal. But it is rather in the methods of teaching and in the administration of classical studies that we must look for the incontestable superiority of the Jansenists. The teachers of the Little Schools were admirable humanists, not of form, as the Jesuits were, but of judgment. They represent, it seems to us, in all its beauty and all its force, that intellectual education already divined by Montaigne, which prepares for life men of sound judgment and of upright conscience. They founded the teaching of the Humanities." Among the most noted of the authors connected with the Port-Royal schools, whose works influenced and continued to influence French education, are Nicole, one of the authors of the Port-Royal *Logic*, and author of *The Education of a Prince*; Lancelot, the grammarian; the great Arnauld; and, less well known, De Sacy, Guyot, Coustel, Varet, Jacqueline Pascal. See Compayré, *History of Pedagogy*; Cadet, *Port-Royal Education*; Cousin, *Jacqueline Pascal*; Sainte-Beuve, *Histoire de Port-Royal* (6 vols., 1871). C. H. Thurber.

Portugal is the part of the Iberian peninsula most favorably situated for foreign commerce, both on account of its large sea-frontage and also because, as a rule, its inland boundary crosses the Spanish rivers flowing to the Atlantic just at the point where they become navigable; still its resources are less developed than those of Spain. Its industries, formerly nearly stifled by importations from Great Britain, have advanced in several lines. The country is particularly weak in metal industries, while cotton, wool, and silk manufactures have considerable development. The principal manufacturing districts are Lisbon and Oporto. The exports to the U. S. in the year ending June 30, 1900, were valued at $3,743,216, and the largest items, in order of importance, were India-rubber (brought from the African colonies), corkwood, and port wine. The U. S. furnished 14 per cent. of the imports. The African colonies are making some commercial progress. A bank was discovered in 1897, about 50 miles S. of the Azores, over which the water is only 250 to 625 feet deep. It is remarkably rich in fish, and is likely to create a new industry for the Azores. The Portuguese colony of Macao, near Canton, has greatly declined in commercial importance. The port is now accessible only to small vessels, owing to sand-banks. Many of the inhabitants have removed to Hongkong and Chinese ports, where they have positions in foreign commercial houses.

The commerce of the Chinese living in Macao is fairly important, and in 1898 amounted to $18,330,043.

Powell, F. York: English lawyer and historical writer; b. in England about 1845; was educated at Rugby, and at Christ Church College, Oxford; then read law in the Middle Temple, where he was called to the bar in 1870. He has held consecutively the positions of tutor and law lecturer of Christ Church College, and historical lecturer at Trinity College, Oxford, and has been Regius Professor of Modern History at Oxford University since 1894. His publications include as editor, *An English History from Contemporary Writers*; as author, *Early England up to the Norman Conquest* (in *Epochs of English History*); *Alfred the Great and William the Conqueror*; *Old Stories from British History*; *History of England to 1509*; and other historical essays and pamphlets, including articles in the *Encyclopædia Britannica*, and in the *English Historical Review*, *National Observer*, *Manchester Guardian*, and other English journals, historical and literary. F. Sturges Allen.

Powell, Maud: violinist; b. in Peru, Ill., Aug. 22, 1868, and began the study of the violin in Chicago when eight years old. When twelve years old she was taken to Europe, spending a year each in Leipzig, Paris, Berlin, and London. Her first public appearance on her return was in New York at a Philharmonic Society concert, in Oct., 1885. Since then she has been constantly playing all over the U. S.
D. E. Hervey.

Power, Polyphase Transmission of: Power may be transmitted by the pumping of water, to be used for water-motors. By using great pressure, a given amount of power may be transmitted by a small quantity of water; to carry this small quantity of water small pipes suffice, and small pipes are cheap. Similarly, a given amount of power may be transmitted over a small wire carrying a small electric current under high electric pressure. The electrical problem is complicated, however, by the fact that the use of high electric pressures involves more or less risk to life and property, and it is therefore expedient to transform the transmitted electrical power so that the inexpert user may be supplied with large electric current at low pressure.

The advantage of alternating current for power transmission lies in the fact that the alternating-current machinery needed for the transformation of a given amount of power from small current and high pressure to large current and low pressure, or *vice versa*, is simpler and cheaper to construct and to operate than the machinery required to accomplish the same result with constant current, or direct current, as it is called. When the transmitted power is to be used solely for lighting, simple alternating current is entirely satisfactory. When the transmitted power is to be used wholly or in part for motive purposes, simple alternating current is not satisfactory, for the reason that a good self-starting motor using simple alternating current can not at present be made.

The employment of alternating current for motive purposes depends upon the use of the so-called *induction motor*. This type of motor needs to be supplied with two or more independent alternating currents transmitted over three or more distinct wires. The use of two or more independent alternating currents in this way is called *polyphase transmission*. When two alternating currents are so used the arrangement is called a *two-phase system*; when three alternating currents are so used the arrangement is called a *three-phase system*. The significance of the term phase will appear in the following discussion.

The Single-phase Alternator.—A dynamo for generating an alternating current is called an *alternator*. An alternator constructed to give a single alternating current is called a *single-phase alternator*; an alternator constructed to give polyphase alternating currents is called a *polyphase alternator*. The single-phase alternator consists of a multipolar electro-magnet (*the field-magnet*), of which the poles N S (Fig. 1) project inward toward the passing slots in an iron wheel, A (*the armature*), which is built up of sheet-iron stampings. An insulated wire is laid in these slots in such a way that an object moving along the wire would move up in one slot and down in the next (*up* and *down* being parallel to the shaft on which the armature rotates), and the ends of this wire are soldered to two insulated metal rings (*collecting rings*), which are fixed to the armature shaft at one end of the armature. Two metal springs (*brushes*) rub on these rings and keep the ends of the armature wire in permanent connection with the terminals of the outside circuit through which the alternating current is to be sent. The projecting poles (N S) of the field-magnet are wound with wire through which a constant current is sent from an auxiliary dynamo called the *exciter*.

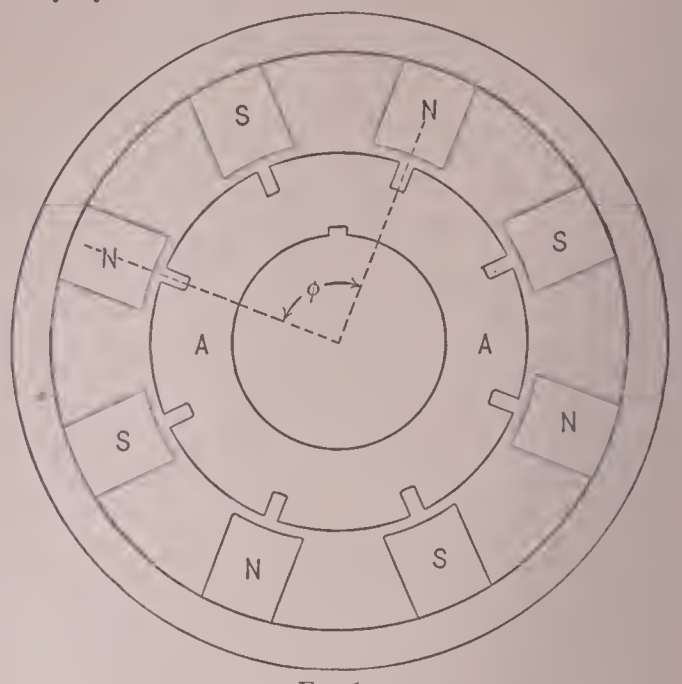

Fig. 1.

The Alternating Current.—Fix the attention on one slot of the armature (Fig. 1). As this slot passes a north pole of the field-magnet a momentary electric current is pushed in one direction through the circuit connected to the brushes; as this slot passes a south pole of the field-magnet a momentary electric current is pushed in a reverse direction through the circuit. Commercial alternators give from 50 to 300 of these reversals or alternations per second. The following geometric representation of an alternating current is useful in the discussion of polyphase systems:

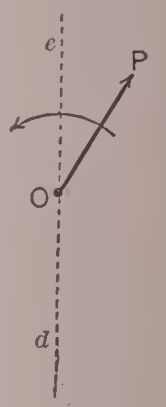

Fig. 2.

Representation of an Alternating Current.—A line, O P (Fig. 2), rotates at constant speed about the point O in the direction of the curved arrow. Consider the projection of O P on the fixed line *e d*. This projection changes value continually, being alternately up and down, or positive and negative, exactly as an alternating current. The rotating line O P thus represents an alternating current.

The Two-phase Alternator.—Consider two similar single-phase alternators, A and B, with their armatures mounted on one and the same shaft. Suppose the armature slots of A to be squarely under the field-magnet poles of this

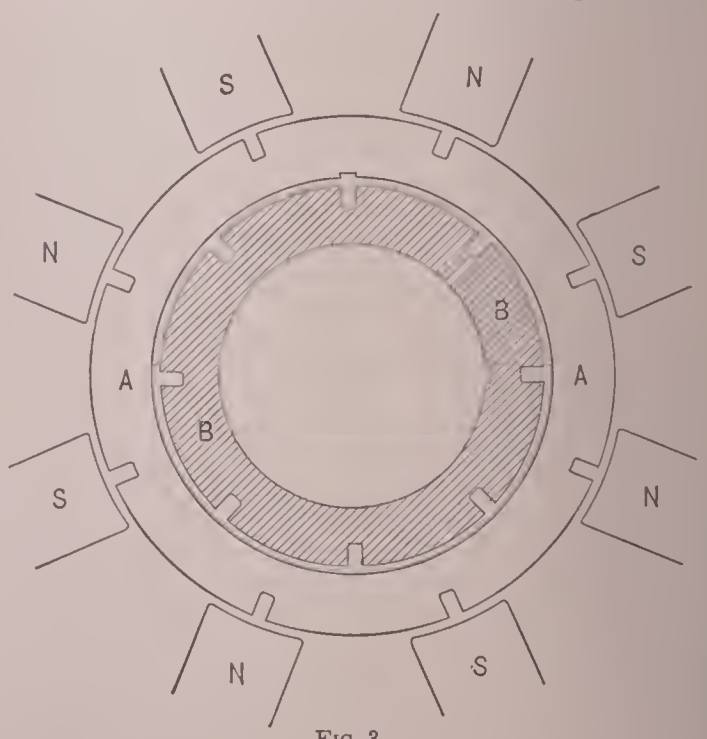

Fig. 3.

alternator when the armature slots of B are midway between the field-magnet poles of this alternator. This is shown in

Fig. 3, the armature B being drawn inside of the armature A for the sake of clearness. Under these conditions the alternating currents given by A and B are so related in their pulsations that the current from A is at its greatest value when the current from B is zero, and the current from B is at its greatest value when the current from A is zero. Two single-phase alternators connected mechanically as here described constitute a *two-phase alternator*. In practice the two-phase alternator is made by placing the armature wires of A and B in slots on one and the same armature. For this purpose the armature has twice as many slots as in Fig. 1, the A winding is placed in slots 1, 3, 5, 7, etc., and the B winding is placed in slots 2, 4, 6, 8, etc.

The four collecting rings are placed at one end of this compound armature, one pair of rings serving for terminals of winding A, and the other pair serving as terminals of winding B. The two-phase alternator has in general four collecting rings and four transmission lines. Fig. 4 is an

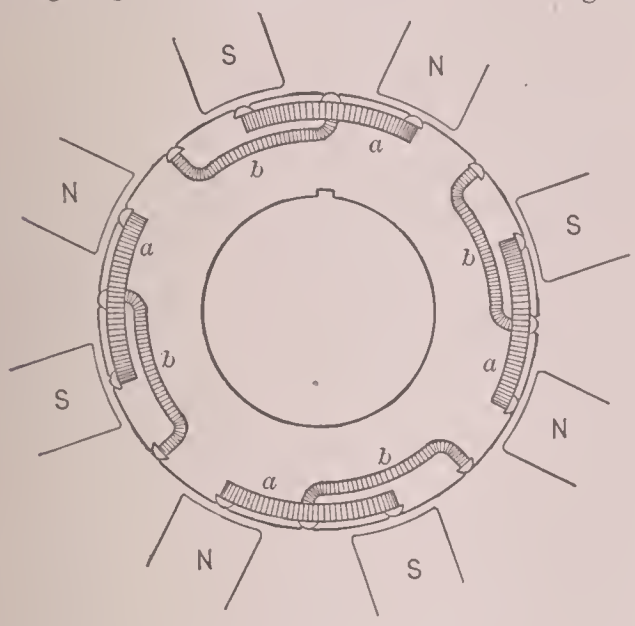

Fig. 4.

end view of a two-phase alternator showing armature windings in place. The two sets of windings are indicated by the letters *a* and *b*.

Representation of Two-phase Currents.—Two lines, O A and O B (Fig. 5), at right angles to each other, rotate at constant speed about the point O in the direction of the curved arrows. Consider the projections of O A and O B on the fixed line *e d*. The projection of O A is a maximum when the projection of O B is zero, and *vice versa*, exactly as the two alternating currents given by a two-phase alternator. The rotating lines O A and O B thus represent the two-phase currents.

The Three-phase Alternator.—Consider three similar single-phase alternators with their armatures mounted on one

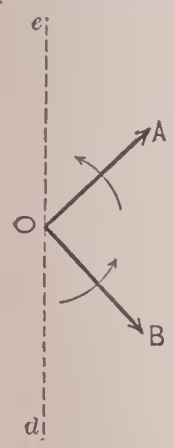

Fig. 5.

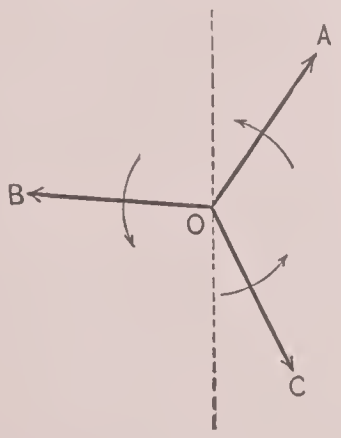

Fig. 6.

and the same shaft. Designate these alternators by the letters A, B, and C. Let ϕ be the angle at the center of the shaft subtending two slots, as shown in Fig. 1. Let the armature slots of each alternator be numbered 1, 2, 3, etc., in succession. Suppose slot No. 1 on B is $\frac{1}{3}\phi$ ahead of slot No. 1 on A, and that slot No. 1 on C is $\frac{2}{3}\phi$ ahead of slot No. 1 on A. Then the three alternators constitute a *three-phase alternator*, and the three alternating currents given by these three alternators will be represented by the projections on *e d* of the three lines O A, O B, and O C (Fig. 6), these lines being 120° apart, and all of them rotating at the same speed in the direction of the curved arrows. In practice the three-phase alternator is made by placing the windings of A, B,

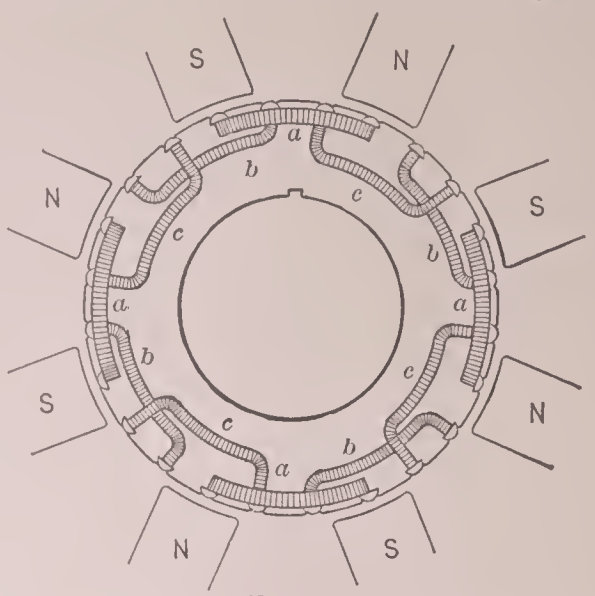

Fig. 7.

and C on one and the same armature body. This practical arrangement is shown in Fig. 7, in which the three sets of windings are indicated by the letters *a*, *b*, and *c*. Three collecting rings, three brushes, and three transmission lines are sufficient for the three-phase alternator, as shown in Figs. 8 and 9. In these figures A, B, and C represent the three armature windings and the points 1, 2, and 3 represent the three collecting rings. Fig. 8 shows what is called the Δ-scheme of connection, and Fig. 9 shows what is called the Y-scheme of connection. The Δ-scheme is clearly enough shown in Fig. 8. In the Y-scheme one end of each winding is connected to a collecting ring, and the other ends of the three windings are connected together as shown at *n*. Corresponding to these two schemes for connecting the three armature windings to the mains (connections made of course by means of brushes on the collecting rings) there are two schemes for connecting to the mains three circuits, A, B, and C, which are to receive current from three-phase mains. These two schemes for connecting receiving circuits are likewise indicated by Figs. 8 and 9.

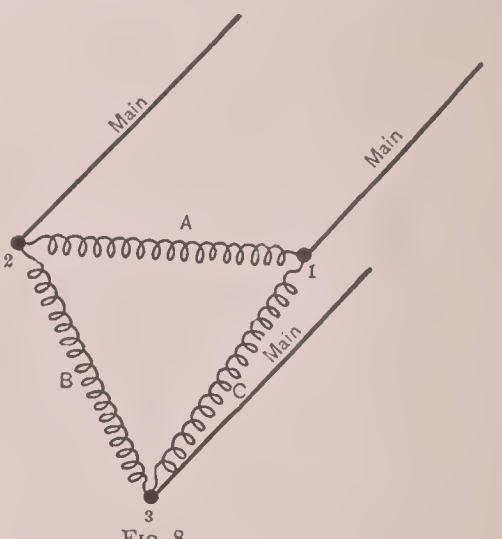

Fig. 8.

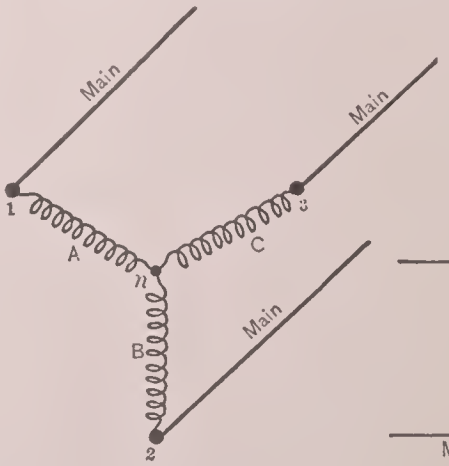

Fig. 9.

The Single-phase Transformer.—The single-phase transformer consists of two distinct and separate coils of wire, a primary and a secondary, wound on the same iron core. One

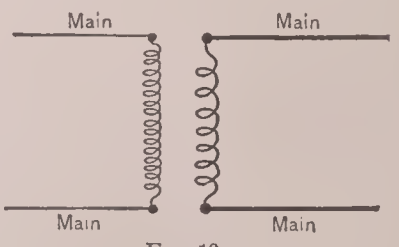

Fig. 10.

of these coils is made of many turns of fine wire, and the other of few turns of coarse wire. When a large alternating current is pushed through the coarse-wire coil by low electric pressure the fine-wire coil gives out a small alternating current at high electric pressure, or *vice versa*.

The actual power given out from the one coil is 97 per cent. or more of the power taken in at the other coil. In connection diagrams the single-phase transformer is indicated as in Fig. 10, in which the heavy lines represent the low-pressure mains and the fine lines represent the high-pressure mains.

Step-up and Step-down Transformers.—It is not convenient to generate in the polyphase alternator itself the very high electrical pressures used for long-distance transmission, on account of the difficulty of sufficiently insulating the armature windings. Polyphase generators are therefore usually constructed to give large currents at low pressures, and the power thus developed is transformed to small current at high pressure by means of the *step-up transformer*, and at the receiving-station the power is transformed from small current at high pressure to large current at low pressure by means of the *step-down transformer*, which is similar in every respect to the step-up transformer. The simplest arrangement is to transform each phase independently by means of a single-phase transformer. Thus Fig. 11 shows the arrangement of two single-phase transformers for step-up or step-down of two-phase currents. Fig. 12 shows the arrangement of three single-phase transformers for step-up or step-down of three-phase currents; A, B, and C are the three single-phase transformers, the points *h h h* are the three high-pressure mains, and the points L L L are the three low-pressure mains.

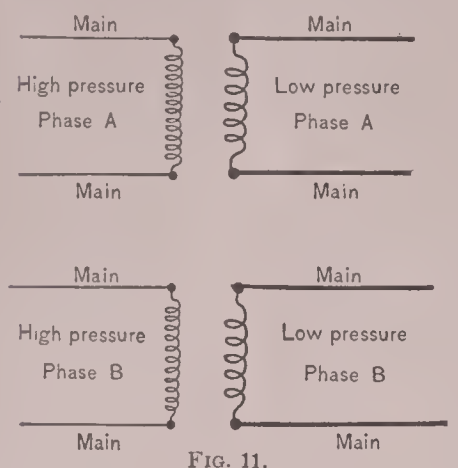

Fig. 11.

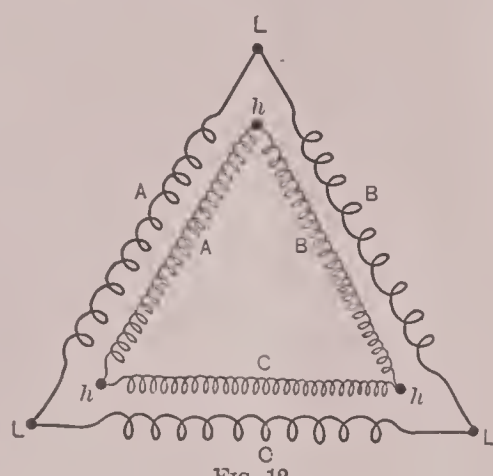

Fig. 12.

The Transmission Lines.—The electrical problems involved in the design and construction of transmission lines are comparatively simple. The larger the wire the greater the initial cost, and the smaller the wire the greater the continuous loss of power due to heating. The size of the wire is so determined that neither the cost nor the continued loss may be excessive. The line is insulated by supporting it on porcelain or glass insulators of large size and great thickness, or, if the line is to be laid underground, it is insulated by a rubber compound and incased in lead. The line is protected from lightning by much the same means as are employed for the protection of city lighting and power circuits. When the electrical pressure is raised to about 60,000 volts or more (this pressure is between the outgoing and incoming wires of each phase) considerable electrical leakage takes place from wire to wire through the air. This leakage produces a great loss of power.

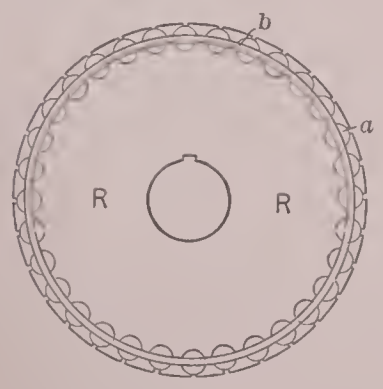

Fig. 13.

The Induction Motor.—It was pointed out in the introduction that the adaptation of alternating currents to motive purposes depends upon the use of the induction motor, and that it is the requirements of this motor that have led to the development of polyphase systems of transmission.

Consider an iron wheel (R R, Fig. 13) built up of circular disks of sheet iron. In this wheel a large number of holes (*a*, Fig. 13) are bored parallel to the shaft and near to the periphery. In these holes copper rods are inserted, and the ends of these rods on each side are soldered to massive copper rings (*b*). This arrangement is called a *squirrel-cage*, and it is the rotating part of the induction motor.

Fig. 14.

Imagine this squirrel-cage to be placed between the poles of a field-magnet, as shown in Fig. 14. If this magnet is set rotating in the direction of the curved arrows, electric currents are induced in the copper rods of the squirrel-cage, and by a sort of dragging action the cage is made to rotate with the field-magnet poles. As used in the induction motor the squirrel-cage is closely surrounded by an iron ring (F F, Fig. 15) which is built up of sheet-iron ring stamp-

Fig. 15.

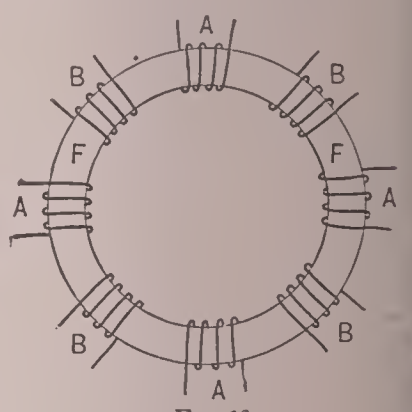

Fig. 16.

ings, and polyphase currents, passing through two or three sets of windings on F F, cause in this ring a *rotating state of magnetism*, which exactly reproduces the conditions represented in Fig. 14, and the squirrel-cage is made to rotate. The windings on F F are shown in Fig. 16. No electrical connections whatever are made with the squirrel-cage.

The following is a description of the windings on F F and of their action for the case of a four-pole two-phase induction motor. The arrangement of windings for three-phase currents does not differ materially from the windings here described.

The ring F F is wound with eight similar coils, each covering one-eighth of the circumference of the ring, as shown in Fig. 16. The four coils A are connected in series and supplied with one current of a two-phase system, and the four coils B are connected in series and supplied with the other current of the two-phase system. These coils in series are so connected that adjacent coils of one set magnetize the ring in opposite directions, as shown by the arrows in Figs. 17, 18, and 19. The manner in which the two-phase currents produce rotating magnetic poles in the iron ring F F is shown in Figs. 17, 18, and 19. Fig. 17 shows the state of affairs at the instant that the alternating current in coils A is at its maximum and the current in coils B is zero. A′ and B′ are the rotating lines of which the

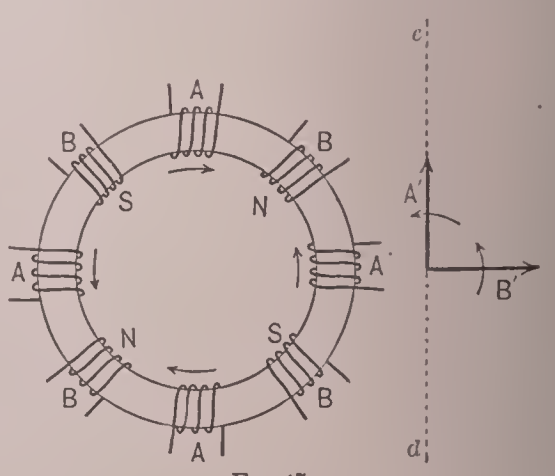

Fig. 17.

projections on the fixed line *e d* represent the varying values of the alternating currents in coils A and B respectively. Fig. 18 shows the state of affairs when the current in coils A has decreased in value and the current in coils B has increased to the same value. Fig. 19 shows the state of affairs when the current in coils A has become zero and the current in coils B has reached its maximum value, as shown by the positions of the lines A′ and B′.

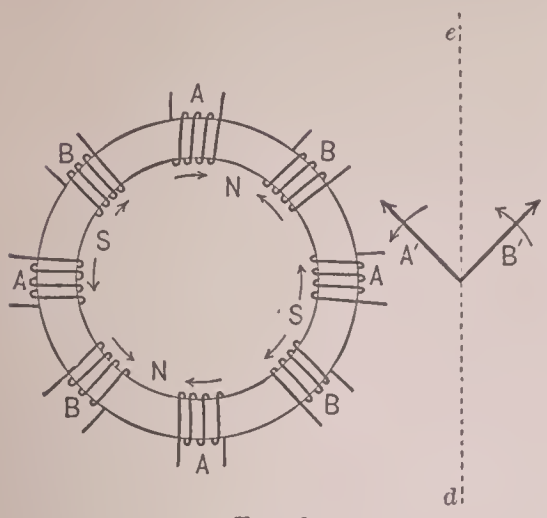

Fig. 18.

Thus from the state of affairs represented by Fig. 17 to the state of affairs represented by Fig. 19 the poles (N S) of the iron ring have moved over one-eighth of the circumference of the ring. An examination of intermediate stages would show that this movement of poles is continuous, and an examination of sueeeeding stages would show that the poles (in this case of two pairs of poles) move once around the entire circumference of the ring while the lines A′ B′ make two revolutions.

In the practical form of the induction motor the windings on the ring F F are imbedded in slots on the inner face of the ring, and instead of enveloping the ring the windings are arranged in a manner similar to the windings of a two-phase or three-phase alternate armature.

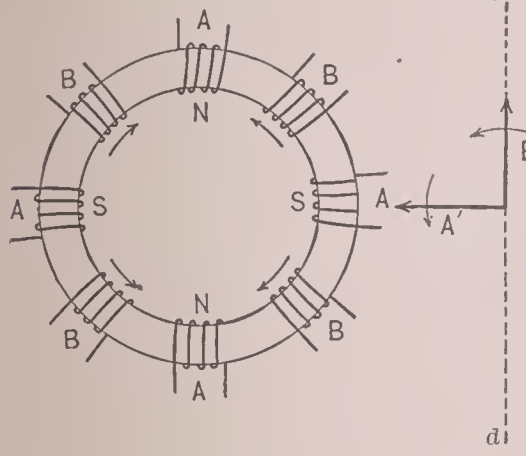

Fig. 19.

The Synchronous Motor.—Any alternating-current generator may be nsed as a motor, provided it is started by independent means, and its speed carefnlly adjusted until the pulsations of the current which it would produce as a generator are in exact unison, or synchronism with the pulsations of the supply-current,* before it is connected to the supply-mains. When once in action such a motor runs at invariable speed as its load is increased, frequency of supply-current being unchanged, and when it is overloaded to the slightest extent it comes to a standstill. A single-phase alternator may be used as a synchronous motor with single-phase current, and a polyphase alternator may be used as a synchronous motor with a supply of polyphase currents. The latter is the more satisfactory, inasmuch as the torque or turning effort is steady, while in the single-phase synchronous motor the turning effort pulsates with the supply-current. A further advantage is that with polyphase currents a small induction motor may be used to bring the synchronous motor up to speed in starting. In fact, the polyphase alternator is essentially an induction motor when running as a motor below synchronism, and will start itself, but not satisfactorily.

The Rotary Converter.—An ordinary direct-current dynamo may be made into a single-phase or polyphase alternator by providing the machine with collecting rings in addition to its regular commutator. Such a machine may be driven as a synchronous motor by supplying alternating current to the collecting rings, and its motor load may be provided by taking off direct current from the commutator. When used in this way the machine is called a *rotary converter.*

The Single-phase Rotary Converter.—Given a direct-current dynamo, bipolar or multipolar. Consider the commutator bars which, for any given position of the armature, lie midway under the north poles of the field-magnet. All of these bars are connected together, and to collecting ring No. 1; and the commutator bars which, for the given position of the armature, lie midway under the south poles of the field-magnet are connected together, and to collecting ring No. 2.

The Two-phase Rotary Converter.—Imagine the armature of a single-phase rotary converter to be turned until the commutator bars connected to collecting rings Nos. 1 and 2 are midway between the field-magnet poles. Then the collecting rings to be added to give a two-phase converter are connected—ring No. 3 to the commutator bars midway under north poles, and ring No. 4 to the bars midway under south poles of the field-magnet. Fig. 20 shows field-magnet,

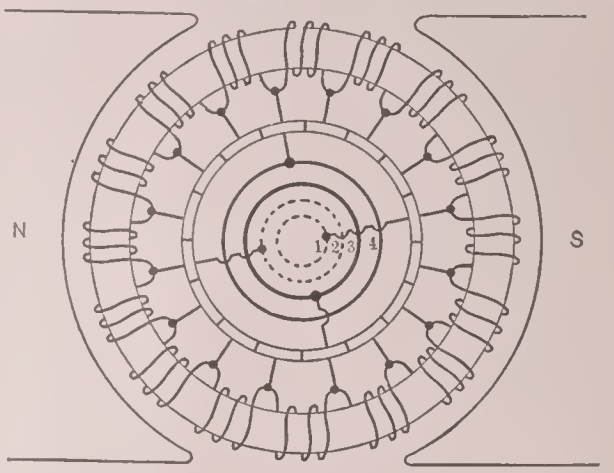

Fig. 20.

armature, and commutator of a two-pole direct-current dynamo, and indicates the connections to the four collecting rings, the addition of which to the machine adapts it for use as a two-phase rotary converter.

The Three-phase Rotary Converter.—Three collecting rings connected as follows to the commutator bars of a direct-current dynamo adapt the machine for use as a three-phase rotary converter. The commutator bars midway under N poles of the field-magnet (armature in any given position) are connected to ring No. 1. Let ϕ be the distance between adjacent bars of this set; then the bars $\frac{1}{3}\phi$ ahead of the first set are connected to collecting ring No. 2, and the bars $\frac{2}{3}\phi$ ahead of the first set are connected to collecting

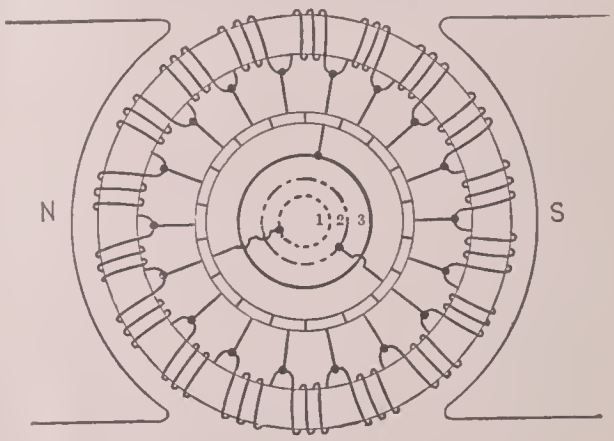

Fig. 21.

ring No. 3. This arrangement is shown in Fig. 21 for a two-pole machine.

The Use of the Rotary Converter.—The rotary converter may be used as an ordinary direct-current dynamo or motor or as an alternator or synchronous motor; or it may be run as a direct-current motor, the load being provided by taking alternating currents off the collecting rings; or it may be run as a synchronous motor, using alternating current, the load being provided by taking direct current off the commutator. This last is the principal use of the machine. Whenever power transmitted by the polyphase system is to be used in the form of direct current the rotary converter is used for bringing about the conversion. Thus in many extended electric-railway plants it is expedient to transmit power, high-pressure polyphase, from a central power-plant

* Further, the machine must be also adjusted until the *pulsations* of its E. M. F. are at each instant opposite to the pulsations of E. M. F. between the mains.

and step it down to rotary converters stationed along the line of the railway; these rotary converters supply direct current at medium low pressure to the trolley-wire.

The Phase Transformer.—In some power-plants the alternators generate two-phase currents, while for long-distance transmission three-phase currents require less copper, and are therefore preferable. In such case the step-up transformer may be arranged to take in two-phase currents at low pressure, and give out three-phase currents at high pressure. Such an arrangement is called a *phase transformer*. The following is a description of the essential features of a two-phase three-phase transformer. The lines A and B, Fig. 22, are the rotating lines of which the projections represent the alternating electromotive forces of the A and B phases of a two-phase alternator. These two electromotive forces act upon the respective primary coils of two transformers, X and Y, as shown in Fig. 23. Let the line E_1, Fig. 22, be the E. M. F. which is to act between Nos. 1 and 2 of the three-phase mains, E_2 the E. M. F. which is to act between mains No. 2 and No. 3, and E_3 the E. M. F. which is to act between mains No. 3 and No. 1. Break E_1 up into its components *a* and *b*, Fig. 22; the secondary coil *a*, Fig. 23, is wound with a number of turns sufficient to give the component *a*, Fig. 22, and the secondary coil *b* on the other transformer is wound with a number of turns sufficient to give the component *b*, Fig. 22. The coils *a* and *b* are connected in series between mains No. 1 and No. 2. Similarly the E. M. F.'s E_2 and E_3 may each be produced by a pair of secondary coils, one on each transformer.

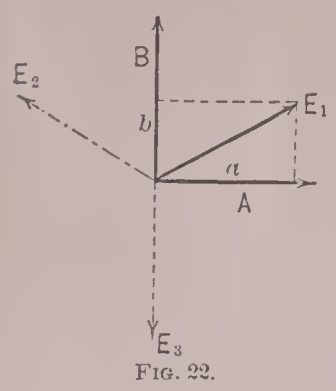

FIG. 22.

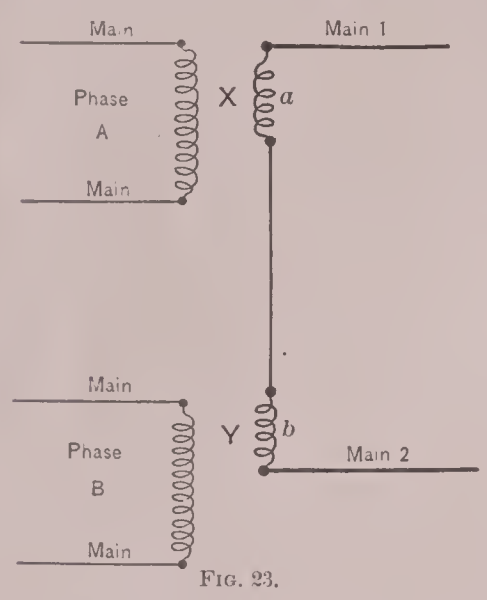

FIG. 23.

The Transmission Plant — Résumé. — The plant for long-distance transmission of power by polyphase currents consists of power-station, transmission line, and receiving-station. The power-station is provided with a prime mover, either water or steam, which drives one or more polyphase alternators, and also one or more small direct-current dynamos for exciting the field-magnets of the alternators. The alternators furnish large current at low pressure to the step-up transformers, which furnish small current at high pressure to the transmission lines. The step-up transformer may be a combination of single-phase transformers or it may be a two-phase three-phase transformer. At the receiving-station the high-pressure polyphase currents from the lines pass through the step-down transformers. These step-down transformers may supply current direct to the user at a pressure of a few hundred volts, or to a local distributing system at, say, 2,000 volts, from which individual users are supplied through additional step-down transformers.

The alternating currents furnished by these step-down transformers are at once available for glow-lamps for the manufacture of calcium carbide and carborundum; in short, for every purpose in which the heating action only of the current is important; and for driving induction motors, synchronous motors, and rotary converters. For arc-lamps, street-car service, storage-battery charging, and for chemical manufactures in general the direct current from the rotary converter is used.

W. S. FRANKLIN.

Princeton University (formerly the **College of New Jersey**): an institution of learning chartered in 1746 by the colony of New Jersey. Its first sessions were held in Elizabethtown in 1747, under President Dickinson. In 1748 it obtained a very liberal charter from Gov. Belcher, and was removed to Newark under the presidency of Aaron Burr (1748–57), who remained at its head until after the institution had been finally located at Princeton in 1757. The famous Jonathan Edwards was its president for part of the year 1758. There were two other presidents in the colonial period—Samuel Davies, who held the office for two years (1759–61), and Samuel Finley, for five years (1761–66). The troubled times of the Revolutionary period saw John Witherspoon in control (1768–94). The influence of this sturdy patriot was often felt in the councils of the struggling nation. He and two of the alumni of the college, Richard Stockton and Benjamin Rush, signed the Declaration of Independence. The next four presidents, Samuel Stanhope Smith (1795–1812), Ashbel Green (1812–22), James Carnahan (1823–54), and John Maclean (1854–68), represent another period in the history of the college as well as of the nation.

During this period Princeton was highly respected as an institution of learning. Its professors were men of sterling character and of wide reputation, and many of its alumni attained eminent positions in every sphere of life. These were the days when the college, as such, filled a high place in the educational system of the country.

The university spirit, however, was moving abroad at the close of this period, and contemporary Princeton felt its broadening influence first under the presidency of James McCosh (1868–88). Under his administration great strides were made in the development of the institution, both intellectually and materially. It was reserved for his successor, Francis Landey Patton, the present incumbent of the office of president, to realize what had been the ideal of his predecessor. On the occasion (1896) of the one hundred and fiftieth anniversary of its foundation, what was formerly the College of New Jersey became Princeton University.

Many munificent gifts, both by generous friends and alumni, have placed handsome buildings upon its campus, and have increased its corps of instructors and added to its appliances, until it represents a logical and healthful growth around the historic nucleus of the one handsome building which well fulfilled every need of the college in 1756.

The John C. Green School of Science and its associated buildings for the chemical and electrical departments provide for the work involved in technical training, as contrasted with the classical courses of the academic department. The main building provides accommodation for the physical, botanical, and engineering laboratories, as well as lecture-rooms for these departments and many others. Properly lighted rooms are secured for the classes in technical and free-hand drawing. The chemical department has recently been equipped with a building wholly devoted to its own uses. This laboratory was constructed after a careful study of the leading chemical laboratories of the world had been made, with a view to combining every advantage in structure to be derived from experience.

The electrical engineering department is provided with two buildings. One of these is devoted to the study of dynamos, their construction and application, and is connected with the machine-shop of the School of Science. The other, where the more technical and theoretical work is done, is located at a distance from all disturbing influences.

The academic and scientific courses of study are completed in four years, and lead to degrees in arts and letters, science, and engineering, both civil and electrical. The curriculum is arranged with the view of giving a broad liberal culture as a basis for any professional career. The graduate courses represent the university work of the institution, and lead to the higher degrees of master and doctor. The undergraduate years are occupied with required classroom work in the first portion. To these are added series of lecture courses, which gradually become so numerous as to afford large series of logically co-ordinated elective studies in the two closing years. At the present time there are in the academic department 42 required courses, 139 elective courses, 77 graduate courses, and 6 optional courses.

In the scientific department there are many courses of study, taken either with the academic classes or in parallel, and in addition there are 64 required technical courses, with 20 elective studies given only to scientific students. The course in electrical engineering is a graduate course occupying two years. At the present time (1899) there are 128 graduate students and 4 in electrical engineering. There are 633 academic and 334 scientific undergraduates, making a total enrollment of 1,099. In 1900, 1,302.

The governing body of Princeton is a self-perpetuating board of trustees, consisting of the Governor of the State, the president, and 25 members. The faculty, which has immediate control of the institution, consists (1900) of 59 professors and 9 assistant professors, together with 22 instructors and tutors and 13 fellows.

The expense of an education at Princeton ranges from $200 to $600. The institution possesses more than a hundred endowed scholarships and 11 fellowships, 6 of which are open to undergraduates, and, in addition, there are awarded each year 32 prizes for successful competition in various departmental examinations.

The library offers especial facilities for study. The Chancellor Green Library building has been refitted as a consulting library, where about 40,000 standard works, including the latest publications and periodicals, are accessible from 8 A. M. to 10 P. M. The new building has capacity sufficient to shelve 1,200,000 volumes, and includes the administration rooms, 15 rooms for seminary work, and a large room for the exhibition of rare books. The building is thoroughly equipped with all the latest modern improvements in heating, ventilation, stacks, elevators, telephones, etc. The general collection of books in this building consists of more than 110,000 volumes and 35,000 pamphlets, besides many special collections of great value. There are several technical libraries which are located in connection with the laboratories or observatories. These include books on astronomy, biology, botany, and geology. There are about 200,000 volumes in all, accessible to the students. There are three museums connected with the institution: (1) geological and archæological; (2) biological; (3) historic art. All of these have extensive collections which have been carefully arranged and are accessible at all times.

There are nine laboratories in which scientific work is done: (1) psychological; (2) physical; (3) electrical engineering; (4) chemical; (5) mineralogical; (6) histological; (7) biological; (8) paleontological; (9) civil engineering.

In addition to these there are two observatories. One of these is devoted to the work of investigation, mainly in the department of astronomical physics. It is furnished with an equatorial telescope of 23 inches aperture and 30 feet focal length, which is provided with all the usual micrometric and spectroscopic accessories. The other observatory is devoted to the purposes of instruction. It possesses an equatorial of 9½ inches aperture, a meridian circle, transit instruments, prime vertical, chronograph, two standard clocks, and all the subsidiary apparatus required for carrying out the work involved in the courses on practical astronomy.

There are 32 buildings on the campus of the university, which covers about a square mile of ground on the south side of the main street of the town near its central portion. Twelve of these buildings are dormitories, which, however, accommodate only about three-quarters of the students. Among the more noticeable of the remaining buildings are the following:

Alexander Hall, a very handsome building, is used for public exercises, lectures, and university gatherings of a general character. Both the exterior and interior of this structure are very ornate, being richly decorated with carvings and mosaic.

The infirmary was built to meet the demand for the proper care of the students who might be taken ill at any time. It contains all the modern arrangements of the best hospital construction. The building is under the charge of the sanitary committee of the university. The students pay a small fee, for which they obtain in all cases of ordinary sickness every needed care.

The Halls, under which name the two literary societies of the institution are generally known, originated early in the history of the university. They are conducted by the undergraduates, and occupy handsome marble buildings which are not only an ornament to the campus, but which serve the purpose of providing the necessary rooms for the meetings of the societies. Each hall possesses a valuable library of more than 10,000 volumes. They conduct courses of literary exercises, and award numerous prizes for orations, essays, and debates.

The religious interests of the institution are provided for by the chapel exercises and the meetings of the Philadelphian and St. Paul's Societies. A broad evangelical spirit is cultivated, and sectarianism is not favored. The Philadelphian Society was founded in 1825, and is therefore one of the oldest societies of this character in the U. S. It has a building of its own, containing a hall for general meetings and a reading-room.

The university athletic grounds are ample and complete in all their appointments. Within the inclosure are a large winter practice-house, a house containing the dressing-rooms, a large grand stand, besides a club-house for the use of the athletic teams. These grounds are used for intercollegiate games of all sorts, while the Brokaw field and its memorial building, containing a swimming-pool, serve as the general playground for the students.

The fortunate location of Princeton, midway between the great cities of New York and Philadelphia, in a town where everything is largely subordinate to the interests of the university, gives it exceptional advantages. While quite near enough to these cities to give easy access, none of their disturbing distractions are felt. In addition, the university is of necessity, from these same conditions, forced to be a cosmopolitan rather than a local center of learning.

WILLIAM LIBBEY.

Pritchett, HENRY SMITH, Ph. D.: astronomer; b. in Fayette, Mo., Ap. 16, 1857; educated at Pritchett College, Glasgow, Mo., and in 1876 went to Washington to continue mathematical and astronomical studies under Prof. Asaph Hall in the U. S. Naval Observatory. Two years later he was appointed assistant astronomer in the Naval Observatory, but resigned in 1880, and spent a year in the Morrison Observatory in Glasgow. In 1881 he was called to the chair of Astronomy in the Washington University, St. Louis, where he remained until his appointment as superintendent of the Coast and Geodetic Survey in 1898. He was a member of the party that went to Auckland, New Zealand, to observe the transit of Venus in 1882, and on the completion of that work he served as acting assistant on the Coast and Geodetic Survey, accompanying the party that visited Australia, Singapore, Japan, and elsewhere, sent to determine gravity with the Koter pendulums. In 1894 he visited Europe, and at that time received the degree of Ph. D. from the University of Munich. His scientific investigations have not been confined exclusively to astronomy, but he has also paid considerable attention to physics and geodesy. In connection with the latter he determined latitudes for the U. S. Geological Survey, and he also participated in the longitudinal determinations with parties from both the U. S. Geological and the U. S. Coast Surveys. Dr. Pritchett is a member of numerous scientific societies, and was in 1891 president of the St. Louis Academy of Sciences. He is the author of many scientific papers, the more important of which are the following monographs: *Determination of the Mass of Mars* (1878); *The Rotation Period of Jupiter* (1880); *A Formula for Predicting the Population of the United States* (1890); *Report on the Total Eclipse on Jan. 1, 1899* (1892); and *Eclipses of the Satellites of Saturn* (1899).

MARCUS BENJAMIN.

Private Road: a popular and quasi-legal designation for a roadway or passage overland for horses and teams which is open to the public, but the ownership of which is vested in private parties. Such private roads or streets are in general governed by the same laws which apply to any private property, except for the rights of the public arising from the fact that they are thrown open so as to give an implied invitation to the public to use them. As a result of this implied invitation, there may be implied duty upon the owners to keep it in reasonably safe condition for the public to use in the way in which it is apparently intended to be used, so that if this is not done any person receiving injury may have a right of action against the owner of the property for damages so sustained.

The matter is frequently regulated by public statute, providing for or requiring the erection of notices to the public that the road or street is a private road, in which case parties using it do so at their own risk of injury or damage. The government or municipality also has the power to regulate and control such roads, and may prescribe the way in which they shall be paved, sewered, and lighted, and impose upon the abutting owners the duty of complying with the regulations made for this purpose. Such a road may become a highway by use and occupation under the law of prescription, or by virtue of an expressed dedication, or by an implied dedication arising out of the manner in which the property is thrown open to the public and used by them. In the absence, however, of the enforcement of any such right by the public, such road may be closed or fenced in at the pleasure of the owner or owners, or parties having rights

or interest in it, in the same manner as any other private property. See Highways. F. Sturges Allen.

Probate Courts: This term is used to designate certain courts in England and in the U. S. which have jurisdiction and control, more or less extensive, of the probate of wills and the regulation of the management and settlement of the estates of decedents, and also the control of the estates of minors and other persons reckoned to be incompetent at law. In Great Britain, up to a very recent date, this jurisdiction was largely vested in the ecclesiastical courts, and was actually administered to a certain extent by the surrogate, or the deputy or substitute of the ecclesiastical judge, whence arises the American use of the term surrogate courts, to designate courts having essentially the same jurisdiction as those elsewhere called probate courts.

In England in 1857, by a statute (20 and 21 Vict., ch. 77), a new tribunal was established, called a court of probate, upon which was conferred the jurisdiction formerly exercised by the ecclesiastical and manorial courts over decedents' estates, and the ecclesiastical courts were deprived of their power to grant or revoke letters of administration. The new court of probate was given jurisdiction in testamentary cases, both in voluntary cases and in cases of legal contention, and had jurisdiction throughout all England. The law of England was further modified by the act of 36 and 37 Vict., ch. 66, of 1873, known as the Supreme Court of Judicature Act, which united and consolidated all the courts then existing so as to constitute one supreme court of judicature in England. By section 16 of this act the jurisdiction of the court of probate was transferred to the high court of justice, and this jurisdiction was declared to include all the jurisdiction which at the commencement of the act was vested in or capable of being exercised by the judges of the several courts of probate, sitting in court or in chambers or elsewhere, when acting as a judge or judges in pursuance of any statute, law, or custom; and they were declared to have the powers which were given to such court or to any such judge or judges by any statute, and also all ministerial powers, duties, and authorities incident to the jurisdiction conferred.

Where there is no dispute as to the grant of probate or letters of administration under the present law the grant is made in what is called "common form," either in the principal registry in London or in the district registries which were created throughout England and Wales. Where there is a contention the questions of probate or granting of letters of administration are determined judicially, in what is called "solemn form," in the court of probate, except where the estate does not exceed a certain amount, in which case the county courts have jurisdiction.

In the English colonies of America the probate jurisdiction of the ecclesiastical courts of England was vested in the minor civil courts, which followed the precedents and principles of the spiritual courts of England, modified by the special history or circumstances attending the formation of the colony. Thus in the colony of New York, which was Dutch in its origin, the probate jurisdiction of the courts was governed by the Dutch Roman law, the custom of Amsterdam, and the law of Aasdon, and was exercised by a tribunal of members of the colonial council; afterward, from 1653 to 1655, by the court of burgomasters and schoppens, and then by the court of orphan masters, and, after the occupation of the province by England, by the mayor's court. It was afterward vested in the court of common pleas, the successor of the mayor's court, and subsequently was, and now is, exercised by the surrogate's court, created by statute.

In England, and in many of the Eastern States of the U. S., each county has a court of probate; in other States, including Pennsylvania, in each county there is what is known as an orphans' court, while in other States, including Kentucky and some other Western and Southern States, the probate jurisdiction is vested in the county court. In still other States probate jurisdiction is vested in the clerks of the ordinary civil courts, either wholly, as in North Carolina, or during vacation, as in Indiana and elsewhere.

Generally speaking, the probate court has jurisdiction over the administration of an estate of the decedent if his domicile at the time of his death was within the limits of the jurisdiction of the court, the question of domicile here being a mixed question of fact and of law. (See Domicile.) For the purpose of such administration the decedent's estate is considered to be situated at the place of his domicile, but the control and administration of his estate is under the administration of the court within whose jurisdiction the estate is situated.

In England, prior to the act of 1857, above mentioned, a distinction was made between wills of personal and real property, it being held that wills of real property or both real and personal property must be probated, but that the probate of wills of personal property only was unnecessary and improper. Subsequent to the act of 1857, however, all papers of a testamentary character were required to be probated in England, as they are in the U. S., where no distinction is made between wills affecting personal and wills affecting real property. Papers not executed and attested according to law, such as letters, memoranda, etc., are not of a testamentary nature, and need not be probated: but where a paper is referred to in a properly executed will, and contains directions as to the disposition to be made of the executor's estate, it should be probated with the will. A properly executed paper merely appointing an executor, without making any disposition of the decedent's estate, is held to be a will, and is held to be proper and necessary to be probated.

The duties and privileges of executors, heirs, devisees, legatees, and other persons having rights under or by virtue of a will, and the procedure for the probate of wills and letters testamentary, is particularly regulated by statutes which should be consulted for their specific provisions.

See Carey, *The Law and Practice in Courts of Probate*; Cootes, *The Common Form Practice of the High Court of Justice*; Redfield, *The Law and Practice of Surrogates' Courts*. F. Sturges Allen.

Prothero, Rowland Edmund: English lawyer and historian; b. in Clifton-on-Terne, Sept. 6, 1852, son of Rev. Canon Prothero, of Whippingham; received his education at Marlborough and at Baliol College, Oxford; was fellow of All Souls College, Oxford, 1875–91, and proctor 1883–84; he studied law and was called to the bar, but has devoted himself chiefly to historical and critical literature, and he is now (1899) editor of the *Quarterly Review*. Besides numerous contributions to the reviews and monthly periodicals, he has published *Pioneers and Progress of English Farming* (1887); *Life and Correspondence of Dean Stanley* (1893); *Letters and Verses of Dean Stanley* (1895); *Letters of Edward Gibbon* (1896); revised Mr. Holmes's *Life of Queen Victoria* (1897); and *Letters and Journals of Lord Byron* (vols. i. and ii., 1898). F. Sturges Allen.

Prowse, Daniel Woodley, LL. D.: b. in Newfoundland in 1834; after a course of education at the Church of England Academy at St. Johns, Newfoundland, the collegiate school at Liverpool, England, and King's College, Windsor, Nova Scotia, he read law and was called to the bar of Newfoundland in 1858; was made queen's counsel in 1870; he was a member of the Legislature 1861–69 for Burgeo and La Poile; was appointed judge of the central district court in 1869, and served as a member of the commission for the consolidation of colonial laws; was chairman of the board of health 1893–96. He is chiefly known for his *History of Newfoundland* (1895), besides which he has written for the periodicals and also a *Manual for Magistrates in Newfoundland* (2d ed. 1898). F. Sturges Allen.

Prume, François Herin Jehin: violinist; b. in Spa, Belgium, Apr. 18, 1839, the son of a distinguished painter, and nephew of François Prume, violinist, and Joseph Prume, an artist of repute. He began his studies at the age of four years, from his uncle François. When twelve years old he took first prize at the Brussels conservatory for playing, and at fifteen he gained first prize for harmony. At sixteen he began his career as a virtuoso, and for many years had uninterrupted success in his concert tours. He followed Emperor Maximilian to Mexico in 1864, and then visited Cuba and the U. S. under the management of Strakosch, achieving great success in New York in 1865. He settled in Montreal, where he died May 29, 1899. D. E. Hervey.

Putnam, George Haven: publisher and author; b. in London, England, Apr. 2, 1844; studied at Columbia College in 1860 and in Göttingen 1861–62, leaving college to enter the U. S. army during the civil war, in which he became brevet major: was appointed deputy collector of internal revenue in 1866, and in the same year became a publisher in New York city, later becoming head of the firm of G. P. Putnam's Sons: has served on executive committees of the Free Trade League, the Reform Club, the Civil Service Reform Association, and as secretary of the American Publishers' Copyright League. He has published *Authors and Publishers* (1875); *Literary Property* (*Lalor's Cyclo-*

pædia, 1879); *Authors and their Public in Ancient Times* (1893); and edited *The Question of Copyright* (1891).

Pyle, Howard: artist; b. in Wilmington, Del., Mar. 5, 1853; studied art in Philadelphia, and after a brief residence in New York city returned to Wilmington, where he has since resided, being chiefly engaged in book and magazine illustration. Some of his publications, for which he made the drawings, are *The Merry Adventures of Robin Hood* (1883); *Pepper and Salt* (1885); *Within the Capes* (1885); *The Wonder Clock* (1887); *The Rose of Paradise* (1887); and *Otto of the Silver Hand* (1888).

Queens, Borough of: one of the boroughs of the city of New York as constituted under the charter of Jan. 1, 1898. It includes the former Long Island City, the former towns of Newtown, Flushing, and Jamaica, and part of the old town of Hempstead, which territory constitutes Queens County, that part of old Queens County not taken into the new city having been formed into the new Nassau County. Pop. (1900) 152,999. For the new government, see New York, City of, in the Appendix.

Quick, Robert Hebert, M. A.: educator; b. in London, Sept. 20, 1831. His father was a merchant of considerable fortune, so that the son did not have the stimulus of the knowledge that he must depend upon his own resources for a livelihood. He was fitted for the university mainly by private tutors, though he had a brief term at Harrow, and completed his education at Trinity College, Cambridge. He took orders and was for a time curate at St. Mark's, Whitechapel. He then studied in Germany. Returning, he took up his clerical duties again, but in another church. In 1858 he went again to Germany, and on his return, in May, took a position in the Lancaster grammar school. Early in 1859 he again went to Germany, and in the summer of that year accepted the mathematical mastership at Guilford grammar school. He taught in several other schools, and finally, in the autumn of 1869, accepted a mastership at Harrow, having in the meantime published his great work, *Educational Reformers*, in 1868. In 1874 he resigned his position at Harrow. In 1876 he started a school of his own at Orme Square. In 1879 he was appointed to give a course of lectures on the history of education for the Teacher's Training Syndicate at Cambridge. These lectures he continued until 1883. He was rather disappointed with them, and says that no one in the university had the slightest interest in the subject, or cared anything about it. His audience at his first lecture was made up mainly of young ladies from Newnham and Girton. In 1881 he gave up the day school in Orme Square and a little later started a private boarding-school at Guilford, the attendance at which never reached more than six. In 1883 he accepted the living at Sedbergh, where he remained until 1887. On resigning at Sedbergh, he settled at Redhill, near London, where he passed the remainder of his life. He died Mar. 9, 1891, while on a visit to his friend, Prof. Seeley, at Cambridge. Few books on education have been more widely read and more generally commended than his *Educational Reformers*, first published in 1868 and in a revised and enlarged edition twenty-five years later. The book achieved its first success in America. It was many years after publication before the English edition of five hundred copies was disposed of. For many years Mr. Quick was the most eminent authority on educational questions in England, and almost the only English writer on education in England of international reputation. His theories found wide acceptance, and he had special skill in interpreting the views of other writers on educational questions. It can not be said, however, that he was himself a successful teacher, a criticism which can be made on most of the educational reformers; but through his writings he probably did more than any one else to encourage the development of the professional spirit among English teachers. See *Life and Remains of the Rev. R. H. Quick*, edited by F. Storr (1899).

C. H. Thurber.

Rachmaninoff, Sergei Wassiliewitch: pianist; b. in Novgorod, Russia, in 1873, and a pupil of Arenski (theory) and Siloti (piano) in the Imperial Conservatory of Moscow, where he received the great gold medal. He belongs to the Neo-Russian school. Several of his compositions were played by Siloti in his tour of the U. S., in 1897–98. Besides works for the pianoforte, he has composed a trio in D minor dedicated to the memory of Tschaikowski. He made his first appearance as a pianist in London in the spring of 1899.

D. E. Hervey.

Radiation: the process by which energy in the form of wave-motion of the luminiferous ether is sent out from the surface of bodies. Radiation is the most important of the three ways in which heat energy is transferred from place to place (radiation, convection, and conduction). The fact is now completely established that the waves with which we have to deal in radiation are in all cases identical in character with those to which the phenomena of light are due. Light-waves and the so-called heat-waves travel at the same velocity and are equally capable of reflection, refraction, dispersion, polarization, diffraction, and interference. There is, indeed, no criterion by which these two classes can be separated one from another save that of wave-length. A certain group of waves only, the lengths of which lie between narrow and well-defined limits and are all contained within a single octave, are capable of affecting the retina, and thus arousing the sensation of light, but all waves in the ether require energy for their production, carry energy with them in their course through space, and when destroyed deliver energy at the point where the wave-motion ceases.

Units of Wave-length.—There are three distinct systems for the expression of wave-length in common use:

(*a*) Spectroscopists, who have to do, primarily, with the visible spectrum, adopt as their unit the *tenthmeter* or Ångström unit, which is 10^{-10} meters or 10^{-8} cm.

(*b*) Students of radiation in the broader sense usually express their results in microns (μ). The micron is one millionth of a meter or 10^{-4} cm. The change from one of these systems to the other is made by shifting the decimal point four places. Thus the wave-length of the yellow light of the sodium flame (D_1) is 5,896·0 Ångström units or 0·5896μ.

(*c*) Hertzian Waves (*q. v.*), which are identical with the waves with which we have to deal in the study of radiation, but of greater length, are usually expressed in centimeters.

In this article all wave-lengths will be given in microns.

The Range of Known Wave-lengths.—The waves which constitute the visible spectrum—i. e. which are capable of affecting the retina—all lie approximately between 0·39μ (extreme violet) and 0·77μ (extreme red). The shortest wave-length thus far actually measured is, however, only 0·1μ, while the longest is 61·0μ. There is every reason to believe that waves much shorter than these on the one hand and longer on the other exist. Becquerel rays* or Uranium Rays (*q. v.*) are very generally thought to be identical with the waves due to ordinary radiation, but of exceedingly short wave-length, and the Röntgen rays (or X-Rays, *q. v.*) are placed by many authorities in the same class. As regards long waves, it should be noted that Rubens and Nichols† predicted with confidence the existence of waves of much greater length than those measured by them (24μ), and indicated definitely the way in which they may be produced. At the time of writing their memoir, however (1897), they had not succeeded in isolating and identifying them. In 1899 Rubens and Aschkinass,‡ by a new and ingenious method to be described later, obtained these waves and found their length to be, as predicted, respectively 51μ and 61μ.

Hertz waves, to which reference has been made in a previous paragraph, and which owe their existence to electrical oscillations, depend as to wave-length upon the size of the apparatus. The mechanical difficulties in producing very short waves are great, but Ledebew§ has succeeded in reducing the wave-lengths to 0·3 cm. (3,000μ). Longer waves (up to wave-length = infinity as a limit) are readily producible at the will of the experimenter.

Of this great series of wave-lengths only those which lie between the narrow limits of the visible spectrum can be studied directly by optical methods. The far greater class, the wave-lengths of which exceed 0·77μ, can be detected most readily by means of their thermal action. The energy, fortunately for such investigations, increases rapidly with the wave-length, so that while it is exceedingly difficult to make thermal measurements in the neighborhood of the violet end of the visible spectrum, indications are more easily obtained in the red and in the infra-red. As for those wave-lengths which lie beyond the violet (the ultra-violet), the energy is almost without exception too small to be measured. There are, it is true, a few isolated instances

* Stewart, *Physical Review*, vol. vi., p. 239.
† Rubens and Nichols, *ibid.*, vol. iv., p. 314.
‡ Rubens and Aschkinass, *Wiedemann's Annalen*, vol. lxvii., p. 459.
§ Ledebew, *ibid.*, vol. lvi., p. 1 (1895).

in which the heating effect of a very brilliant group of waves like those which are found in the spectrum of the arc-light have been shown by means of apparatus of extraordinary delicacy, but were our knowledge of this region confined to that which could be determined by the heating effect it would be very slight. Fortunately, these shortest waves are of great actinic power, so that the photographic plate enables us to study the ultra-violet spectrum in great detail.

It is not many years since the wave-lengths represented in ordinary radiation were divided into three distinct groups: the so-called actinic rays, the visible rays, and the dark-heat rays. It has only gradually been made evident that, as has already been stated in a previous paragraph, all radiation is a form of energy and capable of producing heat in proportion to its energy, and that the actinic and the optical phenomena which we take advantage of on account of the ease with which they enable us to study certain groups of waves do not indicate any difference excepting that of wave-length.

Character of the Ether-waves which Constitute Radiation.—The identity of all the waves emitted by a radiating body being established, we are able to take advantage of our very complete knowledge of the waves which constitute the visible spectrum (which knowledge is obtained by numerous optical experiments) to describe the character of them all. It may be stated in general that radiation is transmitted by means of the ether, and that it consists of transverse waves. These waves travel *in vacuo* with a velocity (the velocity of light) of 30,057,400,000 cm. (186,680 miles) per second; through space occupied by ordinary matter, such as the air, water, glass, etc., the velocity is somewhat reduced.

Production of Radiation.—Radiation depends, both as to amount and as to the character of the waves given off by the radiating body, upon the temperature of that body. Bodies at all temperatures send forth ether-waves. At low temperatures these waves are chiefly of great wave-length, and as the temperature rises shorter and shorter waves begin to show themselves. At the temperature called the red heat or temperature of incandescence—namely, about 500° C.—those waves which make up the visible spectrum begin to be present in sufficient intensity to affect the retina. The very first impression upon that organ is an exceedingly dim sensation of light unaccompanied by any color-impression. This, however, is speedily followed, as the intensity of the stimulus rises, by a recognition of the characteristic colors of a red-hot glowing surface. As the temperature continues to rise, shorter and shorter wave-lengths attain intensities sufficient to produce a physiological effect, and the color-sensation passes gradually from red and yellow into white.

Were radiation homogeneous as regards wave-length, it would be a comparatively simple matter to express the growth or rise of radiating power as a function of the temperature. Owing to the innumerable wave-lengths which are simultaneously given off by glowing bodies, the problem is a very complicated one. We have to consider the growth of each wave-length separately, and since with rising temperature the rate of increase of intensity varies with the wave-length, being greater for short than for long wave-lengths, a complete analysis involves a separation of radiation into its component parts, a study of each of these separately, and the recombination of the results by some process of integration.

The matter is further complicated by the existence of a distinct variety of radiation which is not primarily due to temperature, but to chemical action, the effect of light, exposure to kathode rays, or to any one of a variety of other causes. This type of radiation, which will be left out of account in the present article, is termed Luminescence (*q. v.*).

Methods of Studying Ether-waves.—Radiation belonging to the region of the visible spectrum is studied by means of a variety of optical instruments which are described at some length elsewhere. (See Spectrophotometer, Spectrum, Spectroscope, Telescope, etc.) In the study of waves belonging to the regions of the ultra-violet and the infra-red other means must be employed for detecting the presence of the waves and of measuring the wave-length and intensity.

In the ultra-violet two methods are used, namely photography, first employed by Becquerel* in 1842, and the use of the fluorescent screen. Photographs of the spectrum of the sun, taken under conditions which avoid as far as possible the absorption of the waves by passage through glass and other media, show the presence of radiation from this source extending to about wave-length 0·22μ, at which point the spectrum appears to cease rather abruptly. There is reason to believe that shorter waves are present in the sun, but that they are cut off in passing through the earth's atmosphere. When we substitute for sunlight the radiation from a source of light near at hand, so that the thickness of the layer of air to be traversed is reduced, still shorter waves manifest themselves by their effect upon the sensitive plate. Kayser and Runge,* for example, have been able to detect the presence of radiation, due to burning aluminium, the wave-length of which was 0·1852μ. Victor Schumann,† to eliminate still further the influence of absorbing media in the path of the ultra-violet rays, contrived a spectroscope with lenses and prism of fluorite, which material is even more transparent than quartz for extremely short waves. The apparatus was so constructed that the rays passed through a vacuum instead of air, and fell on a sensitive plate devoid of gelatin. In this way it was found possible to photograph the hydrogen spectrum as far as 0·1000μ.

The other method chiefly employed in the study of the ultra-violet consists in placing in the path of the rays some luminescent material, such as uranium glass, which possesses the property when exposed to radiation, particularly to ultra-violet rays, of emitting longer wave-lengths, some of which lie within the range of the visible spectrum. In this way the presence of the ultra-violet rays may be made evident to the eye, and the spectrum beyond the range of visibility may be explored. Stokes studied the spectrum of sunlight in this way at a very early day (1851), and picked out by means of fluorescent screens the numerous dark lines previously discovered by Becquerel.

The study of the solar spectrum by these two methods shows that it is filled with black lines due to the passage of the light through the incandescent vapors of iron, calcium, magnesium, aluminium, etc.; in short, that the ultra-violet spectrum is simply a continuation of the visible spectrum of the sun. If, on the other hand, we burn a metal such as iron and study the spectrum of the light which it emits, we find it made up of numerous bright lines corresponding to the bright lines of the visible spectrum of this substance.

In the study of the infra-red neither photography nor the use of the fluorescent screen would at first thought seem to be available, since it is to the shorter wave-lengths of the violet and ultra-violet chiefly that actinic action and the power of producing luminescence belong. Both of these methods have nevertheless been of great service in the study of the wave-lengths lying just outside the limits of the visible spectrum beyond the red; and while neither of them was the first method used, nor, on account of the rather narrow range through which they are applicable, can be regarded as the most important, we owe most of our detailed knowledge of these portions of the spectrum to them.

The existence of the infra-red spectrum was first demonstrated by William Herschel.‡ who placed a thermometer in the rays of the sun's spectrum and found an elevation of temperature increasing toward the red and even beyond that point, and presenting several regions of maximum and minimum after the limit of visibility had been passed. In 1840 his son, John Herschel,§ showed the presence of absorption bands or lines in the infra-red spectrum by the ingenious and very simple method of dipping smoked paper in alcohol or ether and placing it in the solar spectrum while still wet with its black face toward the light. The unequal evaporation due to the amount of heat produced in different portions enabled him to trace the lines on the reverse side of the paper and to locate them. It had already been shown by E. Becquerel‖ in the previous year (1839) that the invisible rays beyond the red were capable of affecting daguerreotype plates previously exposed to light, and this effect was utilized by J. W. Draper¶ in 1843 to obtain a photograph of the infra-red spectrum. He found three dark lines, which he designated by the Greek letters α, β, and γ.

E. Becquerel in 1842 noticed an interesting property of these rays—namely, that they were capable of destroying the luminescence of a phosphorescent substance previously exposed to light—and he made use of this property to obtain

* Becquerel, *Bibliothèque Universelle de Genève*, 40 (1842); also Becquerel, *La Lumière*, vol. i., p. 138.

* Kayser and Runge, *Transactions of the Berlin Academy of Sciences*, 1891.

† V. Schumann, *Transactions of the Vienna Academy of Sciences*, vol. cii., pp. 415 and 625 (1893).

‡ W. Herschel, *Philosophical Transactions* (1800).

§ J. Herschel, *Philosophical Magazine* (3), vol. xvi., p. 331.

‖ E. Becquerel, *Comptes Rendus*, 11, p. 702.

¶ J. W. Draper, *Philosophical Magazine* (3), vol. xxi., p. 453.

reversed or negative pictures of the infra-red spectrum on such screens. Regions devoid of energy on account of absorption bands or lines, corresponding to the dark lines of Fraunhofer, continued to glow, while the intervening regions which were exposed to radiation were dark. This method of studying the infra-red spectrum by phosphorescence was later developed and used by his son, H. Becquerel,* who mapped the spectrum as far as wave-length 1·48μ. The younger Becquerel not only studied in detail the infra-red spectrum of the sun within these limits, but likewise mapped a considerable number of absorption spectra, including those of the rare earths. He likewise obtained impressions on the phosphorescent screen of lines due to sodium, potassium, calcium, magnesium, thallium, and silver. He showed by a comparison with the absorption spectrum of water that the three most prominent bands or line groups in the infra-red spectrum of the sun were in all probability due to the absorbing effect of the moisture in the air—a statement which is confirmed by the fact that these bands increase in depth as the sun approaches the horizon and appear of different intensities on different days. Fig. 1

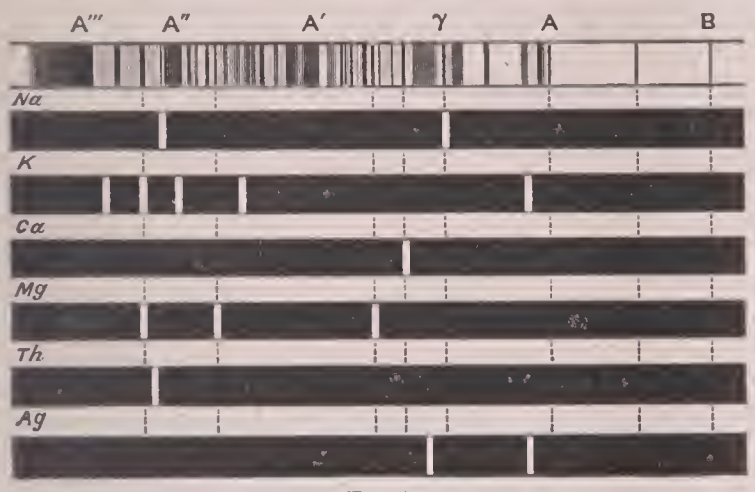

Fig. 1.

shows on a greatly reduced scale Becquerel's map of the infra-red solar spectrum, together with the bright-line spectra of several metals.

The photographic method, which had its origin in the observations of E. Becquerel (1839), that daguerreotype plates were sensitive by a sort of secondary action to exposure to infra-red, was developed by Vogel, by Waterhouse,† and chiefly by Abney,‡ who first succeeded in producing plates on which excellent photographs of the infra-red could be obtained as far as wave-length 1·0μ. Abney's photographic maps show a large number of lines corresponding to the dark lines of the Fraunhofer series within this region. There is considerable discrepancy in the assignment of wave-lengths between his values and those obtained by Becquerel, although both observers made use of the normal spectrum produced by a grating in the determination of the position of the principal lines on their maps. Lommel§ in 1890 made photographs of the infra-red spectrum by exposing a phosphorescent screen to the rays and subsequently placing it in contact face to face with a sensitive dry plate. Measurements of wave-length obtained in this way agree closely with those made by Abney.

The portion of the infra-red which is capable of investigation by these two methods lies within narrow limits—namely, between the red end of the spectrum and wave length 1μ. For the study of longer waves we must have recourse to their thermal action. In this field William Herschel's observation at the beginning of the century, to which reference has already been made, was the only important piece of work for many years. Fizeau and Foucault‖ in 1847 explored the heat spectrum by means of minute thermometers of extreme sensitiveness. Desains¶ (1868) made many explorations of the infra-red spectrum of the sun by means of the linear thermopile and noted the extreme variability of the solar spectrum with the condition of the earth's atmosphere and the height of the sun above the horizon. Similar observations were made by Lamansky* in 1871, and in 1879 Mouton† compared the sun's spectrum by this method with that of artificial sources of light. One of the most important steps in the study of the infra-red was the invention by Langley‡ of the bolometer, an instrument which, on account of its extraordinary sensitiveness, has in great measure displaced the thermopile, and has made it possible to obtain a detailed knowledge of the obscure heat-waves of great length.

The best known of the instruments used in the thermal study of radiation, such as the differential thermometer of Leslie (see Radiometer), the Pyrheliometer (*q. v.*) of Pouillet, the Thermopile (*q. v.*), the Bolometer (*q. v.*), and the compensated actinometer of Ångström (see Radiometer), have been briefly described elsewhere. Of these the most important are the bolometer and thermopile. By the use of them, in connection with that almost inconceivably delicate instrument the galvanometer, it has been found possible thus to explore the whole region of the infra-red, to verify the existence of the lines and absorption bands noticed by Becquerel, and to extend the investigation to wave-lengths far beyond those to which his fluorescent screen was sensitive.

With the bolometer, Langley§ determined the distribution of heat-energy in the spectrum of the sun at various times and at different heights above the sea. He likewise explored the heat-spectrum of various artificial sources, of the firefly, of the moon, etc. Brief reference is made to this work in the article Spectrum. For details concerning his measurements on solar radiation, see the remarkable memoir entitled *Researches on Solar Heat; a Report of the Mount Whitney Expedition.*‖

More recent measurements of solar radiation have been made on Teneriffe and in Switzerland by K. Ångström, using his apparatus mentioned in the previous paragraph; also by Homén¶ in Finland, who employed Ångström's method. Homén recorded the fluctuations in the radiant energy received from the sun and sky throughout the twenty-four hours of each day; also the returned radiation from the surface of the ground. He even followed the passage of the heat thus received by the soil as it slowly penetrated the earth's crust by conduction. The curve in Fig. 2 shows

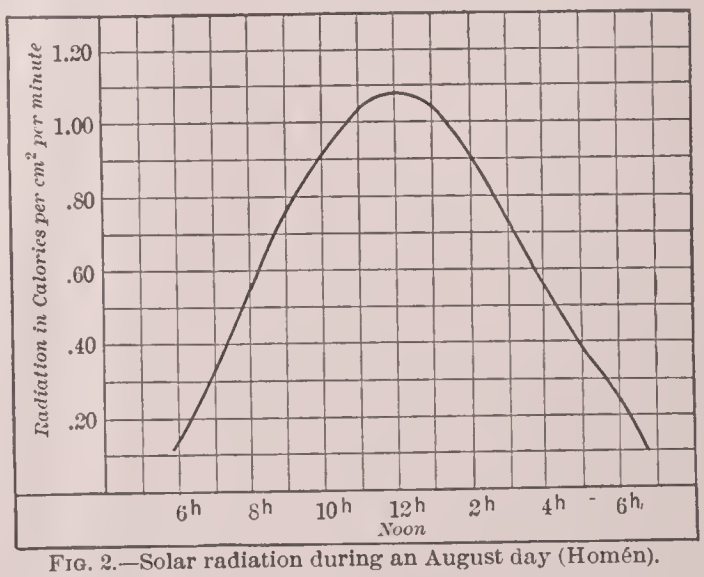

Fig. 2.—Solar radiation during an August day (Homén).

the rise and fall in the intensity of solar radiation during a bright day as determined from his experiments.

Snow** found it possible, by means of a bolometer, to explore the visible spectrum, picking up the Fraunhofer lines, and to obtain indications in the spectrum of the electric arc even from wave-lengths lying on the border-line of the ultra-violet. The region in which the greatest amount of energy was found was that occupied by the so-called hydrocarbon bands in the extreme violet of the arc spectrum, the second or outermost of which is scarcely visible to the eye.

The performance of such experiments depends upon the possession of galvanometers of the utmost sensitiveness, and

* H. Becquerel, *Annales de Chimie et de Physique*, 5th series, vol. xxx., p. 1 (1883).
† Waterhouse, *Proceedings of the Asiatic Society of Bengal* (1875).
‡ Abney, *Philosophical Transactions*, 1880, ii., p. 653; 1886, ii., p. 457.
§ Lommel, *Wiedemann's Annalen*, vol. xl., p. 681.
‖ Fizeau and Foucault, *Comptes Rendus*, vol. xv., p. 447.
¶ Desains, *ibid.* (a series of papers in volumes for 1868, 1869, and 1870).

* Lamansky, *Poggendorff's Annalen*, vol. clvi., p. 200.
† Mouton, *Comptes Rendus*, lxxxix., p. 298.
‡ Langley, *American Journal of Science*, vol. xxi., p. 171 (1881).
§ Langley, *ibid.*, vol. xl., p. 97.
‖ Langley, *Professional Papers of the Signal Service*, No. 15.
¶ Homén, *Der tägliche Wärmeumsatz im Boden und die Wärmestrahlung zwischen Himmel und Erde*, Acte Societatis Scientiarum Fennicæ, tom. xxiii. (1897); also Engelmann, Leipzig (1897).
** Snow, *Physical Review*, vol. i., p. 50.

such instruments are subject to magnetic disturbances to a degree which makes their use trying under the most favorable circumstances. The natural fluctuations of the intensity of the earth's magnetic field, excepting during so-called magnetic storms, one can readily take account of and correct for, but, owing to the widespread use of the electric current in industrial life, the magnetic field in the locality of most laboratories is at the present day subject to sudden and uncontrollable artificial fluctuations, which makes the use of a galvanometer of the highest sensitiveness almost impossible. Fortunately, an instrument has been devised the performance of which, as regards sensitiveness, exceeds that of the best thermopile or bolometer, and which is not affected by fluctuations in the magnetic field. This instrument, which was invented by Ernest F. Nichols (1895), depends upon the principle discovered by Crookes, and exhibited by him in his radiometer. The Nichols radiometer, a diagram of which is given in Fig. 3, consists of two mica vanes, *a a*, blackened on the same side. These vanes are held together by thin fibers of glass, by which they are attached to a vertical glass rod of small diameter, which forms the axis of rotation. To the lower end of this rod a minute mirror, *s*, is attached. A very fine quartz fiber serves to suspend this arrangement within a hollow block of brass over which a bell jar, *b*, fits. By means of the neck of the bell jar the hollow chamber within the metal block is connected with a mercury air-pump. There are two openings: one, not shown, opposite the vanes, which is closed by means of a window, usually of fluorite or of some other substance pervious to the waves which are to be measured; and the other, *c*, of glass through which a beam of light can be sent to the mirror, and, after reflection, returned again to the telescope and scale. When the air has been sufficiently removed from around this suspension it becomes highly sensitive to radiation, and manifests a rotatory tendency like that of the mica vanes used by Crookes in his radiometers. (See RADIOMETER.) If one of the two vanes at *a* is exposed to radiation while the other is protected, they will take up a new position of equilibrium, with the quartz fiber twisted to such an extent as to counterbalance precisely the tendency to rotation. This deflection enables one to measure the energy of the radiation to which the vane is exposed. The instrument is at its maximum sensitiveness when the pressure is reduced to ·05 mm. Since the total weight of the suspension is only 7 milligrammes, its moment of inertia is exceedingly small, and the arrangement in the hands of the inventor has been found to give the highest known delicacy as an indicator of the presence of ether-waves and a means of measuring their intensity.

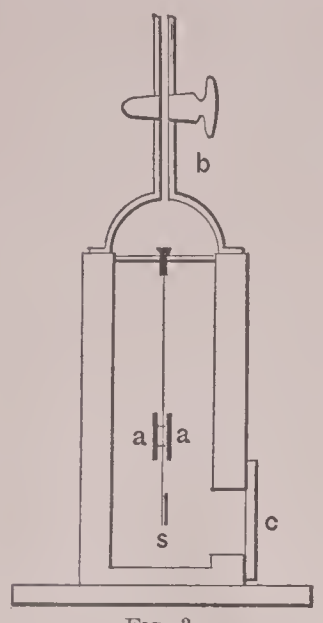

FIG. 3.

The Production and Isolation of the Longer Wave-lengths in the Infra-red.—The study of the longer wave-lengths emitted by radiating bodies is subject to certain difficulties. Glass prisms, which afford the best means of dispersion so far as the visible spectrum is concerned, disperse less and less as the wave-length increases, so that the entire spectrum lying between 3μ and infinity is scarcely separated at all. Glass, moreover, is opaque to all radiation the wave-length of which exceeds 3·5μ. Quartz, which, like glass, is transparent throughout the visible spectrum, in turn becomes opaque at 4·2μ. A favorite substance for prisms for work in this region has been rock salt, which remains pervious for much longer waves. These properties were known to the early students of the subject, Melloni, Tyndall, and others, and it was with rock-salt prisms that Langley's celebrated studies of the infra-red spectrum were made. This material becomes opaque to radiation at about wave-length 20μ.

Rubens, who, in collaboration with Nichols, Trowbridge, and Aschkinass, respectively, has succeeded in working with longer wave-lengths than any other observer, has carefully studied this peculiarity of rock salt and of the similar potassium salt (sylvine, KCl), found that while they transmit longer waves than any other material which has been used for prisms, not excepting fluorite, their use must finally be given up on account of the increasing opacity of the material. Fluorite was found to transmit no waves exceeding 9μ in length.

The regions in which water (and the same curve will apply to alcohol and to aqueous solutions of alums and of various other salts), glass, and quartz, all of which are quite transparent throughout the visible spectrum, begin to be

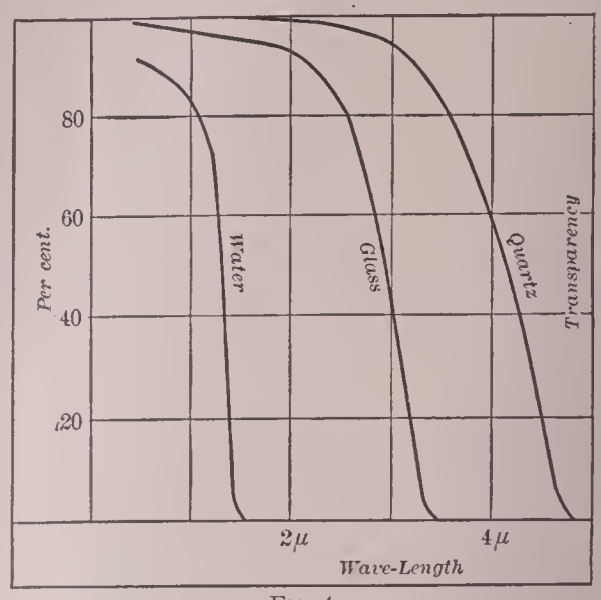

FIG. 4.

opaque, are shown graphically in Fig. 4. Ordinates are transmitting powers for radiation, abscissas are wave-lengths. Fig. 5, which comprises the region between 8μ and 25μ, shows the same property, according to the measurements of Rubens and Trowbridge,* in the case of fluorite ($CaFl_2$), rock salt (NaCl), and sylvine (KCl).

In order to obtain still longer waves than those which can be isolated by means of dispersion, the observers just referred to made use of an ingenious method for the isolation of homogeneous rays of great wave-length in sufficient quantity to make the determination of their wave-length possible. This method may be called the method of *successive reflections*, and is based upon the fact that substances like quartz and fluorite, which are transparent for certain portions of the spectrum, become opaque in others, and that

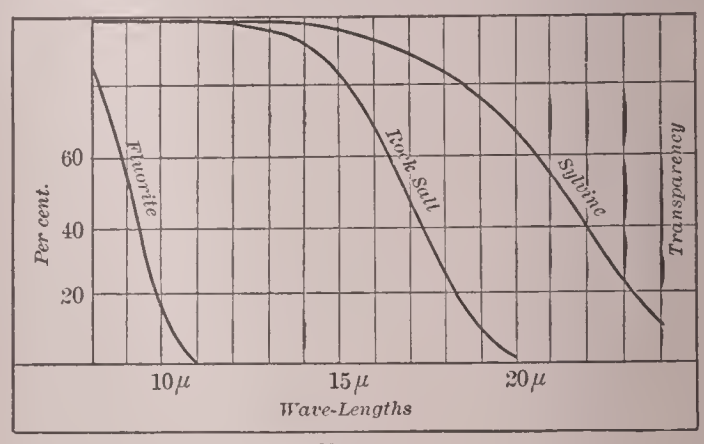

FIG. 5.

their reflecting power for the waves to which they are opaque is very great. By causing the radiation from the body which contains the wave-lengths to be investigated to be reflected from polished surfaces of quartz, fluorite, or rock salt respectively, those waves which are strongly reflected will be sifted out until after three or four reflections scarcely any others are left. The ray thus rendered almost homogeneous can then be measured as to its energy by means of the bolometer, and its wave-length can be determined.

A diagram of the apparatus used in this experiment by Rubens and Nichols † is shown in Fig. 6. Rays from a zircon lamp at *a*, which is at the principal focus of the concave mirror *b*, are sent successively to the three polished surfaces *p p p* by selective reflection, from which the desired wave-length is to be isolated. They are then received by the concave mirror *d*, and focused upon the slit (*s*) of a spectrometer. This instrument has mirrors (*e e'*) in place of collimator and object lenses, a grating (*g*) in place of a prism,

* Rubens and Trowbridge, *Wiedemann's Annalen*, vol. lx., p. 724.
† Rubens and Nichols, *l. c.*

and a radiometer in place of the eyepiece at h. By means of the diffraction of the rays at the grating, which consisted of a set of fine parallel wires, the wave-length is determined. With quartz used in this way, waves of the length of about 8·8μ are obtained; with fluorite the wave-length is very much greater, lying between 24 and 25μ. These waves are absorbed by nearly all known substances. A fluorite plate 2 mm. thick was found to absorb them completely, rock salt 5 mm. thick transmitted only about 3 per cent., and a sylvine plate of the same thickness about 5 per cent. Almost the only substance which does not absorb these waves strongly is the vitreous form of chloride of silver in thin plates, which in a thickness of half a millimeter was found to transmit about 70 per cent. of the rays.

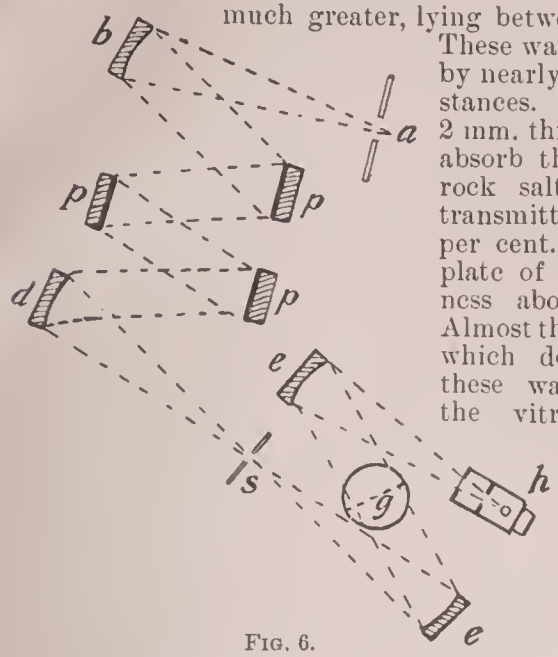

Fig. 6.

Lampblack was likewise found to be comparatively pervious to them. The smoking of the chloride of silver plate until the sun's disk could not be seen through it increased its absorbing power only about 5 per cent. The optical properties of rock salt and sylvine are such as to permit of the isolation, by the method of successive reflections, of waves having lengths equal to 51μ and 61μ.

So feeble are the waves of these lengths in the radiation of glowing bodies that it was impossible to detect them with the apparatus just described, and it was only by the discovery that quartz, which is opaque for all wave-lengths between 4·6μ and 24μ, transmits these still longer waves freely and with high dispersion, that Rubens and Aschkinass* were finally able (1899), by use of a prism of that substance, to isolate and measure them. It was computed that the intensity, which fell off very rapidly in the region explored (as shown by the curve in Fig. 7), was at wave-length 60μ only $\frac{1}{800000}$ as great as the intensity in the maximum of the spectrum at wave-length 1·5μ. It appears unlikely that it will be possible, with the means now at the command of physicists, greatly to extend the range of these explorations into regions of still longer wave-length.

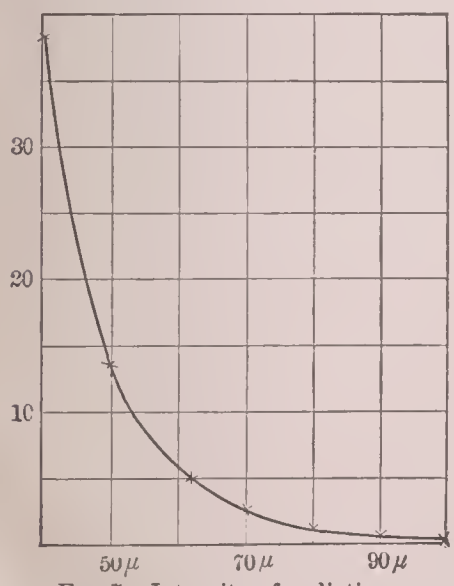

Fig. 7.—Intensity of radiation.

Dispersion in the Infra-red.—Our knowledge of the dispersion of the longer waves of the infra-red spectrum has likewise been notably increased of recent years (1894–99), and the results of the investigations of Rubens and his co-workers, and of Paschen, in this interesting domain have been most important. The variations in the index of refraction of rock salt, with increasing wave-length, which is shown graphically in Fig. 8, will serve to illustrate the nature of these results. The index of this material falls off rapidly within the limits of the visible spectrum, and it is to this change that its dispersing power is due. With increasing wave-length the dispersion decreases in marked degree as indicated by the trend of the curve toward the horizontal direction between 1μ and 4μ. It was commonly believed that the curve beyond the regions actually capable of measurement continued indefinitely in the general direction of the dotted line. Many of the wave-lengths given in the earlier memoirs, including those of Langley, were computed on the basis of that assumption. It was subsequently found, however, that the curve trends downward as shown in the diagram, so that the dispersion increases instead of diminishing, and that the former estimates of wave-length beyond 6μ were altogether at fault. The waves described by these observers were in fact very much shorter than they estimated them to be.

* See the various memoirs already cited.

The curve for rock salt is typical of all the optical materials thus far studied. All of them—i. e. sylvine, fluorite, quartz, and glass—show the same double inflection and the same tendency toward increasing dispersion. In the case of quartz it seems probable, according to the experiments of Ernest Nichols,* that in the neighborhood of 9μ, where the substance becomes opaque and assumes the properties of a metal, the index of refraction is less than unity. This means that in such regions anomalous dispersion occurs.

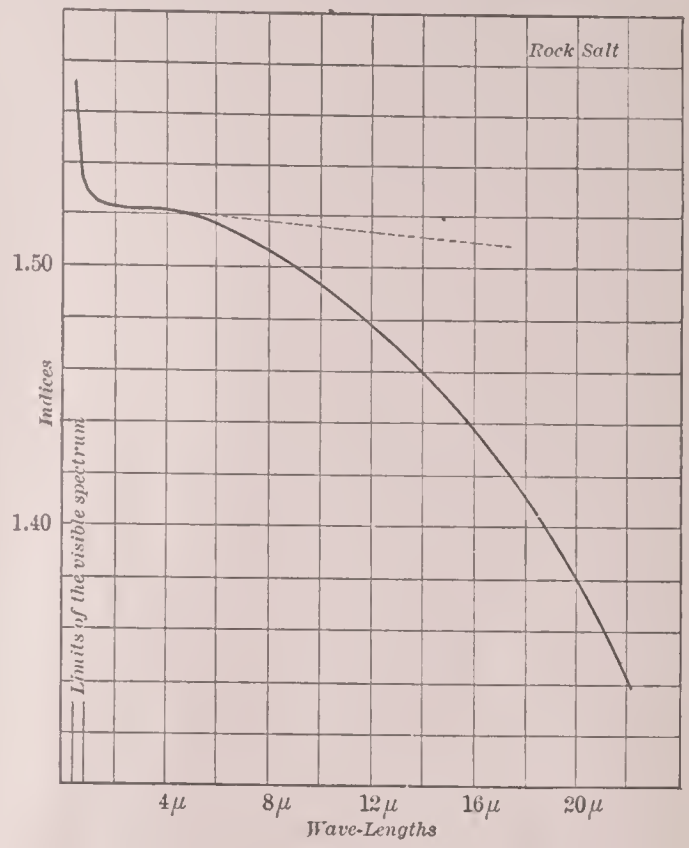

Fig. 8.

For the still longer waves measured by Rubens and Aschkinass, however, the index is 2.17—a value nearly identical with that computed from the dielectric constant for waves of infinite length.

Relation of Radiation to the Character of the Radiating Surface.—The amount and kind of radiation depends not only on the temperature of the radiating body, but likewise on the character of its surface. All bodies radiate in proportion to their absorbing power for radiation, and send out wave-lengths only which they are capable of absorbing. When ether-waves come in contact with a material surface they are either *reflected*, *transmitted* (in proportion as the body whose surface we are considering is transparent or pervious), or *absorbed*. A body reflecting none and transmitting none of the radiation falling on its surface would be a perfect absorber. Such bodies, which do not, strictly speaking, exist in nature, are termed *perfectly black bodies*. Lampblack, platinum black, and certain black pigments approximate so closely to the above definition that they may be regarded, so far as the visible spectrum is concerned, as completely fulfilling it. Lampblack and similar opaque bodies are, however, highly pervious to the longer waves of the infra-red, while, as we have already seen, all known transparent substances become opaque in certain regions.

Selective Absorption and Radiation.—Since the reflecting power and the transmitting power of all substances vary in marked degree with the wave-length, it follows that the absorbing power and radiating power of such substances will differ from that of a black body which absorbs completely waves of all wave-lengths. These phenomena are called respectively *selective absorption* and *selective radiation*. Gases and vapors possess these properties in the highest degree. They are entirely transparent to most waves,

* Nichols, *Physical Review*, vol. v., p. 297.

but opaque to certain ones. When heated to incandescence gases and vapors accordingly radiate those particular waves for which they are opaque, and no others. It is in consequence of this fact that we find the spectrum of gaseous substances to consist of bright lines, and the spectrum produced when light passes through vapors to consist of the continuous spectrum crossed with dark lines. Between this extreme and that of the radiation from a black body which contains all known wave-lengths there is an almost infinite variety.

Through the exhaustive investigations of Stefan,* Wien,† Lummer,‡ Paschen, § and others who have worked for years theoretically and experimentally upon the law of the variation of radiation with temperature, and through the researches of Langley,‖ K. Ångström,¶ and of Rubens and his various co-workers whose labors have been touched upon in this article, the exceedingly intricate problem of radiation is now well in hand. Few subjects are more important to the advancement of science, and few have taxed more severely the skill and patience of the physicist. To no scientific problem, perhaps, has a greater wealth of experimental ingenuity been applied and with greater result. For the details of the remarkable series of investigations to which our present knowledge is due, the reader is referred to the various memoirs cited in this article and in the articles Hertzian Waves, Kathode Rays, Luminescence, and Uranium Rays. E. L. Nichols.

Radium: a metallic element found by P. Curie, Mme. S. Curie, and G. Bemont in the mineral pitchblende. While studying the radio-activity of the constituents of this mineral, these investigators found subsequent to their discovery of the substance which they named Polonium (*q. v.*) a second substance also strongly radio-active and differing entirely from the first body in its chemical properties. The new substance has apparently the properties of almost pure barium. It is not precipitated by either hydrogen sulphide, ammonium sulphide, or ammonium hydrate; its sulphate is insoluble in water and acids; the carbonate is insoluble in water; the chloride is very soluble in water, but insoluble in concentrated hydrochloric acid and in alcohol. These investigators believe that this substance, which consists largely of barium, also contains a new element which gives to the substance its radio-activity and which is close to barium in its chemical properties. This belief is based largely on the fact that, as barium has no radio-active properties, these properties are due to some material present, which therefore must be a new element. Moreover, its spectrum shows a ray which does not appear to be due to any known element. The rays emitted by this new substance yield light, very faint, but functioning apparently without a source of energy. A new source of light has therefore been realized in this discovery. Marcus Benjamin.

* Stefan, *Wiener Berichte*, vol. lxxix., p. 391 (1879).
† Wien, *Wiedemann's Annalen*, vol. lviii., p. 662.
‡ Wien and Lummer, *Ibid.*, vol. lvi., p. 451.
§ Paschen, *Ibid.*, vol. xlix., p. 57; li., p. 9; liii., p. 301; lviii., p. 455.
‖ Langley, *l. c.*, also *Wiedemann's Annalen*, vol. xxii., p. 22.
¶ K. Angström, *ibid.*, vol. xxxvi., p. 715.

Raikes, Francis William, LL. D.: English lawyer; b. in Chester, England, about 1840; educated at Shrewsbury school, Royal Academy at Gossport, and at Peterhouse, Cambridge University; subsequently he was three years at sea in the merchant service, and then entered the royal navy by open examination for navigating officers; served in the navy for about seven years, and then read law with Sir Richard Webster, and was called to the bar at the Inner Temple in 1873. He attained eminence for his intimate knowledge of the intricacies of English practice in admiralty and equity; was made judge of the county court of Hull circuit No. 16 in 1898. He has written numerous papers on maritime law, and translated and edited the maritime codes of the different nations of Europe, and has also published *Jurisdiction and Practice of County Courts in Admiralty* (joint author) and *The New Practice*. F. Sturges Allen.

Rains, Gabriel James: soldier; b. in Craven co., N. C., in June, 1803; graduated at the U. S. Military Academy in 1827, and was assigned to the infantry. He served in various campaigns against Indians, being promoted captain Dec. 25, 1837; brevetted major Apr. 28, 1840, having routed a superior force of Seminoles near Port King, Florida. On the opening of the Mexican war he was among the first engaged, being one of the defenders of Fort Brown in May, 1846. After the battle of Resaca de la Palma he returned to the U. S. on recruiting duty. He became a major on Mar. 9, 1851, and lieutenant-colonel on June 5, 1860, serving meanwhile on the Pacific coast against Indians, and having been in 1855 brigadier-general of Washington Territory volunteers. He resigned on July 31, 1861, and became a brigadier-general in the Confederate army. He commanded a division at Wilson's Creek, was engaged in the fighting at Shiloh and Perrysville, and turned the battle in favor of the Confederates by a flank movement at Seven Pines. He afterward was in charge of the conscript and torpedo bureaus at Richmond, and organized the system of torpedoes for protection of the harbors of Charleston, Savannah, Mobile, and other places. D. in Aiken, S. C., Sept. 6, 1881.

Rains, George Washington: soldier; b. in Craven co., N. C., in 1817; graduated at the U. S. Military Academy in 1842, and was appointed second lieutenant of engineers; transferred to the artillery in 1843. He was Professor of Chemistry, Mineralogy, and Geology at West Point 1844–46. During the war with Mexico he served on the staffs of Gens. Scott and Pillow, and was brevetted captain and major. In 1856 he resigned. He entered the Confederate army in 1861, was commissioned colonel, and built and equipped at Augusta, Ga., the Confederate powder-works, which at the close of the war were among the best in the world. He was made brigadier-general before 1865. In 1867 he became Professor of Chemistry and Pharmacy in the medical department of the University of Georgia, and was dean of the faculty until 1884. He published *Steam Portable Engines* (1860); *Rudimentary Course of Analytical and Applied Chemistry* (1872); *Chemical Qualitative Analysis* (1879). D. in Newburg, N. Y., Mar. 21, 1898.

END OF VOLUME NINE.